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Bibliometric Analysis of Studies on Catastrophic Health Expenditures

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ABSTRACT

According to the World Health Organization, after meeting basic household needs, spending on health that equals or exceeds 40 percent of household income is referred to as catastrophic health expenditures (CHE). Individuals' out-of-pocket expenses for advanced treatments and the risk of being exposed to such financial catastrophe have increased considerably. Consequently, CHE has become a prominent and current topic in scientific research. This study aims to perform a bibliometric analysis of studies related to CHE in order to identify research gaps in the field. A total of 705 studies on CHE, published between 2002 and 2021, were included in the analysis by applying specific search strategies in the Web of Science database. The data were analyzed by dividing them into two periods using the SciMat bibliometric analysis program. As a result of the examinations, it was determined that the themes of 'depression, costs of illness' and 'hemodialysis, aging, direct costs' in isolated themes are areas of study open to further development within the field of CHE. Based on these findings, future researchers may conduct studies to determine the level of CHE exposure, the incidence of CHE, and the determinants of CHE for individuals within specific disease and risk groups.

Keywords: Catastrophic Health Expenditures, Health Policy, Health Economics, Bibliometric Analysis, SciMat.

JEL Classification Codes: I10, I12, I14, I18, C80, D83

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INTRODUCTION

The development of neo-liberal management and policy approaches over the last three decades has also impacted health systems. In this context, it is evident that pro-market policies have been implemented in the health sector in most countries. Health reform programs founded on neo-liberal principles have undergone significant adjustments due to issues such as inefficient resource use, unequal access to healthcare, lack of financial protection, and sustainability challenges in health systems (Burçin et al., 2014). Market-based health policies, which aim to ensure the sustainability of health systems, have successfully reduced health costs, which constitute a sizeable portion of gross domestic product. However, these policies have also led to an increase in out-of-pocket payments for medical treatments. It is widely recognized that under recent health reforms, out-of-pocket expenses for medical treatments now represent a significant portion of the total costs of these services. This burden is particularly high in countries where health insurance coverage is limited, levels of development are low, social assistance frameworks are underdeveloped, and health inequalities are prevalent (Çınaroğlu & Şahin, 2016).

The increase in out-of-pocket payments, which is seen as a means of ensuring household participation in financial risk-sharing for the health system, leads to individuals being unable to access basic health services, a decline in the welfare of disadvantaged and low-income groups, and impoverishment. These findings highlight the issue of catastrophic health expenditures (CHE). The financial difficulty households experience due to medical expenses is measured by CHE (Doshmagir et al., 2021). When individuals are exposed to CHE, they face risks such as losing financial protection, having to limit basic needs like food consumption, depleting deposit accounts, and resorting to borrowing. The World Health Organization (WHO) defines such risks as financial catastrophe caused by out-of-pocket health expenditures. In short, CHE is described as 'the ratio of household income or expenditure on health exceeding a certain percentage at a given time' (Wagstaff & Van

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Doorslaer, 2003). CHE serves as an indicator to assess fairness in healthcare financing and the extent of health insurance coverage for individuals. The 10 percent and 25 percent thresholds of household income or expenditure are commonly used to determine CHE levels (Zhao et al., 2022). nother WHO threshold suggests that healthcare costs exceeding 40% of a household's solvency—solvency being defined as household expenses excluding food—expose a household to CHE (Murray et al., 2003).

A review of the literature reveals numerous studies demonstrating how out-of-pocket medical expenses, when combined with neo-liberal health policies, can lead to catastrophic outcomes by surpassing predetermined thresholds. In addition, it is observed that the effects of health expenditures on the health economy and health systems have been examined using methods such as stochastic frontier analysis and data envelopment analysis (Evans et al., 2001; Özdemir & Bulğurcu, 2015). These studies reveal performance indicators that demonstrate the impact of catastrophic health expenditures on the health economy, as well as the factors that cause such catastrophes (Abou Jaoude et al., 2022). It is argued that the high cost of catastrophic health care, particularly in low- and middle-income nations, is primarily due to insufficient prepayment systems. Furthermore, research has shown that the incidence of CHE is correlated with factors such as household size, income, receipt of social support, having family members over the age of 65, and the working status of the head of the household (Zhao et al., 2022). Research from Mexico (Galárraga et al., 2010), Türkiye (Yardım et al., 2010; Koçkaya et al., 2021), Vietnam (Van Minh et al., 2013), and India (Mondal et al., 2014) have also demonstrated that a household's economic standing significantly affects the CHE level. The primary variables influencing the degree of CHE in terms of health and wellness include the frequency of inpatient, outpatient, and dental care utilization (Doshmangir et al., 2021).

In WHO's 2000 report, it is emphasized that determining CHE, identifying the groups exposed to catastrophe, and understanding the factors that cause such catastrophes are crucial for health policymakers to achieve the goal of ensuring equal access to healthcare for all and equitable participation in health financing. Particularly in recent years, there has been a notable increase in scientific studies on this subject (Yadav et al., 2021; Ravangard et al., 2021; Yang & Hu, 2022; Gummidi et al., 2022).

The aim of this study is to examine the development of scientific publications in the literature on CHE using bibliometric analysis methods. Based on the findings from these examinations, the study will identify the authors, countries, institutions, the most frequently publishing journals and scientific fields, as well as the themes that have developed, emerged, or disappeared over time. In this way, suggestions for potential new research areas for future studies will be provided.

MATERIAL AND METHODS

This descriptive study aims to examine the characteristics of studies on catastrophic health expenditures using bibliometric methods. Bibliometrics is a quantitative scientific analysis methodology that allows for the evaluation of the nature and development of scientific studies. Bibliometric analysis provides a macroscopic overview of the vast amount of academic literature. It sheds light on the research themes that have the most output in a field and identifies influential and leading academics, institutions/universities, publication sources, and countries by considering their outputs and citations (Cobo et al., 2011). By analyzing the entirety or a specific portion of the literature and drawing generalizations, bibliometric analysis offers specific information on the evolution of the relevant field over time and space. It enables the objectification of personal observations and reveals the origins of researchers' influence. Drawing conclusions about a discipline's potential future trajectory is useful for choosing research topics and career planning (Moral-Muñoz et al., 2020). Moreover, bibliometric analysis can uncover the latest developments, research directions, and leading topics in a particular research area (Donthu et al., 2021).

There are many software programs that enable scientific mapping, such as VOSViewer, CiteSpace, Biblioshiny, and Gephi. The reason SciMat software was chosen for this study is that, while it includes the advantages of many similar programs, it also allows for the identification of inter-period themes related to the research topic and the analysis of relationships between these themes. The relationships between the units of analysis—in this study, words—are processed by the program using specific algorithms. It determines the conceptual structures important to the field of interest for each period, visualizes the findings in a way that allows for the evaluation of relationships between periods, and provides quality assessment criteria for the significant structures that emerge. This enables the researcher to evaluate the findings comprehensively. In

this study, SciMat v.1.1.04 software was used (Cobo et al., 2012).

SciMat software is used to conduct conceptual science mapping based on a network of frequently used words. This analysis follows a four-stage approach: research themes are identified, themes (research lines) are visualized, their relationships are shown as a thematic network, new themes are discovered, and performance analysis is conducted. The identified study themes are organized in a strategic diagram. The research is represented as a two-dimensional map, where themes are depicted as globes, with the volume proportional to the total number of publications related to the theme. These themes are categorized into four sections based on their relative relevance: (i) Upper right quadrant: Q1 - Engine Themes, which focus on organizing and expanding the field of study. (ii) Upper left quadrant: Q2 - Advanced and isolated motifs, which are significant but not central to the core research field. (iii) Lower left quadrant: Q3 - Ascending or declining themes, which are weak and may require further investigation or might vanish over time. (iv) Lower right quadrant: Q4 - Basic and cross themes, which, although not highly developed, are fundamental for understanding the subject matter (López-Robles et al., 2019). SciMat, with its advanced algorithms in text mining and theme visualizations, has been used in bibliometric analysis studies on a wide range of topics, including big data (López-Robles et al., 2019), human resources management (Santana & Cobo, 2020), wearable health technologies (Burbano-Fernandez & Ramirez-Gonzalez, 2018), Covid-19 research areas (Herrera-Viedma et al., 2020), emergency health services (Tabur, 2020), sustainability in health services (Morell-Santandreu et al., 2020) . While bibliometric studies using SciMat in the field of health are available, no study has been found on catastrophic health expenditures. Therefore, this study focuses on CHE.

Today, the most preferred databases for science mapping or bibliometric research are WoS, Scopus, Google Scholar, PubMed, and MEDLINE (Chen, 2017). Comparisons between WoS and Scopus have shown that both databases produce similar results in terms of citation counts. However, when examining publication counts by subject categories, it was found that Scopus gives more weight to life and medical sciences, while WoS places greater emphasis on economics and social sciences (Jacso, 2005). Additionally, WoS includes a large number of high-quality journals in the social sciences. This database also provides significant convenience for researchers in conducting analyses and was chosen for this study due to its reputation as one of the most prestigious databases in the world (Demir & Erigüç, 2018).

Web of Science (WoS) was used in this study. WoS is a world-leading scientific database that is frequently preferred in academic research. The data for this research were drawn from the 'Web of Science Core Collection' on January 15, 2022. This core collection includes more than 21,000 peer-reviewed, high-quality scientific journals published across more than 250 scientific disciplines worldwide. Additionally, conference papers and book data are available (Clarivate, 2021).

Since the study aims to identify research related to CHE, the following keywords were used in the search: 'catastrophic health expenditure,' 'catastrophical health expenditure,' 'disastrous health expenditure,' 'devastating health expenditure,' 'catastrophic health spending,' 'catastrophical health spending,' 'disastrous health spending,' 'devastating health spending,' 'catastrophic health spendings,' 'disastrous health spendings,' and 'devastating health spends.' A total of 906 articles were retrieved from the WoS search. Since the search was conducted in January 2022 and publications were still ongoing, 74 publications from 2022 were excluded from the analysis. Only research and review articles indexed in SSCI, SCI, SCI-expanded, and ESCI were included in the study. A total of 127 studies outside this scope were not included in the analysis, leaving 705 publications published between 2002 and 2021. All records and references from these publications were downloaded as plain text files and transferred to the SciMat program. The data were analyzed by dividing it into two periods: 2002-2017 and 2018-2022. The reason for this division was to ensure an equal distribution of articles across the periods. The second period starts in 2018 because there was a significant increase in publications compared to previous years, as seen in Figure 1. This division facilitates better analysis and interpretation of the changes in themes during each period. Additionally, the Excel program was used to gather descriptive information on the number of publications, citations, articles, journals, and authors. The development of themes across the periods and their relationships were analyzed using the SciMat software.

RESULTS

As shown in Figure 1, publications on catastrophic health expenditures began in 2002 and have increased significantly over time. In 2002, there was 1 publication with 123 citations, and in 2003, there were 4 publications with 1,144 citations. In subsequent years, the number of publications remained relatively low but with notable citation counts, such as 2 publications in 2004 with 246 citations, 4 publications in 2005 with 100 citations, 5 publications in 2006 with 601 citations, and 6 publications in 2007 with 620 citations. A substantial increase in publications occurred in 2012 with 21 publications (1,052 citations) and again in 2015 with 39 publications (1,003 citations). Although the number of studies remained low during some years, they garnered significant citation counts. However, in more recent years, interest in the field has surged, as reflected by 121 publications in 2021 (174 citations), 108 publications in 2020 (386 citations), 87 publications in 2019 (534 citations), 94 publications in 2018 (784 citations), and 58 publications in 2017 (690 citations). This demonstrates a growing trend in the number of publications over the years.

In Table 1, it can be observed that the most cited studies on catastrophic health expenditures are from the first period (2002-2017).

The article titled "Household catastrophic health expenditure: a multicountry analysis," published in *The Lancet* in 2003 by Xu, K., Evans, D.B., Kawabata, K., Zeramdini, R., Klavus, J., and Murray, C.J.L., ranks first with 1,120 citations. Additionally, the second most cited study, published in *Health Affairs* in 2002, has 461 citations. The third and fourth studies, published in the *WHO Bulletin* in 2006 and 2012, have high citation counts of 212 and 209, respectively.

Below is a brief summary of the findings from these highly cited studies on catastrophic health expenditures:

Ke et al. (2003) analyze how spending on health services affects households' financial situations and whether these expenditures reach catastrophic levels for households. The research findings indicate that the burden of health expenditures on households varies significantly across countries, with low-income households being particularly at greater risk. Additionally, the study emphasizes the effectiveness of health insurance systems and the role of government investments in health services in protecting households from financial hardship.

Xu et al. (2007) discuss how households can cope with financial difficulties arising from health expenditures. The study states that such expenditures can have devastating effects, especially on low-income households. The article suggests various strategies to prevent catastrophic health expenditures, including establishing effective health insurance systems, providing government-supported health services, and increasing access to healthcare. It also focuses on ways to reduce the impact of health expenditures on households and the role governments play in this process.

Li et al. (2012) aimed to assess the extent to which the Chinese population is affected by catastrophic household expenditures and impoverishment due to medical costs and to examine the health system and

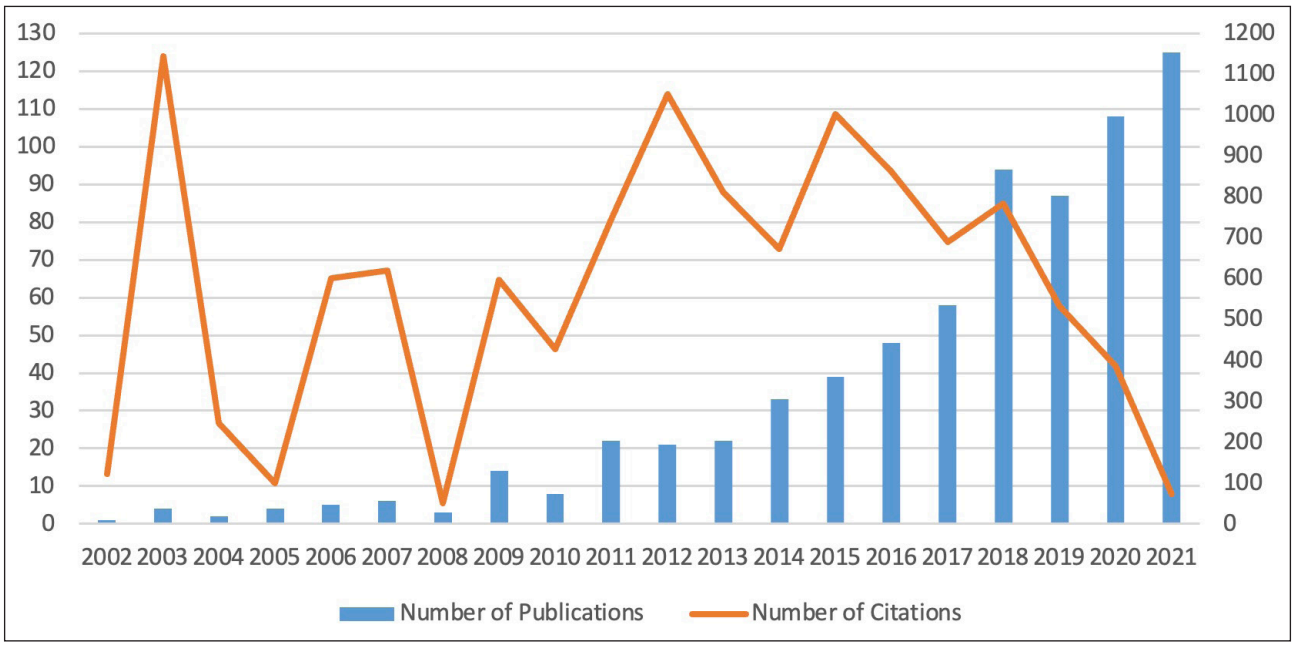

Figure 1: Distribution of Publications and Citations by Years

Table 1: Top 10 Most Cited Studies

No	Article	Author	Year	Citation	Journal
1	Household catastrophic health expenditure: a multicountry analysis (Ke et al., 2003)	Ke, X, Evans, DB, Kawabata, K, Zeramdini, R, Klavus, J, Murray, CJL	2003	1120	Lancet
2	Protecting households from catastrophic health spending, (Xu et al., 2007)	Xu, K, Evans, DB, Carrin, G, Aguilar-Rivera, AM, Musgrove, P, Evans, T	2007	461	Health Affairs
3	Catastrophic household expenditure for healthcare in a low-income society: a study from Nouna District, Burkina Faso (Su et al., 2006)	Su, TT, Kouyate, B, Flessa, S	2006	212	Bulletin Of The World Health Organization
4	Factor saffecting catastrophic health expenditure and impoverishment from medical expenses in China: policy implications of universal health insurance (Li et al., 2012)	Li, Y, Wu, QH, Xu, L, Legge, D, Hao, YH, Gao, LJ, Ning, N, Wan, G	2012	209	Bulletin Of The World Health Organization
5	Understanding the impact of eliminating user fees: Utilization and catastrophic health expenditures in Uganda (Xu et al., 2006)	Xu, K, Evans, DB, Kadama, P, Nabyonga, J, Ogwal, PO, Nabukhonzo, P, Aguilar, AM	2006	187	Social Science & Medicine
6	The financial burden from non-communicable diseases in low- and middle-income countries: a literature review (Kankeu et al., 2013)	Kankeu, HT, Xu, K, Evans, DB, Saksena, P	2013	181	Health Research Policies And Systems
7	Out-of-pocket health expenditure and debt in poor households: evidence from Cambodia (Van Damme et al., 2004)	Van Damme, W, Van Leemput, L, Por, I, Hardeman, W, Meessen, B	2004	167	Tropical Medicine & International Health
8	Catastrophic health expenditure and impoverishment in Türkiye (Yardim et al., 2010)	Yardim, MS, Cilingiroglu, N, Yardim, N	2010	148	Health Policy
9	The new cooperative medical scheme in China (You & Kobayashi, 2009)	You, XD, Kobayashi, Y	2009	137	Health Policy
10	Health system reform in Mexico 5: Assessing the impact of the 2001-06 Mexican health reform: an in term report card (Gakidou et al., 2006)	Gakidou, E, Lozano, R, Gonzalez-Pier, E, Abbott-Klafter, J, Barofsky, JT, Bryson-Cahn, C, Feehan, DM, Lee, DK, Hernandez-Llamas, H, Murray, CJL	2006	135	Lancet

structural factors influencing these expenditures. The survey data were obtained from the Fourth National Health Service Survey. The analysis of impoverishment due to catastrophic health and medical expenditures was conducted using a sample of 55,556 households with varying characteristics located in both rural and urban areas across different regions of the country. Logistic regression analysis was used to identify the determinants of catastrophic health expenditures. The rate of catastrophic health expenditures was 13.0%, while the rate of impoverishment was 7.5%. Households with hospitalized, elderly, or chronically ill members, as well as those in rural and poorer areas, had higher rates of catastrophic health expenditures.

Acombination of adverse factors increases the risk of these expenditures. Families enrolled in insurance plans and living in urban areas had lower rates of catastrophic health expenditures compared to those in rural areas. Finally, it was determined that the need for and use of health services, demographic characteristics, type of insurance package, and payment method to the service provider are key determinants of catastrophic health expenditures.

The aim of the study conducted by Yardım et al. (2010) is to determine the level of CHE in Türkiye and to identify the factors influencing it. CHE was calculated using data from the Household Budget Survey and Consumption Expenditure data of TurkStat from 2006. According to the research findings, the rate of households experiencing CHE is 0.6%. The lowest average out-of-pocket health payment in the lowest quintile is US$7.36, which is approximately one-tenth of that in the highest quintile. The probability of households experiencing CHE increases with each unit increase in per capita expenditures. The health insurance status of the head of the household is closely related to the likelihood of experiencing catastrophic expenditures. Rural households are 2.5 times more likely to experience catastrophic events than urban households. Having a

Table 2: Top 10 Authors with the Most Publications in the Field

Author	Publication	Citation
Ulasi, Ifeoma	13	24
Louis, Siu-Fai	13	12
Garcia-Garcia, Guillermo	13	24
Tangcharoensathien, Viroj	12	289
Strani, Luisa	12	12
Verguet, Stephane	11	174
Prinja, Shankar	11	195
Jan, Stephen	11	238
Wu, Qunhong	10	274
Li, Ye	9	267

preschool child in the household is seen as a protective factor against catastrophic expenses, while having an elderly or disabled person increases the risk.

Table 2 provides information on the top 10 most productive authors in the field of catastrophic health expenditures. In this context, with 11 publications each, Ulasi, F. (Nigeria) and Lui, S.F. (USA) take the top spots. These authors are followed by Garcia-Garcia, Guillermo, Tangcharoensathien, Viroj (Thailand), and Strani, Luisa (Belgium), among others. Additionally, it is noted that Tangcharoensathien, Viroj, Wu, Qunhong (China), and Li, Ye (China) are prolific authors in the field and have high citation counts. The literature review also revealed that all authors listed in Table 2 continue to actively work on catastrophic health expenditures.

In Table 3, the *International Journal for Equity in Health*, with an impact factor of 3.8 in the SSCI index in the field of catastrophic health expenditures, ranks first with 57 publications and 849 citations. It is followed by *PLOS One*, *BMC Health Services Research*, *Health Policy and Planning*, among others. Additionally, although *The Lancet* ranks last with 13 publications, it has 1,460 citations and an impact factor of 70.

In Table 4, it is observed that 85.40 percent of the scientific studies on catastrophic health expenditures are articles, 6.10 percent are compilations, 3.12 percent are meeting summaries, and only 0.42 percent are congress papers.

According to Table 5, 38.58 percent of the studies examined fall under environmental public and occupational health, 19.72 percent under healthcare services and sciences, and health policy, 10.07 percent under general internal medicine, and 6.95 percent under multidisciplinary sciences. Additionally, 6 percent of the studies are categorized under economics.

Table 6 shows the institutions associated with studies on catastrophic health expenditures. In this context, Harvard University, the University of London, and the World Health Organization are the three institutions with the highest number of publications. Johns Hopkins University, Tehran University of Medical Sciences, and Peking University are also on the list of organizations with significant publications in this field.

In Table 7, when examining the distribution of studies on catastrophic health expenditures by country, 24.68 percent are from the USA, 19.14 percent from China, 14.61 percent from England, and 8.22 percent from Iran.

Table 3: Information on Journals with the Most Publications in the Field

Journal	Publication	Citation	Quarter	Impact Factor	Index
International Journal For Equity In Health	57	849	Q2	3.8	SSCI
Plos One	46	952	Q2	3.78	SCI - Expanded
Bmc Health Services Research	44	660	Q3	3.29	SCI - Expanded
Health Policy and Planning	23	501	Q1	3.9	SSCI
Bmj Open	20	82	Q2	3.42	SCI - Expanded
Bmc Public Health	18	240	Q2	4	SCI - Expanded
Bulletin Of The World Health Organization	15	853	Q1	10	SCI - Expanded
Social Science & Medicine	15	397	Q2	5.2	SSCI
Tropical Medicine & International Health	15	492	Q2	3.08	SCI - Expanded
Lancet	13	1460	Q1	70	SCI - Expanded

Table 4: Information on Publication Types of Studies

Type	Number	Percent
Research Article	602	85.40%
Review	43	6.10%
Meeting summary	22	3.12%
Editorial Studies	18	2.55%
Congress Proceeding	3	0.42%
Others	17	2.41%

Table 5: Information on Science Categories Published by Studies

Category	Number	Percent
Public Environmental Occupational Health	272	38.58%
Health Care Sciences and Services	139	19.72%
Health Policy Services	139	19.72%
Medicine General Internal	71	10.07%
Multidisciplinary Sciences	49	6.95%
Economics	44	6.24%
Tropical Medicine	28	3.97%
Social Sciences Biomedical	19	2.69%
Surgery	18	2.55%
Medicine Research Experimental	17	2.41%

Table 6: Number of Publications From Institutions

Institution	Publication	Percent
Harvard University	57	8.08%
University of London	55	7.8%
World Health Organization	37	5.25%
London School Of Hygiene Tropical Medicine	33	4.68%
Harvard TH Chan School Of Public Health	32	4.54%
University Of California System	31	4.39%
University Of Nigeria	25	3.55%
Peking University	21	2.97%
Tehran University Of Medical Sciences	21	2.97%
Johns Hopkins University	19	2.69%

Table 7: Number of Publications From Countries

Country	Publication	Percent
USA	174	24.68%
China	135	19.14%
India	113	16.02%
England	103	14.61%
Iranian	58	8.22%

Table 8: Languages of Publications

English	687	97.45%
Spanish	13	1.85%
Other (French, Korean, Portuguese, Russian, Turkish)	1	0.5%

According to Table 8, 97.45 percent of the studies on catastrophic health expenditures were published in English, 1.85 percent in Spanish, and 0.5 percent in other languages, including French, Korean, Portuguese, Russian, and Turkish.

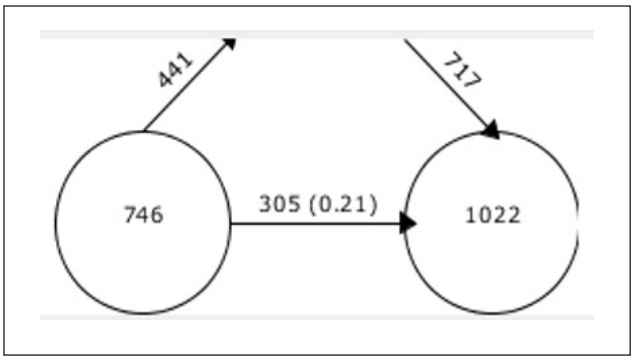

Figure 2: Graph of Development of Keywords

When Figure 2 is examined, the number of keywords and their changes during the 2002-2017 and 2018-2021 periods can be observed. This figure allows for the identification of increases and decreases in the number of keywords in a particular field, providing insights into the breadth and development of the field (Morell-Santandreu et al., 2020). In this context, 746 keywords were used in the first period, 441 of which disappeared without being used in the second period, 305 continued to be used, and 717 of the 1,022 keywords were newly introduced in the second period. Consequently, the recent increase in keywords used in CHE studies indicates that the field is current and continues to evolve.

When the theme map of the first period is examined in Figure 3, four motor themes are identified (Thailand, insurance, financial protection, households), along with seven main themes (HIV/AIDS, financial burden, Mexico, determinants, healthcare, poverty, access to healthcare). Additionally, there are three emerging or disappearing themes (coping strategies, services, health economics) and seven isolated themes (near-miss, lymphedema, being registered, results, economic evaluation, service use, cost-effectiveness analysis).

When Figure 4 is analyzed, it can be observed that there are more studies on catastrophic health expenditures in the 2018-2021 period compared to the first period. During this period, five engine themes were identified (catastrophic health expenditures, middle income, differences, status, equality), along with ten main themes (access to healthcare, health inequality, disease, population, inequality, services, health policy, Iran, expenditures, India). Additionally, there were five emerging or absent themes (depression, association, prevalence, disease cost, financial risk protection) and ten isolated themes (savings, random forest, health deprivation, financial value, direct costs, hemodialysis, household spending, aging, meta-analysis).

In Figure 5, it can be seen that the first period's themes of insurance, financial protection, households, and poverty—also present in the second period—strongly contributed to the development of catastrophic health expenditure studies. The second period theme of illness was further developed, being heavily influenced by the themes of consequences, coping strategies, and financial burdens. The services theme, in turn, significantly evolved with themes such as service proximity and economic evaluation analysis. The population theme has been associated with studies on determinants and service use. Meanwhile, the hemodialysis theme has a strong network relationship with the economic evaluation theme. Additionally, a close relationship exists between the themes of Thailand, healthcare, service use, and financial risk protection. Specifically, numerous themes from the previous period connect with the theme of inequality, considered one of the primary determinants of CHE. Themes such as determinants, household, financial protection, insurance, and financial burden are among these connections. It should also be noted that health policy studies are related to themes of health economics, financial protection, and insurance. However, themes like indirect costs, public health financing, financial value, health deprivation, meta-analyses, old age, health inequalities, prevalence, and disease costs do not interact with the themes from the previous period. This suggests that current studies can be developed around these themes.

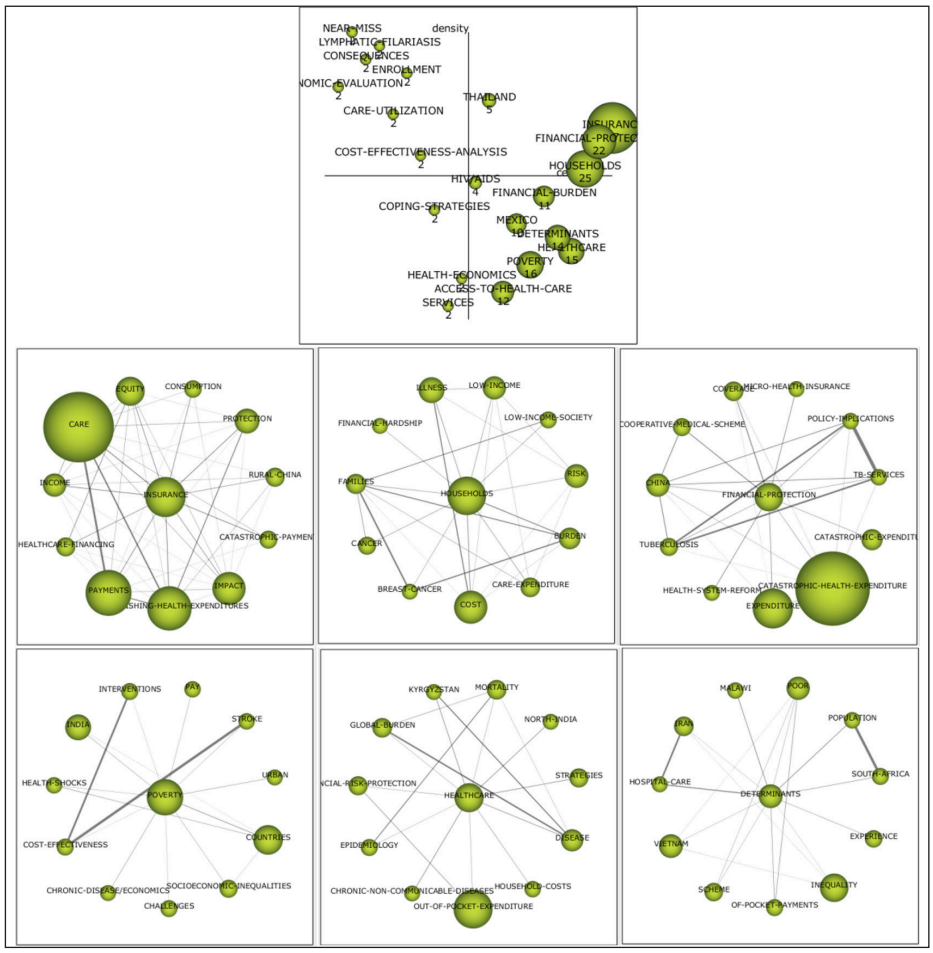

Figure 3: 2002-2017 Period Theme Map

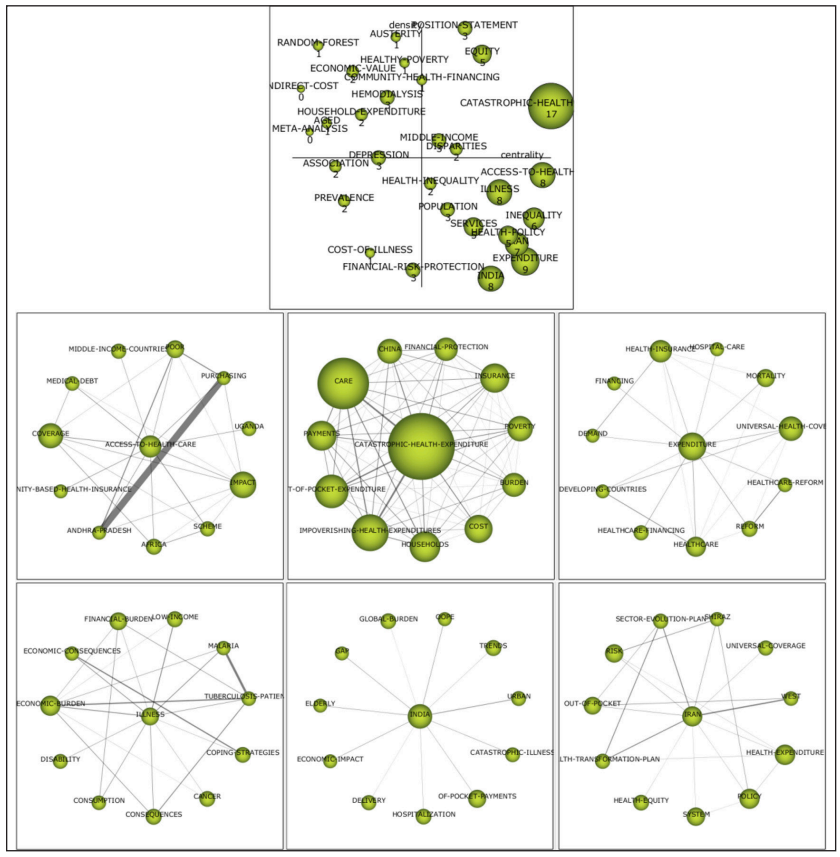

Figure 4: 2018-2021 Period Theme Map

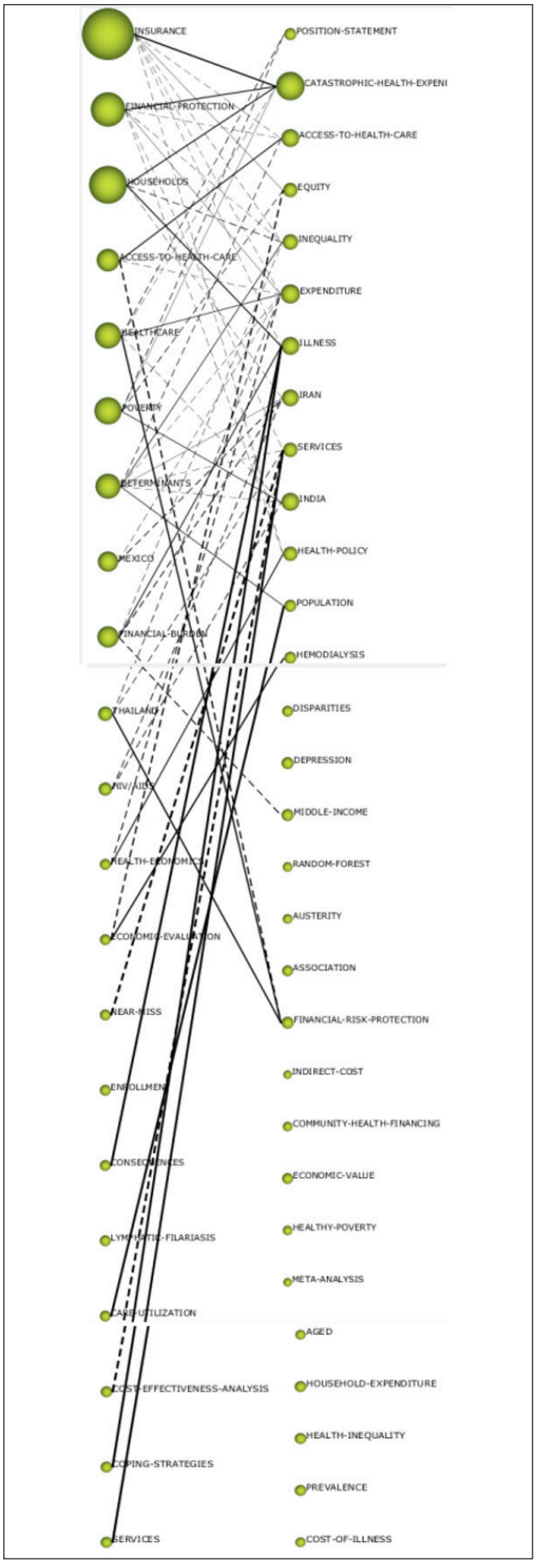

Figure 5: Longitudinal Structure Analysis for the Relationship Between Themes Across Periods

CONCLUSION

A bibliometric analysis was conducted on studies published in the SSCI, SCI, and ESCI indexes in the WoS database from 2002 to 2021 to provide an overview of academic publications on catastrophic health expenditures, a topic that has gained significant attention in health policies and financing. In this context, 705 publications were included in the study. The analysis revealed that the first study on CHE was published in 2002, and research in this field continues today. The most publications were made in 2021, while the most cited studies were published in 2003. Of the studies, 91 percent are research articles and reviews, and 98 percent are published in English or Spanish. In terms of WoS science categories, the studies have been published in fields such as public, environmental, and occupational health, health services, health policies, medicine, and economics, indicating that CHE is a multidisciplinary research area. Additionally, it was found that CHE studies are conducted intensively in countries such as the United States, China, India, and the United Kingdom. Institutions like Harvard University, the University of London, and the World Health Organization (WHO) have made significant contributions to the field in these countries.

Among the studies on CHE, the research article titled *Household CHE: A Multicountry Analysis* was the most prominent in the field, with 1,120 citations. Additionally, authors such as Ulasi, I., Lui, S.F., and Garcia, G. have been the most prolific in the field of CHE, each with 13 publications. Wu, Q., who is also among the prolific authors, has garnered the most attention, with 274 citations for their publications. When examining the journals that publish on CHE, the journal with the highest number of publications in the field is the SSCI-indexed *International Journal for Equity in Health*, which has an impact factor of 3.8.

Important results of the research are related to the strategic theme and thematic network maps obtained using the SciMat program. In this context, it was determined that themes such as depression, disease costs, hemodialysis, aging, and direct costs—categorized as isolated themes in the recent theme map—are areas open to further development in the field of CHE. Additionally, sub-themes like financial protection, financial burden, and impoverishment, which have a weaker relationship with CHE, are less developed. Based on these findings, future researchers may conduct studies to determine the level of CHE exposure, its incidence, and the determinants of CHE for individuals within specific disease and risk groups.

This study has some limitations. The study data were obtained solely from the WoS database, and studies from other academic databases, such as Google Scholar and Scopus, could not be examined. Additionally, SciMat was used as the bibliometric analysis program. Since SciMat does not provide visual mapping methods for author, journal, and institution information, the findings related to these aspects are presented in tables.

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Exchange Rate Bubble Formation in Türkiye: Revealing the Dance Between Reality and Speculation with Empirical Evidence from the Sequential ADF Tests

Gökhan KARTAL[1]

ABSTRACT

This study investigates speculative bubble formations in Türkiye's foreign exchange market from February 2001 to September 2024, utilizing the GSADF and BSADF methods. Through empirical analysis, the study identifies three significant bubble periods—May 2018 to October 2018, September 2020 to November 2020, and November 2021 to March 2022—each shaped by unique economic and geopolitical pressures. In the context of these findings, while some fluctuations in the exchange rate align with fundamental economic indicators, a segment of volatility remains unexplained, indicating the presence of speculative bubbles. This unexplained volatility suggests that traditional indicators alone are insufficient to account for currency valuations, underscoring the need for policy approaches that consider both macroeconomic fundamentals and speculative influences. Notably, the rapid surge in the exchange rate observed in late 2021, culminating in a peak in December, was followed by a dramatic decline precipitated by the announcement of the exchange rate-protected deposit account by economic authorities. This sequence of events highlights the significant impact of policy interventions on speculative activities, as evidenced by the empirical analysis indicating that the exchange rate bubble, which peaked during this period, began to deflate rapidly thereafter, ultimately dissipating entirely by March 2023. The findings emphasize the critical importance of sustainable, structural economic reforms in stabilizing exchange rates, advocating for long-term policies that address root causes of volatility rather than relying solely on short-term interventions.

Keywords: Türkiye Economy, Exchange Rate, Exchange Crisis, Bubbles, GSADF, BSADF.

JEL Classification Codes: C22, F31, O24

Referencing Style: APA 7

INTRODUCTION

The exchange rate is a crucial macroeconomic variable, capable of inducing severe economic crises if not managed effectively, particularly in developing countries like Türkiye. Given its significance, a substantial body of literature exists on the factors influencing the exchange rate, known as exchange rate determinants. These determinants include inflation, interest rates, foreign trade deficits, foreign direct investments, political stability, exchange rate regimes, and speculation. It is worth noting that fluctuations in exchange rates can, in turn, influence these variables, indicating a mutual interaction among them. For instance, during a period of foreign trade deficit, other things being constant, the local currency's value tends to decrease as the country's foreign exchange reserves dwindle. However, this depreciation can render exported goods relatively cheaper, thus setting off a cycle that positively impacts the foreign trade balance by stimulating export growth, assuming the validity of the Marshall-Lerner condition. Consequently, at times, governments allow for currency depreciation to boost foreign trade. Nevertheless, such exchange rate increases can also escalate the prices of imported inputs and other consumer products, leading to an inflationary effect and a chain reaction of rising domestic prices. If this inflation surge surpasses the inflation rate in the country producing the foreign currency, it may further devalue the local currency. On the other hand, raising interest rates can indeed strengthen the local currency's value by increasing foreign exchange availability, thus enticing international capital inflows—a crucial factor in stabilizing the exchange rate. However, this strategy is not without its risks, as evident in the potential for economic crises triggered by sudden shifts in global fund movements, particularly observable in hedge funds' reactions. Moreover, rapid political instabilities can swiftly lead to the exodus of global funds, intensifying the demand for foreign currency and exposing vulnerabilities within the economy, potentially leading to a currency crisis. During periods marked by extreme volatility, the speculative use of the exchange rate becomes more pronounced, potentially uncovering underlying bubbles in the foreign exchange

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market. This speculative behavior can exacerbate the macroeconomic-driven surge in the exchange rate, creating a self-reinforcing cycle that further inflates the bubble and heightens market uncertainties.

When the Türkiye economy is analyzed from the point of view of the exchange rate movements, especially the recent sharp upward trend in the exchange rate has made the economic programs also implemented debatably. In this context, the dollar exchange rate, which was at 7.44 at the beginning of 2021, surpassed the 10 TL threshold in November, subsequently escalating uncontrollably to reach a historic peak of 18 TL in December 2021. Simultaneously, spurred by rising global inflation, Türkiye experienced an inflation rate exceeding 36% in 2021, influenced by fluctuations in the exchange rate. During this period, economic authorities intervened with measures such as introducing currency-protected time deposits announced on the evening of December 20, 2021, which temporarily curbed the increase in the exchange rate. After this intervention, which is effective for a certain period, the exchange rate resumed its upward trajectory and surpassed the 32 TL mark in 2024. Concurrently, inflation reached unprecedented levels in recent years, registering at 64% in 2023. While some circles associate this situation with bad economic policies, some circles argue that these fluctuations are not related to macroeconomic indicators but an artificial situation, in a sense, the existence of a bubble in the exchange rate market.

In this context, while the exchange rate's dynamics unveil intricate relationships with various economic variables, it is equally crucial to delve into the phenomenon of economic bubbles, which can significantly impact financial stability and market dynamics. Economic bubbles, often labeled as "speculative bubble," "market bubble," "price bubble," "financial bubble," or "speculative mania," delineate periods characterized by speculative investment leading to an overvaluation of securities within specific sectors (Chang, Newman, Walters, & Wills, 2016, p. 497; Girdzijauskas et al., 2009, p. 269). This concept has spurred debates among economists, with some attributing bubble occurrences to inflationary factors. In contrast, others argue for an inherent value in assets, portraying bubbles as escalations beyond this fundamental worth (Girdzijauskas et al., 2009, p. 269). Over time, the escalation of asset prices creates anticipations for further escalations, drawing in new investors primarily focused on trading profits rather than the assets' intrinsic utility or income potential. However, such upward trends are typically followed by a reversal in expectations and a sharp price decline, culminating in financial crises (Kindleberger, 1991). Key aspects defining bubble formation and its subsequent collapse include rapid price escalations, unrealistic future price expectations, a detachment of prices from fundamental values, or a substantial price drop post-bubble burst (Smith & Smith, 2006, p. 2).

Building upon the theoretical insights of Minsky's (1992) Financial Instability Hypothesis and Scherbina's (2013) analysis of speculative bubble dynamics, Kartal (2024) provides a general framework for understanding speculative bubble formation. Adapting this framework to exchange rate markets, this study identifies four fundamental mechanisms that drive speculative currency bubbles, offering a structured approach to analysing how psychological biases, market inefficiencies, external shocks, and theoretical modelling contribute to speculative deviations in exchange rates:

Psychological Factors

- Herding Behaviour: Investors, rather than relying on economic fundamentals, react to the movements of others, collectively amplifying speculative pressures. During periods of uncertainty, such as policy shifts or geopolitical tensions, sudden shifts in sentiment trigger large-scale herd behaviour, leading to self-reinforcing speculative buying. In Türkiye, historical episodes of rapid exchange rate depreciation have shown that both retail and institutional investors often rush into foreign currency assets simultaneously, exacerbating volatility.
- Overconfidence: Some market participants believe they can accurately predict exchange rate movements, assuming that rising trends will persist indefinitely. This leads to excessive speculation, where investors continue to buy foreign currency even when prices deviate significantly from economic fundamentals. Such behaviour was particularly evident in Türkiye during speculative surges, as many investors bet against policy interventions aimed at stabilizing the exchange rate.
- Anchoring Bias: Investors tend to base their exchange rate expectations on past price levels, normalizing sharp increases. When a currency depreciates rapidly, market participants may recalibrate their expectations, assuming that the new higher exchange rate is the 'new normal' rather than a temporary mispricing. This tendency reinforces speculative momentum, as investors continue buying foreign currency in anticipation of further depreciation.

Table 1. The Main Economic Indicators

Series Name	2001	2005	2010	2015	2018	2019	2020	2021	2022	2023
GDP [a, b]	201.8	506.3	777.0	864.3	779.0	761.0	720.3	819.9	907.1	1,000
GDP per capita [a, b]	3.10	7.37	10.62	11.05	9.57	9.22	8.64	9.74	10.67	13.38
Real GDP [a, b]	390.0	525.5	614.2	864.3	989.0	997.1	1,015.6	1,131.8	1,194.4	1,242
Growth (%) [a, b]	-5.75	8.99	8.43	6.08	3.01	0.82	1.86	11.44	5.53	4.00
Exports (X) [c]	31.3	73.5	113.9	151.0	177.2	180.8	169.7	225.2	254.2	255.8
%Change [e]	-42.51	134.4	54.99	32.58	17.34	2.07	-6.18	32.75	12.86	0.63
Imports (M) [c]	41.4	116.8	185.5	213.6	231.2	210.3	219.5	271.4	363.7	361.8
%Change [e]	49.05	182.06	58.90	15.13	8.21	-9.00	4.36	23.65	34.00	-0.53
Balance (X-M) [c]	-10.07	-43.29	-71.66	-62.64	-53.98	-29.51	-49.86	-46.21	-109.5	-106.0
%Change [e]	-	330.14	65.52	-12.59	-13.82	-45.33	68.93	-7.31	137.04	-3.24
%GDP	-4,99	-8,55	-9,22	-7,25	-6,93	-3,88	-6,92	-5,64	-12,08	-10,60
Imp. Cov. by Exp [e]	75.69	62.92	61.38	70.68	76.65	85.97	77.29	82.97	69.88	70.70
Balance of Payments [d]	12.92	-23.20	-14.97	11.83	10.38	-6.32	31.86	-23.33	-12.31	2.03
%GDP	6.41	-4.58	-1.93	1.37	1.33	-0.83	4.42	-2.85	-1.36	0.20
Unemployment	8.37	10.63	10.66	10.24	10.89	13.67	13.11	11.98	10.43	9.90
CPI	31.8	65.9	100.0	146.1	203.5	234.4	263.2	314.8	542.4	889.6
Inflation	54.40	8.18	8.57	7.67	16.33	15.18	12.28	19.60	72.31	64.00
Interest Rate [d]	-	-	6.50	7.50	24.00	12.00	17.00	14.00	9.00	42.50
Real Interest Rate [e]	-	-	-2.07	-0.17	7.67	-3.18	4.72	-5.60	-63.31	-21.50
External debt	112.95	178.26	316.66	399.58	425.78	414.62	429.42	437.51	458.70	-
%Change [e]	32.84	57.82	77.64	26.19	6.56	-2.62	3.57	1.88	4.84	-
%GDP	57.41	35.58	41.10	46.75	55.48	55.42	60.34	54.12	51.11	-
FDI (Net)	-2.86	-8.97	-7.62	-14.17	-8.85	-6.58	-4.45	-6.87	-8.17	-
Exchange [d, *]	1.23	1.35	1.51	2.72	4.82	5.68	7.02	8.90	16.59	23.79
Exchange [d, **]	1.46	1.35	1.52	2.92	5.32	5.85	7.73	13.55	18.67	29.07
Real Exchange [e ***]	0.97	1.29	1.42	2.72	4.68	5.17	6.97	11.86	11.70	18.28
Real Effec Exchange [d]	89.64	119.43	120.17	98.98	76.27	76.00	61.88	47.61	54.88	55.33

Notes: : FDI: Foreign direct investment; %Change: shows the % change of the relevant value compared to the previous year; Imp.Cov.byExp: proportion of imports covered by exports (X/M); * annual average dollar exchange rate; **annual closing dollar exchange rate as of December 31st.; ***calculated by the author based on the year-end closing rate.

Source: [a] World Bank (2024); [b] 2023 data are IMF (2024) estimates.; [c] UN Comtrade Database (2024); [d] Central Bank of the Republic of Türkiye (2020); [e] calculated by the author based on the data in the table.

Market Inefficiencies

- Limited Short-Selling and Market Constraints: In many emerging markets like Türkiye, short-selling mechanisms in the foreign exchange market are either weak or actively restricted. Unlike stock markets, where short positions can counteract speculative excesses, limited short-selling in FX markets allows price distortions to persist longer. Additionally, regulatory interventions such as capital controls, foreign exchange transaction limits, or liquidity restrictions can inadvertently fuel speculation by distorting price discovery mechanisms. In Türkiye, restrictions on offshore swap transactions and sudden regulatory changes have historically created conditions where speculative actors dominate market pricing.
- Information Asymmetries: Unequal access to information regarding central bank interventions, monetary policies, and foreign exchange reserves fosters uncertainty and speculation. Large institutional investors may have superior insights into market dynamics, while retail investors operate with limited data, leading to mispricing and speculative surges.
- Market Frictions: Liquidity constraints, high transaction costs, and abrupt policy shifts distort market dynamics, causing price momentum to accelerate. For instance, when a central bank intervenes in currency markets without clear forward guidance, it can unintentionally signal distress, prompting further speculative demand for foreign currency.

External Shocks and Macroeconomic Factors

- Monetary and Fiscal Policy Interactions: Low interest rates, coupled with geopolitical crises, can lead to capital outflows, increasing speculative demand for foreign currency and exacerbating depreciation pressures. In Türkiye, aggressive rate cuts in an environment of rising global interest rates intensified speculative currency demand, reinforcing exchange rate misalignments.
- Global Economic Conditions: External shocks such as Federal Reserve rate hikes, global recession risks, and capital flight from emerging markets can heighten speculative pressures. When major global financial events coincide with domestic vulnerabilities, speculative attacks on local currencies become more intense.
- Geopolitical Uncertainty: Diplomatic crises, sanctions, and regional conflicts often heighten risk perceptions, leading to self-fulfilling speculative runs on the currency. In Türkiye, past exchange rate volatility has frequently been linked to periods of heightened geopolitical uncertainty, triggering capital flight and speculative hoarding of foreign currency.

Theoretical Perspectives on Speculative Bubbles

- Rational Bubble Models: Investors, anticipating future exchange rate increases, may drive up currency demand despite the lack of economic justification. This self-reinforcing speculation creates a scenario where market participants knowingly engage in overvaluation, assuming they can exit before the bubble bursts.
- Behavioural Finance Models: Psychological biases such as overconfidence, herd behaviour, and loss aversion lead to irrational speculative surges, where investors continue buying foreign currency even when market fundamentals do not support such moves.
- Fundamental Value Models: When exchange rates deviate significantly from their underlying economic fundamentals, speculative feedback loops push valuations to unsustainable levels, fostering currency bubbles. In Türkiye, such misalignments have historically coincided with periods of aggressive monetary easing, external funding pressures, and regulatory uncertainty.
- These mechanisms provide a structured framework for understanding speculative exchange rate bubbles, offering critical insights into the forces driving currency mispricing in Türkiye. In the subsequent empirical analysis, this framework will be applied to assess speculative surges and their underlying drivers, shedding light on the mechanisms contributing to bubble formation in the foreign exchange market.

In analyzing the surge in the exchange rate and determining if it reflects a speculative bubble, it is crucial to connect economic indicators directly to exchange rate dynamics. This includes understanding the mechanism of currency bubble formation, which often initiates a disruption in one of the determinants of the exchange rate, such as inflation or interest rates. For instance, the sharp rise in inflation observed post-2021could contribute to nominal and real exchange rate increases, indicating a direct

impact on currency values. Similarly, negative real interest rates can incentivize capital outflows, leading to currency depreciation and heightened exchange rate fluctuations, especially during economic uncertainty. Furthermore, the discussions on various economic indicators, such as trade balances and external debt levels, serve as additional drivers to influence the exchange rate significantly. These indicators are crucial in shaping market sentiments and investor behaviors, contributing to the speculative dynamics observed in the foreign exchange market. The mechanism of currency bubble formation highlights how market reactions can fuel speculative attacks, amplifying what would have been a manageable increase in the exchange rate into a more severe bubble formation. The mechanism of currency bubble formation often initiates a disruption in one of the determinants of the exchange rate, leading to an initial increase in the exchange rate. Subsequently, market reactions fuel speculative attacks, amplifying what would have been a manageable increase in the exchange rate into a more severe bubble formation. This is particularly evident during economic disruptions or geopolitical tensions, where sudden political instabilities can trigger a rapid exodus of global funds, exacerbating the demand for foreign currency in the economy and unveiling a currency crisis.

Moreover, examining the trade balances represented by exports and imports provides insights into the overall balance of payments and its influence on the exchange rate. Persistent trade deficits and increasing external debt levels can impact investor sentiment, prompting capital movements that affect currency values. While relatively stable, the proportion of external debt to GDP remains a point of consideration for currency stability and investor confidence. High levels of external debt can pose risks to currency resilience, requiring prudent fiscal management and monitoring to mitigate potential exchange rate volatility. In this context, some macroeconomic indicators regarding the Türkiye Economy are given in Table 1.

Table 1 provides a comprehensive overview of Türkiye's leading economic indicators over the years. These indicators play a crucial role in understanding the exchange rate dynamics, especially concerning factors like inflation, interest rates, trade balances, and foreign direct investments. One notable observation from the data is the significant increase in inflation, particularly post-2021, which has implications for the exchange rate. A sharp rise in inflation can contribute to both nominal and real exchange rate increases. In a scenario where inflation was the sole determinant of exchange rates, substantial changes in the real exchange rate would not be anticipated. Nevertheless, the data suggests that both nominal and real exchange rates have experienced significant appreciation, implying the presence of additional factors beyond inflation.

Moreover, a closer look at the trade balances, indicated by the Exports (X) and Imports (M) columns, provides crucial insights. The trade deficit, indicated by the negative values in the Balance (X-M) column, has fluctuated over the years, impacting the overall balance of payments and subsequently influencing the exchange rate. However, it is noteworthy that while the trade deficit has been consistently negative, its share in GDP (%GDP) has varied between 4% to 10%. This variation suggests that while the absolute trade deficit figures may be substantial, their relative impact on the economy has shown some degree of stability within a certain range.

Another important factor to consider is the potential influence of negative real interest rates on exchange rate dynamics. Negative interest rates can incentivize investors to seek higher returns elsewhere, including foreign currencies, thereby putting downward pressure on the local currency. This phenomenon can exacerbate exchange rate fluctuations, particularly during periods of economic uncertainty. In addition, negative interest rates can incentivize capital outflows, leading to a depreciation of the currency.

Furthermore, Table 1 data underscores a notable rise in Türkiye's external debt throughout the years, indicating potential implications for the country's economy and exchange rate dynamics. However, it's essential to note that while external debt levels have risen notably, the proportion of total external debt to GDP has not shown a significant change. This observation suggests a relatively stable relationship between Türkiye's external debt burden and its economic output, at least regarding their proportional impact on the economy. A consistent or slightly changing share of external debt to GDP indicates that despite the increasing debt levels, Türkiye's economy has also been expanding, potentially mitigating concerns about the debt burden's immediate impact on currency stability. Nevertheless, the absolute increase in external debt remains a point of consideration for policymakers and investors. High levels of external debt can still pose risks to currency stability and investor confidence, especially if not managed effectively. Concerns about the sustainability of debt repayment and the country's ability to service its obligations can lead to fluctuations in the exchange rate as investors assess the economic risk. Therefore, while the proportional share of external debt to GDP may not have changed significantly, the absolute increase in external debt warrants ongoing monitoring

and prudent fiscal management to ensure long-term economic stability and currency resilience.

Moreover, the sharp increase in inflation, negative real interest rates, and rising external debt likely contributed to upward pressure on the exchange rate. Furthermore, persistent trade deficits and a relatively elevated external debt may have influenced investor sentiment, prompting capital outflows and currency depreciation. Nevertheless, it is crucial to acknowledge that speculative movements, driven by market sentiment and expectations, can magnify exchange rate fluctuations beyond what can be solely explained by fundamental economic factors. Speculative activities, especially during periods of heightened volatility, can lead to rapid and exaggerated movements in the exchange rate, potentially creating a bubble-like scenario.

Considering these factors, it becomes apparent that the sharp increase in the exchange rate, particularly in the latter months of 2021, even partially, can be attributed to variables such as inflation, interest rates, foreign trade deficits, external debt levels, and other macroeconomic indicators. However, this surge in the exchange rate has garnered significant attention and debate, with some arguing that it cannot be fully rationalized by real economic factors alone. Accordingly, it is noteworthy that following the sharp increase in the exchange rate, the announcement on December 20, 2021, regarding the Foreign Exchange-Protected Turkish Lira Deposit (where the Treasury pledged to cover the difference if the return on TL-denominated accounts falls below the exchange rate), led to a drastic drop in the dollar rate from 18 TL to 12 TL overnight. This event serves as a crucial indicator of market dynamics and speculative influences. In this context, this situation was seen by many as evidence that there were no real macroeconomic reasons behind the sharp rise in the exchange rate. Therefore, while macroeconomic variables provide a foundational understanding of exchange rate movements, the presence of speculative elements and market dynamics cannot be overlooked in explaining the sharp increase in the exchange rate observed in late 2021. A comprehensive analysis that considers both fundamental economic drivers and speculative influences is necessary to grasp the complexities of exchange rate dynamics in Türkiye fully. Therefore, it is essential to delve deeper into whether this entire surge in the exchange rate stems solely from these macroeconomic variables or if speculative activities have also contributed, leading to artificial factors such as a bubble formation in the exchange rate. That is, validating or refuting the presence of a speculative bubble during this period holds significant implications for understanding exchange rate dynamics and market behavior in Türkiye. This study is specifically designed to address these critical aspects. In this regard, the primary objective of this study is to investigate whether the exchange rate appreciation observed after 2021 is driven by speculative activity, that is, a bubble formation.

This study is expected to make significant contributions to the existing literature on exchange rate dynamics, especially during periods of rapid volatility and potential speculative activities. Utilizing robust methodologies like the GSADF and BSADF methods, the research aims to unveil a comprehensive analysis of exchange rate movements, revealing the complex interplay between fundamental economic drivers and speculative influences. The anticipated outcomes of this study include not only a deeper understanding of exchange rate dynamics in Türkiye but also valuable insights for policymakers, investors, and researchers addressing similar challenges in other economies. In the following sections of this study created in this direction, firstly a literature review on the exchange rate bubble is be performed, and the added value of this study compared to other studies is be revealed. In subsequent sections, after introducing the GSADF and BSADF methods used to detect bubble formation in the study, then the results are evaluated by reporting the results obtained from the empirical application.

LITERATURE REVIEW

Exchange rate dynamics are a central factor in shaping macroeconomic stability, particularly in emerging markets like Türkiye. In particular, the impact of exchange rate increases on inflation stands out as a critical issue in foreign-dependent economies such as Türkiye. In this context, İlhan et al. (2022) and Akdeniz et al. (2022) emphasize that Türkiye's high dependence on imported inputs amplifies the cost-push inflation triggered by exchange rate increases. İlhan et al. (2023) note that the exchange rate pass-through (ERPT) to consumer prices surged significantly during sharp currency depreciations, particularly after structural problems and inconsistent monetary policies began to undermine the credibility of inflation-targeting frameworks. These inflationary effects were further exacerbated by external shocks, such as fluctuations in global risk sentiment and commodity prices, creating additional challenges for policymakers. Beyond inflationary pressures, exchange rate volatility has broader economic repercussions. Helmi et al. (2023) underline the destabilizing effects of currency fluctuations on trade balances, capital flows,

Table 2. Literature Review

Autor(s)	Exchange Rate	Periods	Methods	Results
Wu (1995)	USD and GBP JPY, and DEM	1974:1-1988:12	Kalman filter	There are no exchange rate bubbles.
Norden (1996)	JPY, DEM, and CAD	1977:09 to 1991:10	A new test developed by Norden (1996)	There are no exchange rate bubbles in many cases.
Elwood et al. (1999)	JPY and DEM	1984:12-1998:11	State-space models	Substantial a evidence supports the existence of a stochastic rational bubble, estimated to have collapsed between the end of March and the end of April 1990.
Chan et al. (2003)	Germany, Hungary, and Poland	during the interwar	Extended Durlauf–Hooker approach	No evidence of price or exchange rate bubbles was found in the three countries under investigation.
Jirasakuldech et al. (2006)	USD and GBP, CAD, DKK, JPY, and ZAR	1989:01-2004:12	GSADF	There are no exchange rate bubbles.
Bettendorf and Chen (2013)	GBP/USD	1972:1-2012:6	SADF and GSADF	There is evidence of exchange rate bubbles.
Jiang et al. (2015)	RMB/USD	1995:7-2013:10	GSADF	No evidence of bubbles was detected prior to 2005, during the fixed exchange rate regime. However, strong evidence of bubbles has been found since 2006.
Rasekhi et al. (2016)	Iran's four main asset markets, including the exchange rate	2002:03-2015:06	Sigma-Point Kalman Filter	there are bubbles spillover among asset markets.
Hu and Oxley (2017)	Some G10, Asian, and BRICS Countries	1991:03-2014:10	GSADF	While the 1994-1995 Mexican currency crisis led to a bubble in the US Dollar-Mexican Peso exchange rate, no such evidence exists for G10 countries.
Maldonado et al. (2018)	BRICS countries' currency relative to USD	1999:03 to 2013:06	Models proposed by Maldonado et al. (2012)	There are speculative exchange rate bubbles, and the bubbles are detected to be cointegrated.
Yildirim et al. (2022)	USD/BRL, USD/RUB, USD/INR, USD/CNY, USD/ZAR, USD/TRY	2002:01 - 2019:08	SADF and GSADF	Price bubbles were detected in all currencies except USD/INR, with speculative movements in exchange rates causing potential problems for national economies.
Özdemir (2021)	EUR/USD	02.12.2019-04.12.2020	SADF and GSADF	There are exchange rate explosive bubbles.
Özdemir (2022)	USD/TRY, GBP/TRY, EUR/TRY, CNY/TRY, RUB/TRY	January 2, 2015, to November 15, 2019, and; November 18, 2019, to February 12, 2021	SADF and GSADF	There is significant bubble activity in all five exchange rates, especially during the COVID-19 period, indicating more inefficiency in forex markets during this time.
Ural (2021)	USD/KZT	23.08.2015-04.04.2021	GSADF	There are two explosive bubbles in 2018 and 2020.
Maldonado et al. (2021)	BRICS countries' currency relative to USD	1999.03-2017.10 for BIS and 2005.07-2017.12 for CR	GSADF, RTADF, Evans, and Froot and Obstfeld	Countries outside China have observed at least one of four distinct bubble types: single explosive, multiple periodically collapsing, periodically collapsing, and intrinsic.

Autor(s)	Exchange Rate	Periods	Methods	Results
Deviren et al. (2014)	TRY/USD, TRY/EUR, TRY/JPY, and TRY/CHF	01.01.2005-20.12.2013	Watanabe et al. (2007)	Multiple instances of bubble formation have been identified. Moreover, the duration of collapses in the TRY/CHF rate is generally shorter. In contrast, the duration of collapses in the TRY/EUR rate is generally longer than in other exchange rates.
Korkmaz et al. (2016)	TRY/USD, TRY/Euro	2002:1-2016:5	SADF and GSADF	Despite detecting a bubble formation in the dollar exchange rate during the specified period, empirical analysis suggests that this bubble had no significant impact on the performance of the BIST-100 index.
Korkmaz (2018)	Euro/TRY, USD/TRY	01.08.2011-23.03.2018	SADF and GSADF	Euro/TRY bubbles: 10.05-15.07.2013, 05.08-28.10.2013, 13.12-14.03.2013. USD/TRY bubbles: 12.08.-03.09.2013, 30.12.2013-18.02.2014, 4.03-13.03.2015, 14.04-20.05.2015, 10.06-16.06.2015, 19.08-19.10.2015, 26.12.2016-09.02.2017.
Afşar et al. (2019)	USD/TRY and EURO/TRY	2005:01 to 2018:11	GSDF	USD/TRY experienced bubble periods in the last quarter of 2008, early 2014, the last quarter of 2015, and from the last quarter of 2016 to mid-2017. Similarly, EUR/TRY exhibited bubble periods during May-October 2011, mid-2012, the third quarter of 2013 to early 2014, and from the end of 2017 to the fourth quarter of 2018.
Gülcan et al. (2021)	03.01.2005 and 20.11.2019 for the USD/TRY, EUR/TRY, GBP/TRY, and CNY/TRY, and 28.08.2013-20.11.2019 period for JPY/TRY		GSADF and SADF	Empirical evidence suggests the formation of financial bubbles within Türkiye's foreign exchange market.
Gök (2021)	USD/TRY	2005 and 2021	GSADF and BSADF	There is evidence of two long bubble periods (02.2015–03.2016 and 09.2016–06.2021) and six short bubble periods (05.2006–07.2006, 08.2011 covering 5 weeks, 08.2013 covering 3 weeks, 01.2014 covering 7 weeks, 05.2016 covering 8 weeks, and 07.2016 covering 4 weeks).

Source: Author.

and investment decisions, particularly in economies with structural vulnerabilities. The study reveals that during periods of heightened uncertainty, such as the COVID-19 pandemic, exchange rate shocks contributed to elevated market volatility, disrupting financial stability and creating spillover effects across global markets. İlhan et al. (2022) further observe that speculative dynamics driven by high exchange market pressure (EMP) intensified currency depreciation, highlighting the interplay between external shocks and domestic vulnerabilities. Moreover, empirical findings from these studies offer critical insights. İlhan et al. (2022) and Helmi et al. (2023) demonstrate that the effects of exchange rate volatility are dynamic and evolve over time, reflecting shifts in global conditions and policy responses. For instance, Türkiye's ERPT surged during specific shocks, such as the May 2006 exchange rate crisis, with İlhan et al. (2023) documenting pass-through rates exceeding 15%. These findings underscore the need for adaptive and consistent monetary policies, alongside structural reforms, to mitigate the inflationary and destabilizing effects of exchange rate volatility effectively. Such measures are essential to enhance macroeconomic stability and resilience against external and internal shocks.

On the other hand, although exchange rate increases have important macroeconomic effects on inflation, trade balance, capital flows, and investment decisions, this study focuses on speculative bubble formations, which refer to unrealistic increases in exchange rate markets, and the dynamics of this bubble formation, rather than on these macroeconomic effects. In this context, numerous studies have focused on various types of speculative bubbles in the empirical literature, especially stock market bubbles, asset market bubbles (real estate bubbles, exchange rate, cryptocurrency markets, etc.), credit bubbles, and commodity bubbles (oil prices, precious metals, agricultural crops, etc.). While most empirical studies on bubble formation tend to focus on stock and real estate markets, fewer have examined speculative bubbles in currency markets, including the Turkish Lira. Table 2 presents a curated selection of studies that have contributed significantly to the discourse on exchange rate bubbles. These studies are included based on their methodological rigor, relevance to the Turkish exchange rate context, and their novel insights into bubble detection and analysis. When the relevant literature is examined, it is seen that many different empirical methods are used to detect bubble formation. However, following the introduction of the GSADF and BSADF methods by by Phillips et al. (2015) and Phillips et al. (2011), these techniques have become the primary tools for detecting speculative bubbles in exchange rate markets. In this context, this study extends their application to the Turkish Lira, offering a novel perspective on bubble formation in the context of Türkiye's recent currency fluctuations. Moreover, while the BSADF curve is primarily utilized to detect speculative bubbles in asset pricing, this study proposes an additional interpretation. Specifically, in examining exchange rates, while not a definitive measure, the BSADF curve may serve as an indicative benchmark for the 'fair price' of the currency. This perspective suggests that observed exchange rates aligning with the BSADF curve could reflect the currency's inherent value, with deviations potentially indicating overvaluation or undervaluation. Extending this concept, similar applications could inform pricing insights in other asset markets, such as equities or real estate, where the BSADF curve could signify the degree of divergence from an implied fair value.

When empirical studies on Türkiye are examined, nominal exchange rates are used as the exchange rate variable in most studies. However, the use of the nominal exchange rate in empirical analyses of exchange rate bubbles may lead to the mistaken identification of exchange rate increases driven primarily by inflationary pressures as speculative bubbles, potentially resulting in inaccurate conclusions about exchange rate market efficiency and stability. Actually, a significant increase in the exchange rate that outpaces the rate of inflation can be interpreted as a sign of a potential bubble, suggesting that market expectations and sentiment may be driving the exchange rate to levels that are not justified by underlying economic fundamentals. Consequently, using the nominal exchange rate in empirical analyses of exchange rate bubbles may lead to identifying a larger number of bubbles than may actually exist, potentially overstating the extent of speculative activity in the foreign exchange market. On the other hand, while existing studies have primarily analyzed the behavior of a few specific currencies, such as the Dollar and the Euro, there is a lack of research exploring the dynamics of the effective exchange rate, which provides a more comprehensive measure of the overall value of the Turkish Lira relative to the currencies of Türkiye's significant trading partners. Additionally, while existing studies on Türkiye's exchange rate dynamics have focused on various periods, none have specifically addressed the potential speculative bubbles during the significant exchange rate movements in the final quarter of 2021. This study aims to fill this gap by applying advanced bubble detection methods to the Turkish Lira during this period, thereby contributing to a more nuanced understanding of exchange rate volatility in Türkiye.

DATA and METHODOLOGY

The study delves into an examination of the potential bubble within the foreign exchange market from February 2001 to September 2024, encompassing the notable surge in exchange rates witnessed in late 2021. A pivotal aspect of the methodology lies in the deliberate choice of the effective real exchange rate, which shows the weighted average value of the Turkish lira obtained from the CBRT (The Central Bank of the Republic of Türkiye), as the primary variable. This decision is not arbitrary but is based on a meticulous consideration of the intricacies inherent in exchange rate dynamics. Had the nominal exchange rate variable been chosen, the influence of inflation-driven fluctuations in exchange rates could have been inadvertently magnified. Such inflation-induced spikes could have falsely contributed to the perception of bubble formation, even during periods devoid of actual bubbles. This would have led to erroneous conclusions, suggesting bubble formation even in non-bubble periods. The effective real exchange rate variable has been judiciously selected to circumvent these pitfalls and ensure precision in the analysis. This

choice is underpinned by the recognition that non-real increases, particularly those fueled by inflation, can artificially inflate the perception of bubbles. By focusing on the real effective exchange rate, a clear lens is maintained on genuine exchange rate movements, untainted by inflationary distortions, thus enhancing the accuracy and reliability of the findings. The study employed the recursive and right-tailed unit root tests proposed by Phillips et al. (2015) as the empirical method for bubble detection. These tests are widely recognized and utilized in the literature to identify potential bubbles within financial markets.

The GSADF test, a generalized form of the SADF test proposed by Phillips et al. (2011), is utilized in this study. Phillips et al. (2011) propose an empirical model (namely SADF: The Supremum Augmented Dickey-Fuller) that uses recursive regression and right-tailed unit root tests to test for bubbles at stock prices on the US Nasdaq stock market. Unlike left-tailed unit root tests, such tests often focus on the alternative hypothesis (rather than the unit root hypothesis) due to the concern for possible deviations from fundamentals and market excesses or mispricing (Phillips et al., 2015, p. 1047). The SADF test starts with estimating equation (1) by using the least-squares method (Phillips et al., 2011, p. 206):

$$x_t = \mu_x + \delta x_{t-1} + \sum_{j=1}^{j} \phi_j \Delta x_{t-j} + \varepsilon_{x,t},\ \varepsilon_{x,t} \sim \mathrm{NID}(0, \sigma_x^2) \quad (1)$$

Here, j represents the lag parameter, and NID denotes an independent and normally distributed error term. While the unit root null hypothesis is H_0: $\delta=1$, the right-tailed alternative hypothesis is H_1: $\delta > 1$. The SADF test is based on the repeated prediction of the ADF model on a forward-expanding set of samples, and the test is obtained as the sup value corresponding to the ADF test sequence (Phillips et al., 2011, p. 207):

$$ADF_r \Rightarrow \frac{\int_0^r \tilde{w} dw}{\left(\int_0^r \tilde{w}^2\right)^{1/2}},\ \text{and}\ \sup_{r\in[r_0,1]} ADF_r \Rightarrow \sup_{r\in[r_0,1]} \frac{\int_0^r \tilde{w} dw}{\left(\int_0^r \tilde{w}^2\right)^{1/2}} \quad (2)$$

Here, w is the standard Brownian motion, also known as the Wiener Method. In this case, the window size r_w expands from r_0 to 1. The parameter r_0 denotes the smallest window width fraction used to initiate the test statistic calculation, while 1 represents the largest window fraction, corresponding to the total sample size. The parameter $r1$, which denotes the starting point of the array, is fixed to 0. Thus, the endpoint of each sample (r_2) is equal to r_w, it changes from $r0$ to 1. ADF statistic is indicated by the statistic for a sample running from 0 to r_2. Accordingly, the SADF test, a sup statistic derived from forward recursive regression, is formally defined as (Phillips et al., 2015, p. 1048):

$$SADF_{(r_0)} = \sup_{r_2\in[r_0,1]} ADF_0^{r_2} \quad (3)$$

Phillips et al. (2011), following the SADF test developed by Phillips et al. (2015) proposed a new recursive test procedure (GSADF: The Generalized Supremum Augmented Dickey-Fuller) and dating algorithm (BSADF: Backwards Supremum Augmented Dickey-Fuller) used to detect multiple bubbles. The GSADF test developed here is constructed recursively on sub-samples of the data, much more comprehensively than the SADF test, based on repeated ADF test regressions in Equation (4) (Phillips et al., 2015, pp. 1047–1048):

$$\Delta y_t = \hat{a}_{r_1,r_2} + \hat{\beta}_{r_1,r_2} y_{t-1} + \sum_{i=1}^{k} \hat{\psi}^i_{r_1,r_2} \Delta y_{t-i} + \hat{\varepsilon}_t \quad (4)$$

Besides adjusting the endpoint of the r_2 regression from r_0 (the minimum window width) to 1, the GSADF test permits the starting point $r1$ in Equation (4) to vary within an appropriate range (from 0 up to r_2-r_0, in contrast to the SADF test). Consequently, the GSADF statistic is defined as the largest ADF statistic obtained from this double recursion across all feasible r_1 and r_2 ranges, and it is represented as GSADF(r_0). The GSADF statistic is formally defined in Equation (5) (Phillips et al., 2015, pp. 1048–1049):

$$GSADF(r_0) = \sup_{\substack{r_2\in[r_0,1] \\ r_1\in[0,r_2-r_0]}} \left\{ \frac{\frac{1}{2} r_w \left[W(r_2)^2 - W(r_1)^2 - r_w\right] - \int_{r_1}^{r_2} W(r) dr \left[W(r_2) - W(r_1)\right]}{r_w^{1/2} \left\{ r_w \int_{r_1}^{r_2} W(r)^2 dr - \left[\int_{r_1}^{r_2} W(r) dr\right]^2 \right\}^{1/2}} \right\} \quad (5)$$

Also, the GSADF statistic is simply defined in Equation (6) as follows (Phillips et al., 2015: 1049):

$$GSADF(r_0) = \sup_{\substack{r_2\in[r_0,1] \\ r1\in[0,r_2-r_0]}} ADF_{r_1}^{r_2} \quad (6)$$

In this context, in contrast to the SADF test (Phillips et al., 2011), the GSADF test (Phillips et al., 2015)

identifies multiple bubble episodes by allowing the window size to vary from 0 to r_2-r_0. In this respect, this test provides a great advantage (Phillips et al., 2015, p. 1048).

To identify bubble start and end dates, Phillips et al. (2015) introduce the Backwards Sup ADF (BSADF) sequence immediately following the calculation of the GSADF test statistic. The Backwards Sup ADF (BSADF) test is a sup ADF test conducted on an expanding sample set. The endpoint of each sample is fixed at the fraction r_2 of the total sample size, while the starting point of the sample is allowed to vary from 0 to r_2-r_0, corresponding to the formation of the window (Phillips et al., 2015, p. 1051).

$$BSADF_{r2}(r_0) = \sup_{r_2 \in [0, r_2 - r_0]} \left\{ ADF_{r_1}^{r_2} \right\} \quad (7)$$

The point where the BSADF sequence first cuts the critical value is the point the bubble formation starts. Points in the BSADF sequence that exceed the critical value indicate bubble zones. Finally, the bubble is considered to have ended at the endpoint where the BSADF sequence falls below the critical value. This endpoint indicates a return to more rational market behavior. In this context, the BSADF curve could also be interpreted as a benchmark for identifying the currency's 'implied fair value.' While not a definitive representation of the fair price, the BSADF curve provides a reference against which the exchange rate's proximity can suggest its relative valuation status. Such an interpretation enriches the bubble detection framework, allowing for the BSADF curve to indicate whether observed exchange rate levels align with fundamental economic factors.

EMPIRICAL FINDINGS

The study delved into the intricate dynamics of Türkiye's foreign exchange market spanning from February 2001 to September 2024. Initially, the Generalized Sup Augmented Dickey-Fuller (GSADF) test unveiled potential bubble formations within this extensive period. Remarkably, the findings illuminated bubble formations in Türkiye's foreign exchange market during this timeframe. Following identifying these bubbles, the Backwards Sup Augmented Dickey-Fuller (BSADF) test was subsequently administered to pinpoint the exact periods of bubble formations, and its corresponding critical values were derived. These pivotal insights from both the GSADF and BSADF tests are meticulously presented in Table 3, encapsulating the nuanced dynamics of bubble formations within Türkiye's foreign exchange landscape.

The empirical analysis spans 284 months; however, due to the minimum window width, the calculation of the BSADF Sequence initiated in July 2003. During the specified periods, the observed exchange rates closely tracked the BSADF curve; in a sense indicating that the currency's valuation was near its theoretical 'fair value'. Periods where significant deviations occur may indicate speculative pressures or mispricing. This finding supports the notion that the BSADF curve can serve as a valuable indicator of the exchange rate's fair valuation, providing insights into when the currency aligns or strays from its economically justified level. Based on the BSADF test outcomes, bubble formations have been identified in the exchange rate market during three distinct periods: May 2018 to October 2018, September 2020 to November 2020, and November 2021 to March 2022. Notably, the longest period of bubble formation is observed from May 2018 to October 2018, encompassing a duration of 6 months. This suggests a more pronounced bubble formation in 2018 than in 2022. The identified bubble formation periods are visually represented in Figure 1, where the left axis showing the "Exchange Rate," the right axis displaying "Backwards SADF Sequences" and "Critical Values (%95)," and the bubble periods shaded in grey for better clarity.

Table 3. The Generalized Sup ADF and Backwards Sup ADF Test Results

GSADF Statistics	Bubbles Periods obtained from the BSADF Sequence
2,959***	**First Bubbles Period** May 2018-October 2018
	Second Bubbles Period September 2020-November 2020
	Third Bubbles Period November 2021-March 2022

Note: The symbols ***, **, and * indicate bubble formation at the 1%, 5%, and 10% significance levels, respectively. The critical values for the GSADF statistic are 1.909, 2.135, and 2.792, corresponding to the 1%, 5%, and 10% significance levels, respectively. Critical values have been obtained with a 2000 replicate Monte Carlo simulation for 284 observations, with a minimum estimation window size of 32 months.

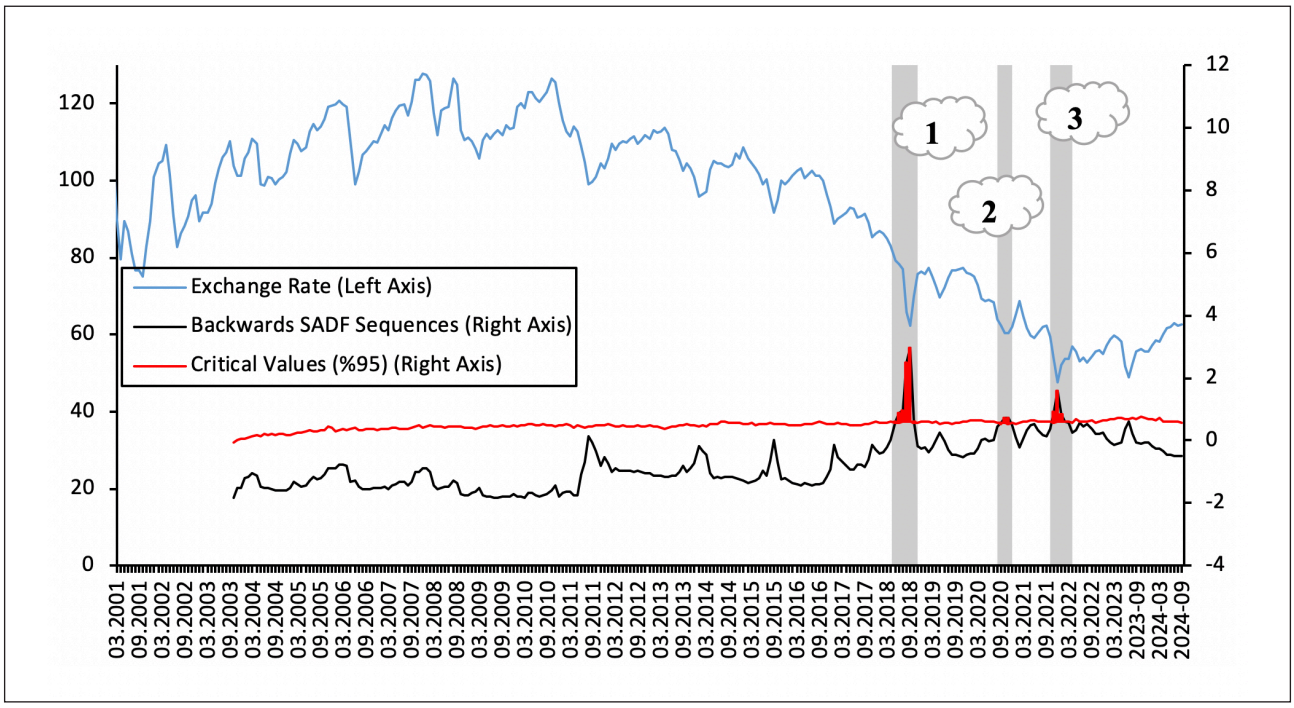

Figure 1. Periods of Bubbles in the Türkiye Exchange Rate Market

Source: Developed by the author based on empirical findings from this study.

Interpretation of the underlying causes of the first bubble formation is important to consider the events and policy implementations that may have influenced the exchange rate movements during this period. In the first bubble period, it is notable that a crisis involving the threat of sanctions with the USA coincided with the case of Priest Andrew Brunson, who faced accusations of espionage and was sentenced to house arrest. This event potentially played a significant role in the exchange rate dynamics. Donald Trump's remarks during his October 7, 2019, press briefing provide compelling evidence of the critical role geopolitical tensions played in shaping exchange rate movements during this period. Referring to the Brunson case, Trump stated: "*They could suffer the wrath of an extremely decimated economy, and I've done it once. I did it with Pastor Brunson. You remember the Pastor Brunson? And they wouldn't give Pastor Brunson back, and they ended up giving Pastor Brunson back pretty quickly. The currency fell at record levels, and lots of other things happened.*" (For the full video of this press briefing, see Euronews, 2019). These remarks underline the direct correlation between political actions and their economic consequences, particularly in the context of the sanctions imposed by the United States. During the escalation of the crisis, the Turkish lira faced unprecedented speculative pressures, amplifying the depreciation in its value. The sanctions and the accompanying rhetoric, as exemplified by Trump's statements, not only heightened market uncertainty but also served as a catalyst for speculative behavior, further exacerbating the volatility in the exchange rate. These events provide a clear example of how external political pressures can trigger significant market reactions, contributing to the formation of financial bubbles. For instance, the dollar exchange rate, which stood at 4.05 TRY at the beginning of this period, rapidly increased, peaking at over 7.20 TRY in international markets on August 12, 2018 (In this context, see the news article Euronews, 2018). The tensions eased after Brunson's release in October 2018, leading to a regression in the dollar exchange rate above the 5 TRY level, with the year-end rate settling at 5.29 TRY. The convergence of geopolitical tensions, particularly those involving the USA and Türkiye during the Brunson incident, alongside market reactions and investor sentiment, suggests a possible connection to the bubble observed during this period. These events underscore the intricate relationship between political developments, policy responses, and exchange rate movements, highlighting the complexities of identifying and analyzing bubble formations in currency markets. It is worth emphasizing that while these observations may not conclusively prove causation, they provide substantial context and potential explanations for the observed exchange rate dynamics. Furthermore, the analysis supports that speculative factor, rather than purely economic indicators, played a significant role in driving exchange rate fluctuations during the identified bubble periods. This study's identification of these bubble

periods provides valuable insights into the dynamics of exchange rate movements, emphasizing the importance of considering non-traditional drivers such as geopolitical tensions and market sentiment in understanding currency market behaviors. By acknowledging these speculative influences, this study contributes to a more comprehensive understanding of the factors influencing exchange rate dynamics and the potential impact of speculative activities on currency markets.

Upon closer examination of the second bubble period spanning from September 2020 to November 2020, it becomes evident that a relatively minor and short-lived bubble formation occurred during this time frame. This period coincided with the global economic challenges posed by the Covid-19 pandemic. The initial six months of 2021, preceding the bubble formation, witnessed a significant both global and national trade slowdown, with many factories and workplaces halting operations. This economic contraction was not unique to Türkiye but was a global phenomenon affecting economies worldwide. Despite the initial economic downturn, various measures were implemented to stabilize and support the economy. Government interventions and public support initiatives, coupled with normalization efforts starting from the end of June, aimed to mitigate the impact of the pandemic on economic activities. However, despite these efforts, the dollar exchange rate, which stood at 5.96 TRY at the beginning of the year, surged to 7.35 TRY in September 2020, when the bubble formation commenced. The escalation of the dollar rate, peaking around the 8.50 levels towards the end of the detected bubble in November 2020, reflected the speculative pressures and uncertainties prevailing in the foreign exchange market. Subsequently, following the conclusion of the bubble formation period, the dollar rate gradually declined to 7.36 TRY. This fluctuation underscores the influence of speculative factors and market sentiment on exchange rate dynamics, particularly during periods of economic uncertainty and crisis such as the Covid-19 pandemic.

Finally, the empirical analysis reveals a particularly notable discovery regarding the presence of a bubble in Türkiye's exchange rate market during the latter months of 2021, coinciding with a sharp upward trend in exchange rates. This result is also the most striking result of the empirical analysis. The study's findings specifically for this period align with claims that at least some of the sharp increase in the exchange rate doesn't align with macroeconomic indicators. The subsequent sharp decline in the exchange rate following the announcement of the Foreign Exchange-Protected Turkish Lira Deposit further underscores this observation. It can be argued that while this instrument may not entirely eliminate the bubble, it impedes its growth or contributes to its decrease. Accordingly, Figure 1 illustrates this bubble formation, which commenced in November 2021, peaked in December 2021, and concluded in March 2022. Examining the bubble period in detail, we observe a significant decline in the effective real exchange rate, from 63.02 in September 2020 to 47.82 by December 2021. Delving into the dollar exchange rate dynamics during this bubble period, we note a remarkable surge. The dollar exchange rate, 8.90 TRY on October 1, 2021, surged to historic highs, surpassing 10 TRY on November 16, 2021, 17 TRY on December 17, 2021, and 18 TRY on December 20, 2021. Subsequently, following the announcement of the Foreign Exchange-Protected Turkish Lira Deposit, introduced to mitigate the depreciation of the TRY from its historical peak, a reversal in trend is observed. As depicted graphically in Figure 1, the BSADF curve starts to trend downward after this intervention. This new policy instrument not only alleviated the excessive demand for foreign currency but also instigated a notable recovery, dispelling concerns of continued exchange rate escalation.

Following the last identified bubble period, it is observed that there has been a visible decrease in exchange rates in Türkiye, particularly after the introduction of the Foreign Exchange-Protected Turkish Lira Deposit as a significant policy measure. This decrease appeared to contribute to the bubble's deflation by March 2022. On the other hand, it's essential to recognize that the exchange rate, which was 14.66 TRY against the dollar in March 2022 (the period when the last bubble formation deflated), rose to 31.22 TRY by February 2024. Although there was a period of relative stability after the Foreign Exchange Protected Turkish Lira Deposit was introduced, the notable rise in the exchange rate stands out. Interestingly, the BSADF curve did not identify a bubble at the 5% significance level during this time, indicating that the factors driving this upward trend are grounded in real circumstances. In this sense, the rise in exchange rates in this period can be attributed to several factors. In this sense, the extensive economic and humanitarian aftermath of the devastating earthquakes on February 6-7, along with the uncertainties surrounding the 2023 Presidential elections, contribute to elucidating the increase in the exchange rate during that period for real economic reasons. The absence of an explosive surge in the exchange rate during the specified periods, unlike the previous period, and the non-conversion of this increase into a bubble can partly be attributed to the reimplementation of orthodox policies,

particularly the reintroduction of interest rate hikes, led by Mehmet Şimşek and Cevdet Yılmaz. Similar to how the bubble in 2021 dissipated following the introduction of the foreign exchange-indexed deposit account, it can be posited that this significant shift in economic management represents a crucial policy measure aimed at mitigating potential foreign exchange bubbles. These observations highlight the dynamic nature of exchange rate fluctuations and the various factors influencing (see Figure 2. Reactions of CDS Premiums and Central Bank Currency Reserves During Exchange Rate Bubble Formation Periods), it is evident that the behaviour of these variables aligns with the formation of exchange rate bubbles identified through the GSADF and BSADF tests. The three bubble periods—May 2018 to October 2018, September 2020 to November 2020, and November 2021 to March 2022—demonstrate notable trends in both the CDS premiums and foreign exchange reserves.

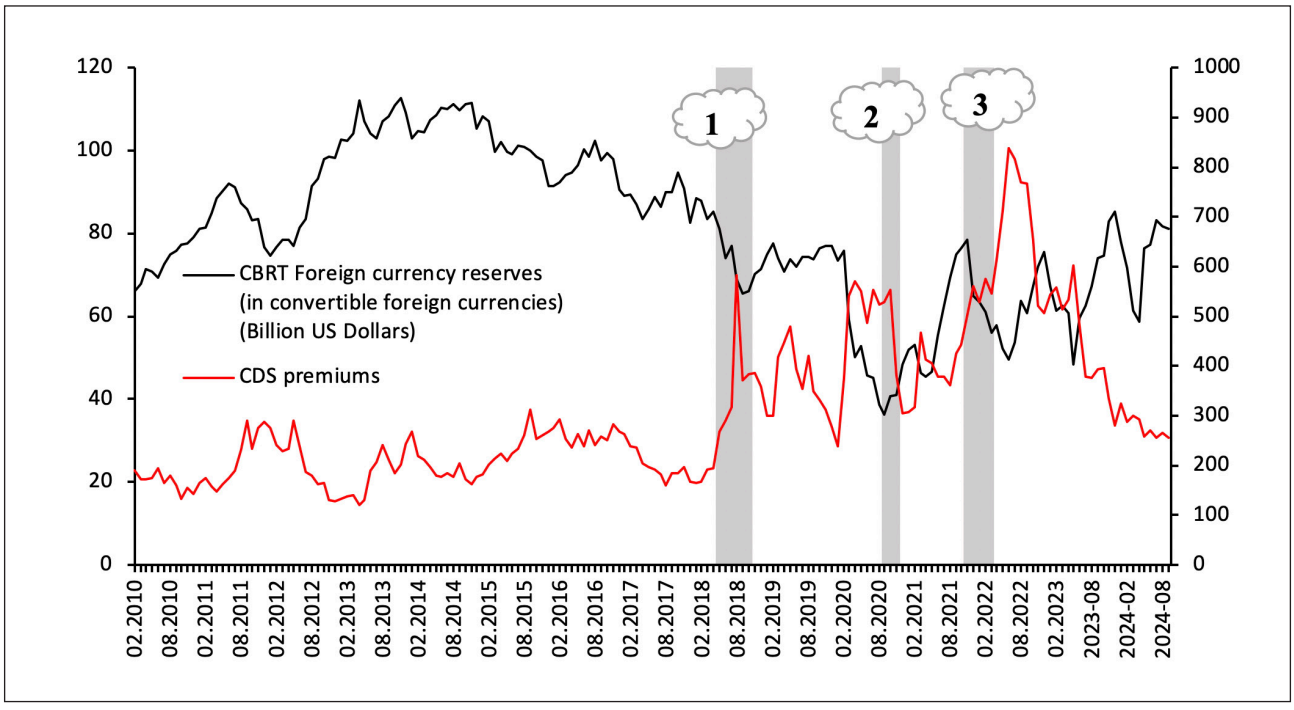

Figure 2. Reactions of CDS Premiums and Central Bank Currency Reserves During Exchange Rate Bubble Formation Periods

Source: CDS Premiums data were obtained from Investing.com, while CBRT Currency Reserves data were sourced from the Central Bank of the Republic of Türkiye (CBRT) EVDS Data Central.

market sentiment and currency valuation. However, it's worth mentioning that the BSADF curve indicated the presence of a bubble at a 10% significance level from May 2022 to September 2022 and June 2023 to July 2023. These observations highlight the dynamic nature of exchange rate fluctuations and the various factors influencing market sentiment and currency valuation. In conclusion, despite the absence of a new bubble formation at a 5% significance level following the last identified bubble period, the exchange rate dynamics remain influenced by many economic, political, and social factors. This underscores the complexity of exchange rate movements and the ongoing challenges in maintaining stability in Türkiye's foreign exchange market.

On the other hand, in the graphical analysis of Turkey's CDS premiums (Credit Default Swap Premiums) and foreign exchange reserves during the bubble periods

May 2018 – October 2018 Bubble: During this period, Turkey's CDS premiums sharply increased from around 267 to 383, indicating rising investor concerns regarding the country's economic stability. Simultaneously, foreign exchange reserves fell from 81.2 billion USD to 66.2 billion USD, reflecting a depletion in reserves amid the speculative pressures on the currency. These developments align with the identified bubble period, which is visually highlighted in grey in the graph.

September 2020 – November 2020 Bubble: In this phase, there is a notable spike in CDS premiums from 527.96 to 552.24, signifying heightened risk perception by international markets. The reserves also show some fluctuation, though less drastic than in 2018. The bubble formation period is again marked in grey on the graph, illustrating that this was a period of significant speculative activity in the foreign exchange market.

November 2021 – March 2022 Bubble: The period from November 2021 to March 2022 saw another surge in CDS premiums from 500.72 to 612.88, highlighting a persistent perception of elevated economic risks. At the same time, foreign exchange reserves decreased from 78.5 billion USD to 56.1 billion USD, confirming the intensifying pressure on the country's currency and reserves. This bubble formation is clearly marked in the graph, indicating another period of speculative behaviour.

The graph not only visually supports the occurrence of these bubbles but also strengthens the empirical findings of the GSADF and BSADF tests, providing a clear connection between the CDS premiums, foreign exchange reserves, and the speculative forces driving the exchange rate bubbles. The use of grey shading effectively highlights the bubble periods, offering a comprehensive view of how macroeconomic variables interact during times of market instability.

Building on the theoretical insights derived from Minsky's (1992) Financial Instability Hypothesis and Scherbina's (2013) analysis of speculative bubble dynamics, Kartal (2024) developed a general framework for understanding the formation of speculative bubbles. This study adapts this framework specifically to foreign exchange markets, applying it to Türkiye's exchange rate market to examine the psychological, market-based, and macroeconomic forces that triggered speculative surges. The empirical findings reveal three distinct speculative bubble periods—May 2018 to October 2018, September 2020 to November 2020, and November 2021 to March 2022—each driven by a combination of these mechanisms. The following section analyses how these forces shaped speculative behaviour in each bubble period:

The 2018 Bubbles: The Pastor Brunson Crisis and Speculative Attacks

- Psychological Factors: The diplomatic crisis between Türkiye and the U.S., particularly centred around Pastor Andrew Brunson's detention, triggered an aggressive herding behaviour among both institutional and retail investors. Concerns over potential sanctions led to a rush into foreign currency, as market participants anticipated further depreciation of the Turkish lira. This collective panic, rather than fundamental economic weaknesses, drove excessive speculative demand. At the same time, investors exhibited overconfidence, believing that the TRY would continue depreciating indefinitely, despite Türkiye's Central Bank's (CBRT) attempts to stabilize the currency. This overestimation of risk led to persistent speculative positioning, further accelerating the exchange rate surge. Additionally, anchoring bias played a role as investors adjusted their expectations based on previous currency shocks, normalizing the sharp devaluation instead of recognizing it as an overreaction.
- Market Inefficiencies: Information asymmetries intensified the bubble, as conflicting government statements and uncertainty surrounding potential U.S. sanctions heightened speculation. Moreover, Türkiye's regulatory measures, including restrictions on offshore swap transactions, further distorted price discovery, exacerbating volatility. Market frictions also played a role, as capital controls and liquidity constraints in domestic financial markets made it difficult for rational investors to counteract speculative pressures.
- External Shocks and Macroeconomic Factors: Prior to the crisis, the CBRT maintained a relatively low interest rate of 7.25% to stimulate growth. However, as the lira came under intense pressure with Pastor Brunson Crisis, low interest rates had negative pressure on the exchange rate and further triggered the increase in the exchange rates (monetary and fiscal policy interactions). Then, the CBRT implemented a sharp increase in the policy rate, raising it to 22.5% by September to stabilize the currency. This tightening had limited effectiveness in addressing the underlying causes of the speculative bubble since the main reason for the currency crisis was geopolitical risks and uncertainties regarding Türkiye's foreign relations. Foreign capital flight, driven by concerns over economic stability, pushed CDS premiums higher, while deteriorating global risk sentiment, exacerbated by U.S. trade policies and emerging market sell-offs, further fuelled the speculative bubble.
- Theoretical Model Alignment: The rapid depreciation of the TRY despite CBRT's interventions suggests that speculative sentiment overrode economic fundamentals, aligning with rational bubble models. The mass movement into foreign currency during the crisis exemplifies behavioural finance models, as investors engaged in herd-driven speculation, assuming further depreciation was inevitable. The TRY's deviation

from its theoretical fair value, evident in extreme volatility, further supports the fundamental value model perspective.

- Dissipation of Speculative Bubbles: Following the sharp depreciation of the Turkish lira, the CBRT took decisive action by raising interest rates from 7.25% to 22.5% in September 2018, aiming to restore confidence and curb speculative activity. The resolution of the diplomatic crisis with the release of Pastor Brunson, combined with a significant interest rate hike by the Turkish Central Bank, played a crucial role in stabilizing the exchange rate and reducing speculative demand. As a result, speculative demand for foreign currency subsided, leading to a gradual revaluation of the lira.

The 2020 Bubbles:From Pandemic to Global Uncertainty and Speculation

- Psychological Factors: The global financial uncertainty caused by the COVID-19 pandemic led to heightened speculative sentiment. As economies locked down and global trade slowed, investors rushed into safe-haven assets, contributing to a speculative surge in the exchange rate. Amid global uncertainty and concerns over Türkiye's foreign exchange reserves, both individual and corporate investors engaged in herding behaviour foreign currency purchases, fearing continued depreciation. Overconfidence was also prevalent, as some market participants incorrectly anticipated a prolonged devaluation due to economic contraction.

- Market Inefficiencies: Information asymmetries became more pronounced as inconsistent policy responses from global central banks created confusion, leading to speculative trading strategies. Additionally, liquidity shortages (market frictions) in emerging markets, including Türkiye, intensified volatility, exacerbating mispricing in exchange rates.

- External Shocks and Macroeconomic Factors: The global demand collapse and supply chain disruptions earlier in 2020 triggered heightened risks and capital outflows from emerging markets. Thus, in Türkiye, foreign exchange reserves declined sharply, increasing investor concerns and accelerating speculative positioning (global economic conditions). As global economic conditions worsened, Türkiye's fiscal and monetary challenges, compounded by the pandemic-driven expansionary policies, exposed its economic fragilities. This environment, marked by declining foreign exchange reserves and rising inflation expectations, intensified capital flight and exchange rate instability. In this context, the expansive fiscal and monetary measures, including credit incentives and accommodative interest rate policies, further deepened public finance stress, contributing to a self-reinforcing cycle of depreciation and inflationary pressures (monetary and fiscal policy interactions).

- Theoretical Model Alignment: The strong deviation of the exchange rate from macroeconomic fundamentals, despite temporary improvements in global market conditions, aligns with the rational bubble model. Behavioural biases, such as herding behaviour and overconfidence, dominated market reactions, reinforcing speculative pressures (the behavioural finance models). During this period, the deviation from fair value of the exchange rate is also consistent with fundamental value models.

- Dissipation of Speculative Bubbles: As the global economy began recovering from the initial shocks of the COVID-19 pandemic, risk appetite improved, and speculative pressure on emerging market currencies, including the Turkish lira, gradually declined. The stabilization of global trade and the partial recovery of Türkiye's foreign exchange reserves contributed to the correction of the exchange rate. Additionally, as economic contraction eased, the speculative demand for safe-haven assets weakened, leading to a stabilization in foreign exchange markets. Furthermore, the appointment of a new CBRT governor and a shift in monetary policy direction following Berat Albayrak's resignation restored some market confidence, reinforcing the stabilization of the exchange rate.

The 2021 Bubbles: Heterodox Policies, Global Inflation, and the FED's Tightening Cycle

- Psychological Factors: The CBRT's unexpected rate cuts in late 2021 triggered widespread herd behaviour, as market participants rushed to hedge against further depreciation, with large corporations and exporters increasing their foreign currency demand, further amplifying speculative pressures in the exchange rate market. This speculative momentum intensified

as investors interpreted policy shifts as a loss of monetary credibility, exacerbating capital flight. Overconfidence also played a role, as many market participants assumed that the TRY would continue depreciating at an accelerated pace, dismissing potential corrective interventions. In fact, the sudden wave of falling exchange rates that emerged with the introduction of the exchange rate-protected deposit account dealt a major blow to those who had made investments based on this assumption.

- Market Inefficiencies: Severe information asymmetries emerged as frequent changes in economic leadership and contradictory policy signals created confusion in the market. Investors lacked clear forward guidance on exchange rate policy, leading to heightened speculative trading. Meanwhile, declining foreign exchange reserves further eroded confidence in the CBRT's ability to stabilize the currency, reinforcing speculative positioning (market frictions).

- External Shocks and Macroeconomic Factors: The 2021 bubble coincided with rising global inflation and expectations of Federal Reserve interest rate hikes, both of which fuelled emerging market capital outflows (global economic conditions). CBRT's rate cuts, despite rising inflationary pressures, significantly eroded market confidence, reinforcing speculative demand for foreign currency and accelerating exchange rate misalignments (monetary and fiscal policy interactions).

- Theoretical Model Alignment: The extreme price movements observed in the exchange rate align with rational bubble models, where market participants continue purchasing foreign currency despite the absence of a proportional macroeconomic justification. Additionally, the speculative rush into foreign assets closely follows behavioural finance models, particularly herding behaviour. Moreover, during this period, the deviation from fair value of the exchange rate is also consistent with fundamental value models.

- Dissipation of Speculative Bubbles: Unlike previous bubbles, which primarily ended due to external stabilization factors or policy rate adjustments, the 2021 speculative surge was abruptly reversed by the introduction of the Foreign Exchange-Protected Turkish Lira Deposit (KKM) scheme on December 20, 2021. This policy instrument initially curbed speculative pressures and triggered a sharp exchange rate correction by reassuring domestic investors and reducing foreign currency demand. As a result, the Turkish lira experienced a significant revaluation, with the BSADF curve reflecting a downward shift following the policy intervention. However, the effectiveness of KKM waned over time as concerns over its long-term sustainability grew, leading to the resurgence of structural pressures on the exchange rate. Despite this, the absence of a new speculative bubble in the subsequent period suggests that the transition to orthodox policies than heterodox policies following the 2023 presidential elections, particularly the initiation of interest rate hikes, played a pivotal role in preventing the formation of another speculative surge. CBRT's decisive return to conventional monetary tightening helped restore investor confidence, curb speculative pressures, and reinforce exchange rate stability. This shift highlights the fundamental role of credible and consistent monetary policies in mitigating excessive exchange rate volatility and reducing the risk of recurrent speculative bubbles.

CONCLUSION and EVALUATION

While some exchange rate movements align with macroeconomic indicators, a volatility segment remains unexplained, indicating bubble presence. This underscores the need for nuanced analysis considering economic fundamentals and speculative influences. Factors like interest rate policies, investor sentiment, and global economic conditions also impact currency fluctuations, as seen in Türkiye's experience post-2018. In this context, the empirical analysis conducted from February 2001 to September 2024 aimed to identify and interpret currency bubbles within Türkiye's foreign exchange market. Employing the Generalized Sup Augmented Dickey-Fuller (GSADF) and Backwards Sup Augmented Dickey-Fuller (BSADF) tests, the study revealed multiple bubble formations, with a notable focus on the period from November 2021 to March 2022. These findings contribute significantly to understanding the complex dynamics of exchange rate movements and the impact of speculative factors on currency valuations.

The mechanism of currency bubble formation often initiates a disruption in one of the determinants of the exchange rate, leading to an initial increase in the exchange rate. Subsequently, market reactions fuel

speculative attacks, amplifying what would have been a manageable increase in the exchange rate into a more severe bubble formation. In essence, this study accepts that exchange rate fluctuations are influenced by many factors, including economic fundamentals, geopolitical events, and market sentiment. However, it claims that at least part of the increase in the exchange rate cannot be explained by macroeconomic reasons. While some movements align with traditional indicators, there remains a segment of volatility unexplained by these factors, indicating the presence of a bubble. In this regard, the study claims that there is a speculative bubble formation in this unexplained section, as proven by empirical findings. Accordingly, the study emphasizes the need for a nuanced understanding of exchange rate dynamics, considering both economic fundamentals and speculative influences. Moreover, this study offers a novel perspective by suggesting that the BSADF curve may serve as an indicator of 'fair value' in currency markets, especially when exchange rates align with the curve during non-speculative periods. While the BSADF curve does not conclusively determine fair value, its role as a benchmark for assessing deviations offers a valuable tool for policymakers. Extending this approach to other markets could also provide insights into mispricing across financial assets, encouraging further exploration into the broader applications of the BSADF test.

The analysis identified three distinct periods of bubble formations, each corresponding to unique economic and geopolitical contexts: May 2018 to October 2018, September 2020 to November 2020, and November 2021 to March 2022. The first bubble period coincided with a crisis involving the threat of sanctions from the USA and geopolitical tensions surrounding Priest Andrew Brunson's case. The subsequent easing of tensions post-Brunson's release resulted in a regression in the exchange rate, highlighting the sensitivity of currency markets to geopolitical developments. The detected bubble during this phase serves as a stark indicator of the artificiality of the exchange rate surge. It highlights how market perceptions, influenced by geopolitical factors, can lead to speculative increases that are not necessarily grounded in fundamental economic realities. Detecting a bubble in this context underscores the need for a nuanced understanding of market dynamics, considering both external geopolitical pressures and internal economic fundamentals.

The most notable bubble formation was observed during the latter months of 2021, and compatibility with macroeconomic fundamentals has been questioned many times. This period was characterized by heightened market uncertainties, investor sentiment fluctuations, and policy interventions aimed at stabilizing the exchange rate. Notably, introducing the "exchange rate-protected deposit," announced on December 20, 2021, led to a rapid decrease in the dollar exchange rate from 18 TRY to 12 TRY overnight, highlighting the market's sensitivity to policy interventions. This intervention underscores the effectiveness of policy measures in addressing speculative activities and promoting market stability.

The analysis confirmed the presence of a bubble during the specified periods; on the other hand, it should be particularly highlighted that the complexity of the exchange rate increases beyond attributing it solely to the bubble. Following 2018, particularly during the recent bubble formation period, Türkiye's macroeconomic indicators showed no significant signs of major deterioration except for inflation. However, the inflation rate in Türkiye, significantly higher than the global average, hinted that factors beyond inflation played a role in the rise of both nominal and real exchange rates. The expectation was that the rise in inflation would primarily affect the nominal exchange rate, with a more constrained impact on the real exchange rate. However, contrary to this expectation, both the nominal and real exchange rates experienced an increase. This indicates that the exchange rate surged beyond the inflation rate.

Moreover, there's a possibility that the inflation surge in countries like Türkiye could be attributed to exchange rate movements. These observations suggest that factors beyond inflation are driving the exchange rate increase. In this context, various factors such as the economic repercussions of the Covid-19 pandemic, global and local inflation expectations, FED's statements on asset purchase tapering, market pricing of FED's rate hike expectations, misapplications of Central Bank policies, and Türkiye's underlying structural challenges have significantly impacted exchange rate fluctuations. Factors such as interest rate policies and investor sentiment also played significant roles in influencing currency fluctuations. Despite Türkiye grappling with high inflation, the persistent reduction in interest rates led to real interest rates falling well below inflation rates, prompting potential foreign investor fund withdrawals and resulting in a decline in the exchange rate.

While these factors may have triggered increases in exchange rates, they also underscore a more nuanced understanding. Some increases in exchange rates

can be justified by macroeconomic reasons; however, there remains a segment of volatility unexplained by traditional indicators, indicating the presence of a bubble. This study reveals bubbles that are the reason for the increases in exchange rates unexplained by macroeconomic indicators in the given period. The study's findings support claims that at least some of the sharp increase in the exchange rate doesn't align with macroeconomic indicators. The subsequent sharp decline in the exchange rate following the announcement of the Foreign Exchange-Protected Turkish Lira Deposit further emphasizes this observation.

Before the Foreign Exchange-Protected Turkish Lira Deposit announcement on the night of December 20, 2021, the dollar exchange rate had soared above 18 TL. Notably, the rate plummeted to 12 TL after the announcement, showcasing a remarkable turnaround. The recent bubble formation culminated in December 2021, marked by a notable decline in the BSADF curve, signaling the impact of the Foreign Exchange-Protected Turkish Lira Deposit on mitigating the exchange rate bubble. This decline underscores that some of the exchange rate surge can be attributed to speculative bubbles. Furthermore, this development serves as a crucial validation supporting the empirical findings of this study during the specified period.

The introduction of the "exchange rate-protected deposit" policy in December 2021 is a prime example of effective policy intervention, as it mitigated the bubble's growth and helped stabilize the market in the short term. However, while this measure temporarily curbed the speculative surge and led to a sharp decline in the exchange rate, its long-term sustainability remains questionable. Relying on such temporary policy instruments can provide immediate relief, but it does not address the underlying vulnerabilities contributing to bubble formations. Therefore, while the exchange rate-protected deposit was crucial in preventing further escalation, it should not be viewed as a comprehensive solution. The true strength of a stable and resilient foreign exchange market lies in the implementation of structural reforms that address the root causes of economic instability. Proactive measures, such as enhancing monetary policy frameworks, improving fiscal discipline, fostering political stability, and addressing structural economic imbalances, are essential for creating a more robust and resilient currency market.

By focusing on long-term structural reforms rather than short-term fixes, policymakers can build a stronger economic foundation, reducing the likelihood of speculative bubbles and fostering sustainable economic growth. Particularly, focusing on structural reforms related to key determinants of exchange rates such as inflation, interest rates, foreign trade deficits, foreign direct investments, political stability, exchange rate regimes, and speculation is essential. Moreover, this approach not only enhances market stability but also boosts investor confidence, attracting foreign investment and promoting a healthier economic environment. The study's findings highlight the critical need for such comprehensive reforms, emphasizing that sustainable stability in the exchange rate market can only be achieved through a multifaceted strategy that addresses both immediate challenges and long-term economic health. Furthermore, the paper emphasizes the impact of recent economic policies on bubble formation. Notably, the absence of a new bubble formation in the exchange rate, despite continued increases, points to the effectiveness of policy measures implemented by Türkiye's economic management and the Central Bank. This observation is particularly relevant following the 2023 elections and the subsequent shift to orthodox economic policies under the guidance of Mehmet Şimşek and Cevdet Yılmaz. This aligns with the conclusion drawn from the analysis, highlighting the need for long-term structural reforms rather than short-term fixes to ensure sustainable stability in Türkiye's foreign exchange market. By acknowledging the role of policy interventions in mitigating speculative activities and promoting market stability, the study emphasizes the critical importance of a comprehensive approach to economic management. In conclusion, the analysis underscores the importance of understanding the nuanced dynamics of exchange rate movements and the impact of policy interventions on mitigating speculative bubbles. The empirical findings support the need for a comprehensive approach to economic management, focusing on long-term structural reforms rather than short-term fixes to ensure sustainable stability in Türkiye's foreign exchange market.

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Investigating the Impact of Social Assistance and Borrowing Behavior on Reducing Economic Worries

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ABSTRACT

When individuals have insufficient financial resources to meet their basic needs, they are more likely to experience economic worries. For those experiencing hardship, social assistance is one of the most important public tools for supporting people's financial standing to better sustain their lives; social assistance is also expected to reduce economic worries for the same reason. When individuals experiencing economic worries cannot receive adequate social assistance, this may result in more borrowing behavior. With this in mind, the primary purpose of this study is to examine the possible effects of social assistance on economic worries so that we create an economic worries index using principal component analysis. To identify these potential effects, data from the 2016 KONDA Research and Consultancy Survey were analyzed with the help of a generalized ordered logit model. Empirical findings show that an increase in education level results in a decreasing effect on economic worries. In addition, the study shows that borrowing increases life-related worries; when the relationship between economic worries and social assistance is more closely examined, the findings indicate that social assistance is insufficient for reducing economic worries.

Keywords: Social Assistance, Economic Worries, Socioeconomic Worries, Life-related Worries, Debt Behaviors, Sociodemographic Factors, Türkiye.

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INTRODUCTION

Social assistance comprises social welfare programs designed to provide cash and/or in-kind support to impoverished or disadvantaged individuals (Niño-Zarazúa, 2019:1). In this respect, social assistance is considered a public service that helps individual households and communities manage risks, supporting the most vulnerable groups (Barrientos and Hulme, 2008:3). In other words, for the most vulnerable people, a critical service can minimize their economic and social fragility, improve their social prestige and human rights, and enable them to improve their living standards (Naseer et al., 2021: 67). These services are expected to act as a redistribution mechanism to benefit vulnerable groups, positively affecting overall well-being, including poverty and inequality, particularly in contexts where these services are implemented nationally (Niño-Zarazúa, 2019).

Among the reasons for household indebtedness, an insufficient income level, underemployment, a high tendency of non-household resources not meeting basic needs, stereotypes in credit use (Dearden et al., 2010: 5), and inadequate public services are the main factors (Lavinas et al., 2022: 22). In this respect, borrowing behaviors are related to many economic, social, and individual quality of life-related factors (Alpar, 2022a). Because debt is an economic concept indicating a lack of resources (Xiao and Kim, 2022: 138) and considering that individuals are mentally affected by their economic conditions, these realities affect the relationship between individuals' economic behaviors and their psychological well-being (Lea, 2020: 6; Alpar, 2022a: 1335). Therefore, debt is closely related to economic worries (Xiao and Kim, 2022: 138). Economic worries result from difficulties in meeting life's basic needs. For example, people experiencing economic difficulties face problems such as the inability to pay their electricity bills and insecurities related to food and shelter. Therefore, economic worries often lead to borrowing that exceeds the household budget. Economic hardships are a significant source of distress and are associated with adverse mental and/or physical health outcomes. Given the negative impact of these situations, it is important to examine which factors might serve to mitigate them (Greenglass et al., 2013). Social assistance is thought to help reduce the harmful effects of economic worries (Roth et al., 2017: 133).

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Economic worries negatively affect household welfare and social life. To reduce them, social benefits are generally designed to help individuals cope with the economic difficulties they may face (Howell, 2001). Social benefits can reasonably reduce economic burdens and debt. In addition, these forms of aid can protect against economic worries such as lack of food and shelter (Kim, 2021: 2). Low-income individuals may be more worried about their economic situation than high-income individuals are (De Bruijn and Antonides, 2020: 1). Conversely, having a high income allows individuals to worry less about survival and financial issues (Rojas-Méndez, 2021: 10). For example, it has been emphasized that low-income households have strikingly greater levels of worry than middle- to high-income households (De Bruijn and Antonides, 2020: 1). According to other studies, the decline in social assistance for the poorest households over the past three decades has been associated with increased economic worries felt by families with children (Shaefer et al., 2020; Belarmino et al., 2021: 2). Therefore, providing social assistance as financial aid to low-income households is considered a fundamental tool for tackling economic difficulties (Parolin, 2021: 1119). All of the above circumstances reinforce the expectation that social assistance, prepared and applied in accordance with its purpose, should reduce economic worries. However, social assistance programs may increase worries in cases where individuals do not reach the right target group or can be insufficient. Situations in which social assistance is lacking and/or when social assistance benefits are insufficient increase an individual's tendency to borrow to finance his/her basic needs (Alpar, 2022b). These occurrences can potentially increase economic worries by placing vulnerable groups in more precarious situations. In this respect, it is important to focus on the quality and quantity of social assistance benefits to determine the causes of economic worries and direct policies accordingly.

Since economic worries are generally channeled through *financial burdens* (Miller, 2018: 8), this phenomenon has also been evaluated within the framework of financial worries. Along with financial support, social support is often associated with the formation of four different support systems: emotional, informative, and supportive services (Wellman and Gulia, 2018: 83). While social support can be obtained from many sources, such as family, friends, colleagues, and organizations, social assistance programs are generally public aid initiatives and include cash-in-kind transfers. Generally, the current literature separately focuses on social assistance, economic worries (Brunila et al., 2020; Bou-Hamad et al., 2022), and borrowing behaviors, and this results in a lack of a truly integrative perspective. Accordingly, although the impact of social assistance on economic worries has not been adequately studied before, an increasing number of correlational studies suggest that social support reduces worry factors (Bedaso et al., 2021). In addition, the main determinants of social assistance are factors such as unemployment (Brum and De Rosa, 2021), income inequality, and poverty (Westmore, 2018; Wang et al., 2021). These factors often cause people to borrow to finance even basic needs. Worry factors that negatively affect an individual's quality of life may arise due to increasing socioeconomic vulnerabilities and borrowing behaviors (Alpar, 2022b).

Research has shown that social assistance is more important during political elections (Pellissery and Barrientos, 2013). Considering that social assistance was a preferred key political tool in 2016 between Türkiye's general elections in 2015 and a referendum in 2017 (Özel and Yıldırım, 2019: 485), an analysis of this period can reveal the effect of social assistance on economic worries. For Türkiye, due to increasingly severe poverty issues (Yıldırım et al., 2018) and a chronic unemployment rate, social assistance is widely considered the leading solution to these problems, requiring more intensive studies of the country's situation (Aslan, 2022: 171). The fact that social assistance is primarily based on the poor (Yu and Li, 2021: 1060) and the unemployed (Pritadrajati, 2023), along with the increase in economic worries these situations entail, demonstrates the importance of studies in this area. This important issue necessitates disseminating datasets suitable for these and similar contexts, especially in terms of analyzing the effectiveness of social assistance in different dimensions in more detail. However, empirical studies examining the relationship between social assistance and economic worries are relatively limited because of a lack of available data.

The scope and content of social assistance are determined by many factors, such as social state understanding and the economic and cultural structures of countries (Daigneault, 2014; Aravacık, 2018). Therefore, the findings obtained mainly from developed countries cannot be evaluated in the context of developing countries (Farwa, and Henman, 2023: 1). This study makes several contributions to the existing literature. Unlike in previous studies, instead of examining the variables of worry separately, an index has been proposed to account for the multidimensional nature of worry (Roth et al., 2017; Rojas-Méndez, 2021; Xiao and Kim, 2022). This approach allows for the consolidation of related variables into a

single index, enhancing the accuracy of measuring worry factors. Given the susceptibility of single-question scales to measurement errors, employing a multifactor index proves more advantageous (Zhou and Guo, 2021: 4). In our study, we generated two indices from five distinct worry levels, all serving as dependent variables. To the best of our knowledge, this is the first study conducted in Türkiye that empirically analyses the effects of public outreach on different worry factors. In addition, the study focuses on specific borrowing behaviors that may cause different types of worry and examines the role of demographic factors that may impact economic worries. The study results are significant because they provide clues to relevant institutions that will enable them to focus on the causes of economic worries while preparing social assistance programs or revising their programs in this direction as needed. Furthermore, it could be a source of essential information for policymakers regarding the regulation of social assistance programs in Türkiye and other developing countries, as these states could benefit from the study data to reduce economic worries in their specific environments.

LITERATURE REVIEW

Many studies examining the various aspects of social assistance have focused on its ability to reduce poverty and income inequality (Tekgüç, 2018; Westmore, 2018; Yu and Li, 2021). In addition, social assistance is closely related to the income inequality that may arise when these benefits are insufficient; it is also linked to an increase in economic worries (Roth et al., 2017), economic difficulties, welfare, and other socioeconomic indicators, leading researchers to focus on the fact that economic worries may increase along with other inequalities experienced by marginalized groups. In other words, poverty, income inequality, unemployment, and economic worry that these factors may occur together and often directly affect disadvantaged populations. Borrowing is another factor that can cause economic worries (Walega and Walega, 2021). In this respect, when the literature on borrowing behaviors is examined, the focus is generally on the positive relationship between debt and financial stress (Xiao and Kim, 2022). While this and related research is proliferating, the lack of an integrative and critical review is considered a significant shortcoming. Therefore, this study provides a comprehensive perspective and aims to contribute to the literature by filling this research gap with data specific to Türkiye.

Burke and Frongillo (2017) concluded that those participating in the Supplementary Nutrition Assistance Program in the USA had fewer financial worries. Tran et al. (2018) indicated that women are more financially stressed when there is little or no social support. In their study, Yu and Li (2021) concluded that social spending helps reduce income inequality and rural poverty in China. Bedaso et al. (2021) considered anxiety and low socioeconomic status to be the most important determinants of social support for women. Kim (2021) noted that anxiety and food inadequacy continue even when individuals experiencing economic difficulties during a pandemic receive social assistance. Overall, existing studies generally focus on social support and anxiety.

Roth et al. (2017) argued that when income inequality is greater, people experience economic worry. Conversely, Lima-Nunes et al. (2021) showed that economic worries increase when income and life satisfaction are lower. Rojas-Méndez (2021) identified four different worry dimensions (economic, health, security, and overall); in their study, one of the obtained results was that the adverse effects of the COVID-19 epidemic on the workforce and income levels had increased economic worries. While the determinants of borrowing (Ntsalaze and Ikhide, 2016) have a more significant place in the literature, their relationship with economic worries has remained relatively limited. Hojman et al. (2016) noted that overindebtedness leads to greater depressive symptoms. In another study, Amassoma (2021) concluded that sociopsychological factors increase the household debt burden. Gao et al. (2022) concluded that elderly people, who have higher expectations of household debt and social support in the future, are less depressed. Xiao and Kim (2022) found that financial capacity can increase financial stress in individuals who cannot pay off their debt. In addition to the factors affecting borrowing in Türkiye (Nas and Özkoç, 2016), Özbilge (2022) examined the impact of borrowing on digital banking, while Canatan et al. (2024) analyzed the effects of borrowing on digital financial inclusion.

Most of the studies conducted in Türkiye have emphasized that the effect of social assistance on poverty and the increase in this type of aid positively affect poverty reduction (Bayar et al., 2023). Studies conducted in Türkiye (Dayar and Akıncı, 2020; Gemicioğlu and Bildir, 2023; Yılmaz and Rakıcı, 2024) have emphasized that social transfer expenditures reduce income inequality. Earlier studies have pointed out that social transfer expenditures have been insufficient in preventing income inequality and emphasized the need for more careful design of social policies (Gürsel et al., 2000; Çetin, 2011). These studies have generally focused on

poverty, income inequality, and employment; however, they concluded that social support affects stress/anxiety factors in a decreasing way. One of the common findings in studies examining populations benefitting from social assistance in Türkiye is that individuals receive more social assistance as their age increases (Tekgüç, 2018; Canatan and İpek, 2021). Studies addressing worry in Türkiye are generally concentrated in the field of psychology. Bozkurt (2020) demonstrates that digitalization leads to a decrease in economic worries. The impact of economic worries on water-saving behavior (Avci, 2023) has been studied, and there are studies from various disciplines comparing different types of worry (Kasapoğlu et al., 2009). Studies examining life satisfaction, anxiety and (Dökme Yağar and Yağar, 2023), social support and perceived stress (Özer et al., 2021), perceived social support and state anxiety, and trait anxiety (Özmete and Pak, 2020) during the COVID-19 period can also be found. Özbilge et al. (2024) have examined the factors affecting (such as socioeconomic, financial behaviors) different types of worry.

Although findings obtained from developed countries in the literature (Burke and Frongillo, 2017; Kim, 2021) are informative in terms of social assistance and worry factors, the understanding of the social state of these countries is markedly different from that of Türkiye, making it difficult to compare these findings and make generalizations in the context of developing countries such as Türkiye. Considering the suggestions of Roth et al. (2017) and Rojas-Méndez (2021), observing economic and cultural interactions at the national level and obtaining broader inferences about the effects on different types of worry—instead of determining economic worry factors over a single variable—may be more efficient. In this study, an analysis was performed on three different levels of worry: economic, life-related, and socioeconomic. However, the study differs from others in the literature, as it focuses not only on the relationship between social assistance and economic worries but also on the socioeconomic determinants of economic worries and the effects of borrowing behaviors on economic worries. In this respect, the study is expected to contribute to the related research by providing clues on how to increase the effectiveness of social assistance in Türkiye and other countries similar to Türkiye.

DATA SET AND METHODOLOGY

In this study, data on the factors causing economic worries in Türkiye and the effects of social assistance on economic worries were collected from 2,666 observations in 2016. This information was obtained through questionnaires prepared by KONDA, a Turkish research and consultancy company that has conducted representative surveys, conducted different field studies, and published reports on information gathered in Türkiye since 1986. The relevant dataset has been prepared specifically for a single year (2016). While it is not up-to-date data, it is the only available data. The need for the datasets in this context remains current. Although it is known that it may not fully reflect the realities of today, it is important for providing significant insights and for comparison with the current perceived situation. The aforementioned data used in this study include a representative sample at the national level, allowing us to examine the impact of social assistance on economic worries.

Instead of using or studying worry variables separately, an index is usually created so that a multidimensional structure can be taken into account (Roth et al., 2017; Rojas-Méndez, 2021; Xiao and Kim, 2022). By doing so, an index from related variables can be created rather than using the variables independently; this method strengthens the ability to measure worry factors better. Because a single-question scale can be subject to more measurement errors, using a multifactor index may be more beneficial (Zhou and Guo, 2021: 4). In this study, two indices were created from five different worry levels and were included as dependent variables. First, a single index of economic worry was created from 4 different worry levels.

The second dependent variable—worries related to being unable to maintain an adequate living standard—was included as an ordered categorical variable in the dataset. Creating an index for this worry factor was unnecessary because it was the only factor representing worries about life. The third and final dependent variable, socioeconomic worries, was created as a composite worry index from 5 different worry levels and included all worry factors.

In this study, socioeconomic and demographic factors thought to impact economic worries were included in the model. Overindebted households are usually in the lowest income category and are unemployed (Ntsalaze and Ikhide, 2016: 79). In Türkiye, institutions exist from which low-income households can borrow money. Additionally, the fact that the main target groups of social assistance are low-income households and unemployed individuals—along with the fact that loans obtained from financial institutions are a source of income for members of these groups to meet their basic needs (Alpar, 2022b)—requires an examination of all these factors together.

Table 1: Information about the Variables

Variables	Definition	Min	Max	Frequency (%)		
				1	2	3
Economic Worries Index	Do you have economic worries about not being able to meet health expenses, not being able to pay for the house, car installment or rent, not being able to meet the daily expenses, not being able to make the credit card minimum payment? (1: low, 2: medium, 3: high)	1	3	41.5	25.2	33.2
Worries About Life	Are you worried about not being able to protect your living standards? (1: low, 2: medium, 3: high)	1	3	17.2	10.4	34.9
Socioeconomic Worries Index	Do you have socioeconomic worries? (1: low, 2: medium, 3: high)	1	3	36.7	31.4	31.7
Social Assistance	Social assistance recipients (1: Yes, 2: No)	1	2	17.8	82.1	
Gender	1-Female 2-Male	1	2	48.5	51.5	
Age	Age is numerically measured.	18	44+			
Household Size	How many people live with you in your household?	1	9+			
Marital Status	1-Married 2-Single (including separated/widowed/ divorced)	1	2	70.1	29.9	
Educational Status	Uneducated, Literate without a degree, Elementary school graduate, Middle school graduate, High school graduate, College graduate, Master's / PhD	1	7			
Credit Card Debt	Do you have credit card debt? (1: Yes, 2: No)	1	2	22.9	77.1	
Bank Loan	Do you currently have a personal bank loan that you continue to pay? (1: Yes, 2: No)	1	2	30.6	69.4	
Non-Financial Debt	Do you currently have debts that you are paying from family/friends/workplace other than the bank? (1: Yes, 2: No)	1	2	24.5	75.5	

Explanatory information about the variables used in the study is presented in Table 1. In addition to its limited reliability, using single-indicator measurements for economic worries may result in partial and incomplete information about the relationships examined (Roth et al., 2017). As a result, we used Rojas-Méndez's (2021: 4) three dimensions to better reveal the unique structures of worry based on *face validity*: (i) economic worries, (ii) worries about life, and (iii) socioeconomic worries. Therefore, three models with different dimensions of economic worry were created. In the first model, the dependent variable was created as an index of economic worry using principal component analysis (PCA) on four economic worry indicators: i) not being able to meet health expenses, ii) not being able to pay rent and car payment installments, iii) not being able to meet normal daily expenses such as food expenditures, and iv) not being able to make minimum credit card payments.

In the second model, the dependent variable, being unable to ensure one's living standards, is considered a manifestation of a cultural dimension unique to Türkiye. In the context of worry, uncertainty is characterized as the tendency to prevent and/or reduce the possibility of negative situations by taking into account the uncertainty of the future; in this case, individuals from different cultures may react differently to stimuli (Rojas-Méndez, 2021). Finally, a multidimensional worry index—a combination of Model 1 and Model 2—was created to observe the impact of the economic and cultural dimensions together. Demographic factors (household size, education, age, sex, marital status), borrowing behaviors (borrowing from financial institutions and nonfinancial institutions), and social assistance payments (child benefits, education benefits, conditional health benefits, pregnancy/ pregnancy benefits, retirement benefits, aid in kind and other) were used. Control variables (pensions provided to widows, disability benefits, and in-kind benefits such as fuel and food) were added to the empirical model.

This study's research strategy combines a set of descriptive statistics that reveal the main features of the data. With this strategy, PCA helps to transform a large number of variables into only a few selected main dimensions (Wu, 2021: 3). Thus, an index consisting of each worry factor is obtained. Before creating the economic worries and socioeconomic worries indices, the PCA's suitability and the compatibility of the variables are tested with the Kaiser–Meyer–Olkin (KMO) test and Bartlett's test of sphericity. If the KMO index is above 0.50 and the Bartlett test is small ($p<0.001$), the variables and PCA are deemed appropriate. The KMO and Bartlett test results are presented in Table 2. According to the results, it was determined that the variables were suitable for PCA.

Table 2: KMO and Bartlett's Test Results

Socioeconomic Worries		**KMO**		**Economic Worries**		**KMO**	
Overall		0.693		Overall		0.621	
Health expenses		0.765		Health expenses		0.811	
House expenses		0.767		House expenses		0.724	
Kitchen expenses		0.652		Kitchen expenses		0.609	
Credit expenses		0.700		Credit expenses		0.585	
Life expenses		0.702					
	χ^2	df	p		χ^2	df	p
Bartlett's	693.610	10	0.000	**Bartlett's**	1592.821	6	0.000

Methodology

For this study, the ordered logit (ologit) model was preferred due to the ordered nature of the dependent variables. Ologit is frequently preferred when the dependent variable takes ordered values rather than continuous values. The generalized ordered logit model (gologit) is employed when the parallelism assumption, which is the most important assumption of the ologit model, is violated. Gologit was developed by Fu (1998) and Williams (2006) and provides ease of use for researchers by expanding the assumption of parallelism that the logit model should provide and allowing easy production of estimations with econometric software programs.

Table 3: Tests of the Parallel Regression Assumption

Economic Worries Test	χ^2	df	$P> \chi^2$
Wolfe Gould	248.6	9	0.000
Brant	354.3	9	0.000
Score	171.8	9	0.000
Likelihood Ratio	128.9	9	0.000
Wald	321.4	9	0.000
Information Criteria	ologit	gologit	difference
AIC	4489.99	4379.07	110.92
BIC	4554.76	4496.84	57.92
Life-related Worries Test	χ^2	df	$P> \chi^2$
Wolfe Gould	41.09	9	0.000
Brant	49.94	9	0.000
Score	47.19	9	0.000
Likelihood Ratio	44.46	9	0.000
Wald	49.23	9	0.000
Information Criteria	ologit	gologit	difference
AIC	4933.50	4907.04	26.46
BIC	4998.27	5024.81	-26.54
Socioeconomic Worries Test	χ^2	df	$P> \chi^2$
Wolfe Gould	249.3	9	0.000
Brant	388.7	9	0.000
Score	201.4	9	0.000
Likelihood Ratio	140.6	9	0.000
Wald	306.9	9	0.000
Information Criteria	ologit	gologit	difference
AIC	4341.03	4218.43	122.61
BIC	4405.81	4336.19	69.61

Gologit can be written based on Williams (2006), as shown in Equation (1):

$$\mathrm{P}(Y_i > j) = \frac{\exp(a_j + X_i\beta_j)}{1+\exp(a_j + X_i\beta_j)}, \mathrm{j} = 1,2,\ldots,\mathrm{m}-1 \quad (1)$$

When m is the category number of the ordered dependent variable, the model is as follows:

$$\mathrm{P}(Y_i > j) = \frac{\exp(a_j + X_{1i}\beta_j + X_{2i}\beta_j)}{1+\exp(a_j + X_{1i}\beta_j + X_{2i}\beta_j)}, \mathrm{j} = 1,2,\ldots,\mathrm{m}-1 \quad (2)$$

In ologit, α values may vary for each category, while β slope values are assumed to be the same for each j category; that is, they are parallel. However, this assumption is often violated. To overcome this limiting assumption, too many parameters need to be estimated. However, the gologit model overcomes these limitations, allowing some β slope coefficients to be the same and others to be different (İpek, 2019: 62). This study first estimated the empirical model using the ologit method, and the parallelism assumption was tested. The values of the parallelism tests of the ologit model and the goodness of fit of the model are given in Table 3. The parallelism assumption of the ologit model is not met since the probability values of the Wolfe Gould and Brant tests are less than 0.05. Therefore, the gologit was used to investigate the causes of economic worries and the effect of social assistance on economic worries.

EMPIRICAL RESULTS

The findings related to the gologit model results used in the study to investigate the causes of economic, life-related, and socioeconomic worries and the effect of social assistance on these worry factors are presented in this section. Table 4, which includes the gologit model estimation results, includes the odds ratios (ORs) estimated according to the reference group; the tables show the proportional effects of the variables on economic worries. In logit models, the odds ratio is used to interpret the obtained coefficient (İpek, 2020: 234).

When the findings in Table 4, which include economic worries according to Model 1, are analyzed, it is found that an increase in age results in a greater probability of having a low or medium level of economic worries. In addition, being single, a rise in the number of household

Table 4: Results of the Gologit Model Estimation

	Model 1		Model 2		Model 3	
	Low &Medium	Medium&High	Low &Medium	Medium&High	Low&Medium	Medium&High
Variables	**OR**	**OR**	**OR**	**OR**	**OR**	**OR**
Social Assistance	1.077 (0.183)	1.665* (0.310)	1.024* (0.168)	1.036 (0.168)	1.013 (0.017)	1.528* (0.287)
Gender	1.069 (0.096)	1.023 (0.103)	1.116 (0.101)	0.803* (0.073)	1.140 (0.108)	1.004 (0.105)
Age	1.384* (0.085)	1.883* (0.132)	0.444* (0.000)	0.547* (0.034)	1.758* (0.112)	2.344* (0173)
Household Size	0.788*** (0.075)	1.222* (0.086)	1.024 (0.064)	1.015* (0.085)	1.045 (0.097)	1.273** (0.090)
Marital Status	0.206* (0.021)	0.126* (0.126)	4.139* (0.527)	4.039* (0.400)	0.159* (0.016)	0.122* (0.020)
Educational Status	0.688* (0.064)	0.428* (0.071)	1.036 (0.129)	0.965 (0.080)	0.723* (0.067)	0.325* (0.063)
Credit Card Debt	0.102* (0.015)	0.039* (0.005)	5.152* (0.568)	3.462* (0.454)	0.138* (0.021)	0.028* (0.028)
Bank Loan	0.960 (0.192)	1.223 (0.026)	0.612** (0.120)	0.981 (0.209)	0.670*** (0.154)	1.073 (0.232)
Non-Financial Debt	1.012 (0.241)	0.555*** (0.138)	1.600** (0.359)	0.806 (0.196)	1.335 (0.276)	0.709 (0.179)
Pseudo R^2	0.2455		0.1620		0.2850	
Wald Chi2	1031.09		708.21		1039.86	
Loglikelihood	-2169.5		-2433.5		-2089.2	
Prob	0.000		0.000		0.000	
McFaddenR²	0.245		0.162		0.285	
Cox-Snell R^2	0.411		0.297		0.465	
Cragg–Uhler	0.465		0.335		0.523	
CountR²	0.570		0.580		0.649	

*p < 0.05, ** p < 0.01, *** p < 0.001. The numbers in parentheses indicate standard errors.

members, having credit card debt, and a higher education level all reduce the probability of having a low or medium level of economic worry. Considering the estimation results that include medium and high economic worry levels versus a high level of economic worry, an increase in age, an increase in the number of household members, and social assistance increase the probability of having a high level of economic worry. A higher education level, having credit card debt, borrowing from family/friends/workplace, and being single were factors reducing the probability of having high levels of economic worry. According to the findings related to Model 2, which includes worries about life, factors such as being single, being female, receiving social assistance, an increase in household size, and borrowing from nonfinancial institutions are relatively more likely to cause worries about life. Finally, when the findings related to Model 3 and socioeconomic worries are examined, the findings show that increasing age, being married, receiving social assistance, increasing household size are relatively more likely to result in socioeconomic worries.

In summary, receiving social assistance increases the probability of three worry levels: economic, life-related, and socioeconomic. The higher the education level is, the lower the possibility of experiencing economic and socioeconomic worry. An advance in age increases the likelihood of having economic and socioeconomic worries while decreasing the likelihood of general life worries. Married people are more likely to have economic and socioeconomic worries, while single individuals are more likely to have life worries. While women are more likely to worry about life, gender does not exhibit a statistically significant impact on other types of worry. Individuals with credit card debt are more likely to have life-related worries and less likely to have economic and socioeconomic worries. Individuals with bank loans (individuals who currently have bank loan debt) are less likely to have low to moderate levels of life and socioeconomic worry. Although it may not be statistically significant, it can be intuitively inferred that individuals who take out bank loans are likely to have high levels of economic and socioeconomic worries. Finally, individuals who borrowed money from family/friends/workplace were less likely to have high levels of economic worry and more likely to have low or moderate levels of worry about life.

When examining the differences between various types of worries, age, marital status, and credit card debt emerge as significant factors. As individuals age, they may generally reduce their worry about maintaining their standard of living by considering retirement and savings. However, economic and socioeconomic worries may increase due to factors such as rising (Mann et al., 2020: 4) healthcare costs and caregiving needs that come with age. The worry of not being able to maintain one's standard of living may be related to a sense of uncertainty about the future. It is likely that married individuals feel more cautious (Schwartz, 2005: 45) and experience greater economic worries due to their responsibilities. Credit cards can provide temporary economic relief, especially for unexpected and urgent expenses. Additionally, the option to defer payments can reduce economic worries for a certain period. This information supports the notion that it already increases the level of worry about maintaining general and future living standards.

While the other variables are held constant, the marginal effects show the impact of the factor affecting the worry factor compared to the average. Table 5 shows that women, individuals with lower education levels, older individuals, individuals from larger households, social assistance recipients, individuals with credit card

Table 5: Marginal Effect

	Economic Worry			Life-related Worry			Socioeconomic Worry		
Variables	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
Social Assistance	-0.01**	0.05**	0.06*	-0.00	0.00*	0.01*	-0.02	0.05*	0.05*
Gender	-0.01	0.01	0.00	-0.01	0.05*	-0.03	-0.02	0.02	0.01
Age	-0.06*	-0.03**	0.07*	0.14*	-0.03*	-0.10*	-0.09*	-0.01	0.10*
Household Size	0.04**	-0.07*	0.02*	-0.00	0.00	0.00	-0.01	-0.02*	0.02*
Marital Status	-0.31*	0.07	0.24*	0.24*	0.04	-0.28*	-0.36*	0.13*	0.22*
Educational Status	0.06*	-0.05**	-0.11*	0.06	-0.01	-0.01	-0.05*	-0.08*	-0.13*
Credit Card Debt	-0.01*	0.03	-0.02*	0.31*	-0.10*	0.20*	-0.28*	0.27*	0.56*
Bank Loan	-0.36**	-0.17**	-0.54**	-0.08*	0.08*	0.01	-0.06**	0.07**	-0.01
Non-Financial Debt	0.02***	-0.08**	0.08**	0.08*	-0.12*	0.03	0.04	-0.09*	0.04

*p < 0.05, ** p < 0.01, *** p < 0.001.

debt, and individuals borrowing from non-financial institutions are more likely to have one or more types of worry. Overall, in line with the causes underlying the increase in worry factors, it is essential to increase education levels through social policies and take steps, especially toward women, to develop human capital and reduce/eliminate worries that increase with age.

According to the estimation results, the most influential factor affecting economic worries is age, while marital status and credit card debt are the most influential factors for life-related worries. Considering that marriage requires more financial and emotional responsibility, it is logical that married individuals (marriage and even being a single-parent family) are more likely to worry compared to singles (including separated/widowed/divorced). While using credit cards increases borrowing capacity, it can negatively affect the welfare of individuals/households (Xiao and Kim, 2022) and positively affect their life-related worries. Türkiye's traditional social structure brings the family dynamic to the fore. This is also the case in many areas, including borrowing behaviors and social assistance. For this reason, the prevalence of borrowing from family and social networks confirms that more value is attributed to the family and that family and kinship ties are the basis of social assistance. Although many people can benefit from this type of aid, there is usually the phase of having no one, such as family or relatives. It is noteworthy that the name of the ministry dealing with social policy in Türkiye is called the Ministry of Family and Social Services.

This study allows us to determine the different effects of the same variables on different types of worry. Sources of financing reduce generally financial-related economic worries but increase future-oriented life-related worries. For some segments of the population, credit cards and bank loans have become a normal part of life. Apart from household income, bank loans and credit cards constitute important sources of financing (Alpar, 2022a:30). Individuals who have to meet their basic needs by using loans are often more prone to experience life related worry.

The study's results show that social assistance does not reduce worry at the expected level for all three types of worry. The findings show that social assistance does not help mitigate economic worries related to obligations such as mortgage payments, paying for a car in installments (an automobile and a home are considered basic needs), or paying for minimum credit card payments. Perhaps more importantly, the results show that important steps should be taken to prevent worries about life in general and socioeconomic worries consisting of a combination of these. In this respect, especially during the year the study was conducted, when previous and current social assistance programs were examined, the limitations of this aid may be due to the lack of focus on quality—while quantity, in terms of assistance offered, is generally aimed at specific groups in need (disabled, elderly, etc.). The findings indicate that financial support alone is insufficient and that social assistance programs should be better prepared and revised in line with the causes of worry. Considering social and cultural integration processes, the fact that social assistance programs are insufficient and that there are worries about life beyond the material dimension means that social support should be provided psychologically. Therefore, by reviewing the target population of social assistance, the scope and reach of social assistance programs can be increased, especially on an individual basis. In summary, with this study, the effects of social assistance on various worry factors were estimated and can provide insight into the situation for policymakers.

CONCLUSION AND DISCUSSION

Social assistance aims to protect people from the adverse effects of economic inequalities by providing individuals and households with cash and in-kind aid. Economic inequalities place an excessive burden on vulnerable groups, and this situation exacerbates economic worry. Social assistance targets groups such as poor and unemployed individuals, enabling them to address economic worries arising from economic inequalities. Households with debt are generally part of low-income groups, and their borrowing behavior may increase worry. Although some studies have examined different aspects of social assistance and research on the economic worries linked to borrowing exits, the potential link between these relationships has not been investigated. For this reason, to address these gaps in the empirical literature, this study aimed to determine the underlying causes of economic, life, and socioeconomic worries in Türkiye and the effect of social assistance on these worries. The study findings are significant in that they focus on the causes of worry and provide important clues that will help individuals diminish or regulate them during the preparation of social assistance programs. Therefore, using a sample that represents the entire nation, this study adds to the existing literature by exploring the association between social assistance and worries related to economic worries in Türkiye.

Specifically, the main finding of this study contributes to the national social policy literature from the Türkiye

perspective, showing that the country is different from others studied in the literature (Burke and Frongillo, 2017) about reducing worry related to social assistance. In light of the study results, given that an increased level of education has a decreasing effect on worry, education—primarily aimed at vulnerable groups—should be given greater importance in reducing economic worries. The fact that individuals without social security are included within the scope of social assistance in Türkiye and because the economic worries of the unemployed are quite elevated (Godinić and Obrenovic, 2020) is evidence that long-term, permanent solutions are needed, such as increasing participation in the labor market.

Although this study can serve as an important guide for policymakers because it identifies economic worries and the effects of social assistance on these worries in Türkiye, it identified several limitations that could guide future research directions. When more current data containing variables on social policies and worry factors become available for Türkiye, a prospective study that reconsiders factors affecting economic worries can be suggested. In addition, longitudinal studies could be conducted on the causal dimension and effect mechanism between social assistance and economic worries.

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Nash Equilibrium in Control-Unregistered Employment Decisions Under Incentive and Punishment Strategies

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ABSTRACT

Unregistered employment, which gained attention on the global economic agenda following the ILO's Kenya Report in the 1970s, has become a significant issue on par with unemployment in many countries. Policymakers and social planners have been working to mitigate this problem by intervening in the wage bargaining process between workers and employers through control mechanisms. They implement policies aimed at reducing unregistered employment, including routine audits of companies and the application of penalties and incentives to promote registered employment. These measures not only aim to increase tax and social security revenues for the state but also seek to boost worker productivity by motivating them to secure registered employment. However, a conflict arises between the control objectives of social planners and the profit-maximizing, cost-reducing tendencies of employers. This article explores this conflict by analyzing the employer's decision to opt for registered or unregistered employment against the backdrop of the social controller's punitive and incentivizing actions using a mixed-strategy 2x2 game model. Through this game model, the "best response functions" of both parties are derived, and the Nash Equilibrium is identified to determine the optimal response probabilities of the social planner and employer. The analysis examines the effectiveness of penalties and incentives in reducing unregistered employment based on the strategic interactions of both parties..

Keywords: Informal Employment, Informality, Social Planner, Social Control, Game Theory, Nash Solution.

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INTRODUCTION

As countries around the world grappled with the aftermath of the oil crisis, two significant developments in the 1980s had a profound impact on the concept of employment. The first was a decline in the registered workforce, leading to a rise in unregistered employment. The second was the weakening of the welfare state model (Agarwala, 2006). These simultaneous trends resulted in workers being unable to access secure wages and adequate social rights, while the state faced reduced tax revenues and other financial inflows, thereby increasing public deficits and creating shortfalls in the social security system (Fidan and Genç, 2013). The phenomenon of unregistered employment, also referred to as the informal sector or informality, first gained attention among economists and policymakers through Hart's influential work in 1973 (Maloney, 1999; Jütting et al., 2008). The extensive literature that followed generally defines informal employment based on its deficiencies compared to formal employment (Williams and Lansky, 2013). In the current era, marked by the effects of the second major global economic crisis, the dualistic structure of labor markets (Esteban-Pretel and Kitao, 2021) has become a critical issue, necessitating targeted solutions and reforms (Leyva and Urriata, 2020; Eichhorst and Marx, 2021).

In both developed and developing countries, registered workers are those with an employment contract officially recorded in the Labor and Social Security registry, which documents their work history. Similarly, legitimate businesses possess a tax identification number, incur registration costs (in terms of time and money), pay payroll taxes, and face termination costs when dismissing employees. Conversely, all employees working for an unregistered company are automatically classified as unregistered. However, even formal companies can engage in informal employment by hiring workers without official contracts. The Ministry of Labor is responsible for conducting inspections to ensure that companies comply with labor laws (Brotherhood et al., 2023). These inspections can be conducted unannounced across all companies. This research article begins by examining this critical area of labor regulation.

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Unregistered employment is widely recognized as a serious economic issue (Elgin et al., 2021; Kanbur, 2017; Heintz, 2021), with its nature, measurement, macroeconomic and microeconomic effects (Ulyssea, 2020; Dellas et al., 2024), and associated productivity challenges (Fredström, 2021; Haanwinckel and Soares, 2021) being subjects of extensive research and analysis. Economists have made numerous contributions to the literature on unregistered employment, exploring it from economic, statistical, sociological, psychological, and various other social science perspectives. This body of research continues to expand. Additionally, several studies have examined the decisions of workers and employers—the two key actors in unregistered employment—focusing on the factors influencing their choices to engage in registered or unregistered work. Game theory and Nash Equilibrium are often employed as analytical tools to assess these decisions, evaluating the costs and benefits for both parties (Nohoua, 2023).

Studies on game theory in the literature predominantly focus on the Nash bargaining equilibrium (Carneiro and Henley, 1998; Bouev, 2005; Araujo and de Souza, 2010; Ciccarone et al., 2016; Sun, 2022). These studies typically examine game models that analyze wage-based strategies between workers and employers, exploring the economic impacts of their strategic interactions. They often aim to explain the macro-level effects of micro-level decisions or how macro-level employment dynamics influence decision-making at the micro-level between employees and employers. In conflict game analyses involving unregistered employment or in wage bargaining scenarios like those described by insider-outsider theory (Çolak and Koç, 2017), the dominant strategies of both parties tend to be well-defined.

In line with these dominant strategies, the worker, who seeks to maximize their benefits, and the employer, who aims to minimize costs, often align on a common approach toward informal employment. The employer prefers to hire informally to lower costs and increase profits, while the worker may accept precarious, unregistered work to meet basic livelihood needs. In this scenario, informal employment emerges as a pure strategy for both parties, resulting in a stable equilibrium. Consequently, such static and non-cooperative games have not typically been modeled in the existing literature. This study distinguishes itself by addressing this gap. It acknowledges the dominant strategies of both the employer and the worker, models the employer's behavior in response to the social planner, and analyzes the optimal strategy using the Nash Equilibrium solution, thereby contributing a novel perspective to the literature.

This study does not focus on the mutual strategies and reactions of employees and employers. Instead, it incorporates the role of a social planner (Parker, 2020), tasked with combating and preventing informal employment, into the game model. The primary objective of this article is to mathematically model the conflict of interest between the state, acting as the social planner, and the employer, specifically examining their motivations and strategies regarding informal employment. By directly involving the state in the game model, the study evaluates the responses of both parties to their chosen strategies using the Nash equilibrium framework. Game theory is particularly effective for mathematically explaining conflicts of interest, the strategies each party may use to maximize their benefits, and their potential decision-making in response to opposing strategies. Thus, the study's contribution lies in proposing a model to re-analyze the labor market dynamics using a Nash equilibrium based on the mixed strategies of the social planner and the employer, focusing on their behavioral strategies.

CONCEPTUAL FRAMEWORK and THEORETICAL BACKROUND

This study is fundamentally centered around two key concepts: unregistered employment and game theory. In this chapter, we will first provide a brief introduction to the concept of unregistered employment, followed by an explanation of the conceptual framework of game theory and its relevance to this study. Given the focus on the intersection of unregistered employment and game theory, aspects such as the measurement of unregistered employment or its broader economic implications will not be explored in detail.

Unregistered Employment

The OECD defined unregistered employment in 1987 as "activities that are legal in nature but not reported to one or more institutions" (Mateman and Renooy, 2001). The European Commission describes it as any paid activity that is legal in itself but not declared to public authorities to evade taxes and social security contributions (European Commission, 2007). Similarly, the ILO broadly defines unregistered employment as encompassing all individuals, whether in primary or secondary jobs, who were employed in unregistered firms or at least one informal sector enterprise during the reference period, regardless of their employment status (Hussmanns, 2004).

More broadly, unregistered employment encompasses a range of work patterns in both the formal and informal sectors, involving economic activities that are not fully captured in statistical records, whether performed by self-employed individuals or wage workers. These activities remain outside public records and official statistics (Uçarı and Koç, 2017; Moghaddasi Kelishomi and Nisticò, 2023). Informal employment can occur in firms of all sizes, not just small enterprises. For instance, in small firms (fewer than 10 employees), up to 40% of workers may be unregistered during audits, while even in large firms (500 or more employees), nearly 10% of the workforce can be unregistered. Interestingly, registered and unregistered workers within the same firm often share similar characteristics in terms of age, education level, and gender distribution. However, unregistered workers tend to earn slightly less. This suggests that the issue is not about fundamentally different types of workers but rather similar individuals working under different employment statuses (Brotherhood et al., 2023).

Unregistered employment has both positive and negative effects (Moghaddasi Kelishomi and Nisticò, 2023). Its consequences extend beyond a specific segment of society, impacting workers, employers, and the state, all of whom are part of the formal economy. On the positive side, unregistered employment can prevent individuals who would otherwise be excluded from the formal job market from remaining unemployed and without income. It can also enhance employer competitiveness by allowing them to hire workers at lower costs. However, the negative effects are significant, including workers' lack of access to secure wages and social rights, and the state's inability to generate sufficient revenue through taxes and other sources. While some positive outcomes may be observed, the negative effects tend to outweigh the positive ones in the short term and can be particularly detrimental in the long term (Yanici Erdal, 2019).

One of the policy tools used to combat informality is the regulation of penalties that compel lawbreakers to change their behavior. Unfortunately, in Turkey, there are no criminal sanctions for employing unregistered workers within the social security system. Instead, the penalties are administrative, related to the failure to issue employment and bonus documents within the legal timeframe (Işıklı, 2015). In contrast, many European countries impose severe sanctions for unregistered employment. For example, Kızılot (2015) highlights that in France, those who employ unregistered workers face fines of 45,000 Euros and up to five years of imprisonment; in the Netherlands, the fine is also 45,000 Euros with a one-year prison sentence; in Finland, the penalty is one year of imprisonment; and in Germany, it can reach up to 500,000 Euros in administrative fines and up to five years in prison. In Poland, businesses that employ unregistered workers lose access to various government incentives, and previously granted aid must be repaid (Kaleli and Karaca, 2019). Beyond fines, the imposition of severe penalties, such as imprisonment, serves as an effective deterrent, prompting employers to change behaviors that disrupt public order (Karaaslan, 2010).

Another tool used in the fight against informality is for countries to reduce financial obligations periodically or continuously, or to provide premium support to encourage the registration of employment (Kanbur, 2017; Elgin et al., 2021; Heintz, 2021). Offering such incentives, along with reducing tax and premium rates on employment—applied unconditionally to all employers—can significantly contribute to increasing registered employment (Kaleli and Karaca, 2019). When countries implement regular and frequent inspection mechanisms, informal sector firms and their employees face a higher risk of detection. The potential for fines upon detection may deter workers and firms motivated by tax evasion from participating in the informal sector. As a result, variations in the size of the informal sector between countries can be partly attributed to differences in tax policies and punishment systems (Kolm and Larsen, 2002; Bíró et al., 2022).

The drivers of informal employment vary from country to country, but it is widely recognized that factors such as high tax burdens, high labor costs, bureaucratic red tape, insufficient labor market inspections, and a lack of trust in government contribute to the growth of this phenomenon. While labor inspectorates play a crucial role in addressing the issue of informal employment, they often lack sufficient resources, tools, procedures, and coordination with other relevant authorities (Görmüş, 2017).

Game Theory and Nash Equlibrium

Game theory was first methodically introduced by Hungarian-American John von Neumann in 1928 in his article *On the Theory of Strategic Games*, where he demonstrated that multiple strategies can be determined for each player in two-person zero-sum games. About 15 years later, John von Neumann and economist Oscar Morgenstern (1944) from the same university published *Economic Behavior and the Theory of Games*, which marked the first time game theory was applied to

economics. However, the most significant contribution to the field came in 1950 from John F. Nash, whose work helped bring game theory to its present prominence. Between 1950 and 1953, Nash published four pivotal papers on game theory. Two of these, based on Cournot's (1838) work on oligopolistic markets, laid the foundation for the Nash equilibrium, named after him (Korolev and Ougolnitsky, 2023; Sarafopoulos and Papadopoulos, 2023). These four papers had a profound impact on the development of game theory. Nash's work expanded game theory beyond zero-sum games to include non-zero-sum games. In his papers *Equilibrium Points in N-Person Games* (1950) and *Non-Cooperative Games* (1951), Nash demonstrated the existence of strategies that ensure Nash equilibrium in non-cooperative games. By reducing these equilibrium strategies to non-contracted games, he elucidated the principles of consensual games (Eichherger, 1997). The mathematical solution methods introduced by game theory offer an alternative to the "ceteris paribus" assumption commonly used by economists, meaning "all other conditions being constant" (Savaş, 2000). Unlike Walras' concept of homo economicus, game theory does not rely on the assumptions of the invisible hand theory (Holler and Klose-Ullmann, 2020). In game theory, "rational behavior" is no longer a constraint on the preferences players can have. Players are free to have a wide range of preference relations, allowing game theory to internalize all kinds of behavior (Koray, 2012; Çolak and Koç, 2023).

In game theory, there are three key concepts that form the foundation of the theory: player, strategy, and payoff, along with the element of information. These concepts are often referred to as the "rules of the game." A player, seeking to maximize their earnings, employs different strategies based on the information available to them (Rasmusen, 2007). A strategy refers to a set of decisions that defines a player's preferences for every possible situation that could arise throughout the game, from start to finish. In other words, a strategy involves setting goals and objectives and determining the steps a person or organization should take to achieve them (Çolak and Koç, 2017). In game theory, strategies are typically categorized into two types: pure strategies and mixed strategies. Pure strategies are those played with certainty, while mixed strategies involve making decisions based on a certain probability (Jordan, 1993).

Conflict situations in real life are influenced by a wide range of complex, interrelated factors, making their analysis challenging and intricate. To address this, new models are developed by simplifying these situations, excluding less significant factors, to make mathematical analysis feasible. These models are referred to as games (Fudenberg and Tirole, 1991). In this context, game theory is defined as the systematic study of strategic interactions, aimed at understanding how economic agents behave in situations where their actions are interdependent and identifying how they can act more effectively (Çolak and Koç, 2023).

The concept of Nash equilibrium, introduced by John Forbes Nash (1950, 1951), is a fundamental solution method that helps players identify the most appropriate strategies (Myerson, 1991). It is defined as a situation in which each player's strategy is the optimal response to the strategies chosen by the other players (Fudenberg and Tirole, 1991). In a Nash equilibrium, no player has an incentive to deviate from their current strategy unilaterally (Carmichael, 2005). Nash equilibrium has two key characteristics: First, each player selects their best strategy based on their expectations of the strategies chosen by others. Second, since switching to an alternative strategy would decrease the player's payoff, no player has the desire to change their strategy in equilibrium (Dutta, 1999; Aydın and Karabacak, 2023).

LITERATURE

In the literature, analyses of Nash Equilibrium have primarily focused on wage markets. However, there is a lack of studies that model the interaction between the social planner or social auditor and the employer. For instance, Carneiro and Henley (1998), in their study "Wage Determination in Brazil: Union Bargaining Power and the Growth of Informal Employment," specifically highlight the role of auditing in combating informality.

In the model developed by Ciccarone, Giuli, and Marchetti (2016) based on the American economy, the unregistered segments, as defined by the Nash market model, are examined in the context of their dynamics within a detailed business model that incorporates search and exchange capacities. The study highlights the differences in wages and hours worked between regular and undeclared employment, showing that a higher degree of informal work correlates with lower average employment, greater employment variability, and lower regular wage variability. According to the findings, in the Nash process, the steady-state ratio is influenced by the minimum wage a worker can accept and the maximum wage a firm can offer. The larger the gap between these values, the greater the employment volatility and the lower the wage volatility (Ciccarone et al., 2016).

In another adaptation of the Nash model, integrated with the DSGE framework and applied to analyze the dynamics of the informal employment surge in China, Sun (2022) confirms the findings regarding the limitations of informal employment, despite its substantial costs. The study reveals a negative correlation between interest rates and the rate of unregistered employment in China. Sun suggests that the limited increase in rates, particularly during economic shocks, is due to the rise in informal employment. In economies affected by shocks, the Nash wage bargaining model indicates that household decisions lean towards informal employment, while firms also opt for unregistered workers (Sun, 2022).

In a study analyzing the emergence of the informal economy within non-competitive labor markets characterized by wage bargaining, Bouev (2005) extends the standard search model of Pissarides (2000) by incorporating both formal and informal sectors. The model demonstrates how government control over informal firms and the corrupt influence of bureaucracy on the formal sector can enable companies to maintain stable coexistence. Bouev (2005) explores market failures and matching frictions in both formal and informal job search processes, highlighting the effects of audits, taxes, bribery in bureaucratic processes, and productivity on workers, employers, and firms in both sectors. The study reveals that these factors lead to a shared interest between the two sectors. These findings are framed within the context of the Nash Bargaining Solution. The model suggests that higher unemployment benefits could contribute to the expansion of the informal sector.

Araujo and de Souza (2010) examined the key factors driving workers and companies toward informality in developing countries, focusing on the dual structure of the labor market. Using an evolutionary game theory approach, they identified excessive regulatory systems as one factor that makes the formal economy unattractive. Their study analyzed the dynamics of entry and exit for workers and firms in both the formal and informal economies, aiming to assess the impact of taxes by examining how economic actors choose between these markets based on expected returns. The study also evaluated the optimal balance between government regulation and enforcement actions (Araujo and de Souza, 2010).

In a similar vein, Çolak and Koç (2017) developed a model to analyze the strategies and reactions between the social planner and the employer. The study focused on punishment and control mechanisms, establishing the Nash equilibrium of the game in the context of punishments and inspection possibilities. The best response values for the parties' potential behaviors, based on opposing strategies, were identified. However, they noted that their model does not encompass all possible scenarios or response strategies (Çolak and Koç, 2017). The primary objective of this study is to construct and analyze the best response functions of the parties within the context of punishment, incentives, efficiency, and the tax spiral.

This study examines the control mechanism that, while not directly influencing the employee's choice between registered or unregistered work in wage and labor bargaining, has a significant impact on the employer's decisions. In other words, it evaluates the mutual strategies and reactions of the employer within the context of the social planner, who acts as a sanctioning authority in the power balance within the game theory framework between the employee and the employer.

METHODOLOGY

Model

As outlined in the introduction, the wage and employment bargaining between the employer and the employee can be modeled as a 2x2 zero-sum game. In terms of the game matrix, the key strategies for both parties are registered work and unregistered work. If the employer offers unregistered employment during the job interview, the likelihood of the employee rejecting the offer is very low, depending on the employee's level of need for work. Conversely, if the employee proposes unregistered employment to the employer, the employer is highly likely to accept the offer. In this scenario, when the game model is established between the employee and the employer, the only dominant strategy is unregistered employment for both parties. The dominant strategy for the employee who has secured a job is to accept the unregistered employment offer, which incurs lower costs for the employer. In this case, when both the employee and the employer agree on unregistered employment, they each maximize their own interests.

In his article "Gift Exchange and Efficiency-Wage Theory: Four Views," Akerlof argued that workers might accept an employer's offer despite low wages and the loss of certain rights if they are facing unemployment, but would be more inclined to accept an offer with higher wages and full employment rights, as noted in Burawoy's (1979) work. He suggested that workers who have social rights would experience increased productivity (Akerlof, 1984). Research in the literature also supports the idea

that registered workers tend to be more productive than unregistered workers (Loayza, 2018; Aberra et al., 2022). Informality is particularly prevalent among low-skilled workers and can negatively affect their motivation (Milica and Milica, 2019; Haanwinckell and Soares, 2021). Moreover, it can harm not only individual productivity but also firm productivity and growth (Endale, 2022; Kelishimo and Nistico, 2023). Additionally, missed tax and premium payments contribute to public sector losses (Mariola, 2022; Haanwinckell and Soares, 2021; Ulyssea, 2023). The main objective of this study is to analyze employer behavior within an employer-social controller 2x2 mixed strategy game, drawing on these insights.

A similar study was previously conducted by Yalama and Çelikkaya (2014) in their work titled "Determination of Optimum Tax Rate, Tax Punishment, and Audit Relationship for Turkey with Game Theory Model," which focuses on tax collection and the determination of the optimal tax rate. By analyzing the Nash Equilibrium and strategies within the model, they calculated the appropriate audit levels, punishment rates, and optimum tax rates for the period. Their findings indicate that as the audit rate increases and rational punishment rates are applied, employers' motivation to evade taxes decreases, as they perceive these measures as threats to their profits (Yalama and Çelikkaya, 2014).

Establishing the Model and Determining Strategies

In the model developed in this study, a mixed strategy game model will be applied to 2x2 static games, and Nash Equilibrium will be determined. This game theory model is also non-cooperative and non-zero-sum. When multiple strategy pairs influence the outcome of the game, a mixed strategy is used (Nohoua, 2023). In mixed strategy games, strategy pairs are represented by probability values, and the sum of these probability values equals 1. If it is not possible to find the equilibrium value using the peak approach within the full strategy method, the mixed strategy method can be employed. In such games, players can ensure a gain that does not fall below a certain level and a loss that does not exceed a certain threshold by selecting and playing their strategies according to a probability distribution. The value achieved through the mixed strategy method is known as the expected value (Straffin, 1996).

The model examines the social planner's response to the company's decisions regarding informal employment and the company's reactions to the social planner's audit decisions. The social planner expects employment to be registered and productivity to be high. This is because the social planner understands that when employment is registered, tax revenues are fully collected, social security premiums are paid in full, strengthening the system. Additionally, this ensures fairness by preventing tax evasion and unfair competition. Registered employment, along with higher wages and the security of future benefits, increases worker productivity, which, in turn, contributes to economic growth and higher production (Carneiro and Henley, 1998; Çolak and Koç, 2017; Parker, 2020).

The employer, aiming to maximize profits, will seek high levels of production from the worker while minimizing labor costs. One way to reduce labor costs is through informal employment, where taxes and social security premiums are avoided. Thus, the employer is inclined to choose unregistered employment. However, this decision comes with trade-offs, as the employer will not be able to extract full performance from the workforce. The worker, knowing they are in a temporary position or in an unstable work environment where they can leave at any time, will struggle to internalize the corporate culture and fully dedicate themselves to the job, leading to a decrease in productivity.

Table 1. Social Planner – Employer 2x2 Game Matrix

		Firm (Employer)	
		Formal	Informal
Social Planner	Audit	a-h-b , v+a+b-w-t	f-h , v-w-f
	No Audit	a-b , v+a+b-w-t	-b , v-w+b

The columns represent the strategies of the firm, while the rows represent the strategies of the social planner. The firm has two main strategies: the worker who attends the job interview will either be employed informally or

formally. In this context, informal employment refers to the worker being either fully excluded from social security and financial protections or employed partially, where only the minimum amounts are paid, resulting in missing the full contributions and losing rights in the future.

In the decision stages of the game, the parties have the option to implement social planner supervision based on their strategy profiles, while the company may choose to opt for informal employment. Specifically, in the first case (audit, formal), the strategy profiles of the parties are formed by pure strategies. In the second case (audit, informal), the strategy profiles of the parties are defined accordingly. The third case (no audit, formal) and the fourth case (no audit, informal) also represent distinct strategy profiles.

The social planner is depicted as an entity responsible for overseeing the state's public revenues and transfer expenditures, similar to social security or tax inspectors. Any shortfall identified through an audit by one authority can be immediately collected by another institution through penalties. Therefore, combining the roles of these two controllers into a single entity enhances the model's comprehensiveness. The social planner has two possible strategies: auditing and not auditing.

In the 2x2 social planner-employer game matrix, the benefit values are as follows: *v* represents the monetary value of the production level of the unregistered worker; *w* denotes the wage; *f* is the punishment (penalty); *t* refers to tax and social security premiums (legal obligations); *a* represents the monetary value of the productivity increase resulting from the worker's formal employment and payment of insurance premiums; *h* is the audit cost; and *b* stands for the incentives for registered employment provided to the employer. The constraint between these parameters is:

$$f>v>w>t>a>h>b>0$$

The benefit functions of the players, based on this information, lead to the following loss-gain clusters for the social planner:

$$U_{SP}= u(a,f,h,b)$$

For firm;

$$U_{F}= u(a,v,w,k,f,b)$$

As reflected in the utility function of the social planner (SP), SP's goal is to increase the number of registered workers, which in turn aims to enhance labor productivity (a) and overall production at both micro and macro levels. To achieve this, SP incurs audit costs (h), manages incentives (b), and imposes penalties (f) on companies that employ unregistered workers. The employer's behavior, as outlined in the company's utility function, is driven by several factors: the wage (w) paid to the workforce, the production level achieved in return for the wage, the legal obligations (t) associated with registered employment, the audit penalties (f) imposed if unregistered employment is chosen, and the incentives (b) offered by the government for registering workers.

In the first scenario, if the social planner chooses to conduct an audit and the firm opts for formal employment, the social planner's gain, which reflects the public interest (as the social planner makes decisions on behalf of the state), will be an increase in efficiency represented by *a*. However, since the audit incurs a cost of *h* for the public, the actual gain will be (a - h). It is also important to consider that countries offer certain tax and premium incentives to combat informal employment, which introduces an additional cost for the public. Thus, the net gain for the public will be (a - h - b).

On the other hand, since the firm has chosen formal employment, its gain will be (v + a + b - w - t), where *v* represents the monetary value of the production level under unregistered employment, and *a* is the increase in productivity from registered employment. In this case, the labor cost for the firm will be (w + t - b), with the remaining amount being the firm's profit. The productivity increase associated with the worker's formal employment, *a*, is the additional output generated when the worker is employed formally, and this is directly linked to *v*, the output level under informal employment. Mathematically, we can express the increase in productivity as $a = \frac{1}{X} . v$, where *x > 1* and *1/x* represents the productivity rate.

In the second case, if the social planner chooses to audit and the company opts for informal employment, the social planner's gain will be (f-h). This means that the social planner's profit is the punishment imposed on the company (f), minus the audit cost (h). On the other hand, if the company chooses informal employment and is audited, its earnings will be (v-w-f). In this case, the company's income from informal employment is (v-w), but it will be reduced by the penalty (f) imposed by the social planner during the audit.

In the third case, if the social planner decides not to audit and the company opts for formal employment, the social planner's gain will be an increase in efficiency

of "a", while the incentives provided to the formally employing company will result in a budgetary loss of "b". Since the audit cost is zero in this scenario, the economy will benefit by an additional amount of (a-b) from the state's perspective. However, this is only applicable if the company chooses formal employment. As the company prefers formal employment, its earnings will be (v+a+b-w-t), similar to the first case.

In the fourth case, when the social planner chooses not to audit and the company opts for informal employment, the social planner's gain will typically be zero. Since the workers are not registered, they will not work at full efficiency, resulting in no productivity-driven increase in production. With no subsequent inspection, there will be no punishment or audit cost. The company, therefore, will have minimized its labor costs and achieved the highest profit, which is (v-w). However, the company may not want all its workers to work informally. Some workers might be employed informally in addition to their registered positions, or all workers could be registered at the minimum wage, while the remainder of their agreed-upon wage is paid informally. This arrangement causes workers to forfeit social rights such as severance pay and retirement pensions, while allowing the company to calculate these amounts at lower levels and benefit from tax and premium incentives due to regular premium payments (Uçarı and Koç, 2017). As a result, the social planner's loss will be the incentives provided (-b), while the company's gain will be the lower labor costs, represented as (v-w+b). The model assumes that the company has a dual employment structure.

However, as observed, there are pure strategies in all four cases. Therefore, a Nash equilibrium cannot be formed using pure strategies, as the expected benefits and strategies of the parties differ from one another. Since no equilibrium can be achieved in this static game, it is necessary to explore whether a Nash equilibrium can be established using mixed strategies. To do so, the strategy options for the parties must be incorporated into the game model, and the matrix needs to be reorganized accordingly.

Table 2. Social Planner – Employer 2x2 Mixed Strategy Game Matrix

		Firm (Employer)		
		Formal	Informal	
Social Planner	Audit	a-h-b , v+a+b-w-t	f-h , v-w-f	p
	No Audit	a-b , v+a+b-w-t	-b , v-w+b	1-p
		q	1-q	

The "p" and "q" values in the new matrix represent the decision probabilities for the players. Specifically, "p" denotes the probability that the social planner will choose to audit, while "q" represents the probability that the company will opt for registered workers (or informal employment). These probability values, "p" and "q," range between 0 and 1. Therefore, the probability that the social planner will not conduct an audit is (1-p), and the probability that the company will choose unregistered employment is (1-q). With this in mind, when the benefit functions and loss-gain sets of the parties are adjusted, for the social planner:

$$U_{SP} = u(a,f,h,b,q)$$

for firm;

$$U_{F} = u(a,v,w,k,f,b,p)$$

In this new scenario, where there is no pure strategy equilibrium but a mixed strategy equilibrium, a player is indifferent between the pure strategies they randomize. To find the mixed strategy equilibrium of the game, the expected utility functions of the pure strategies must be equalized. Once this condition is met, the probabilities "p" and "q" can be determined through algebraic processes:

$$EU(\text{Audit}) = (a\text{-}h\text{-}b)q + (f\text{-}h)(1\text{-}q) \quad (1)$$

$$EU(\text{No Audit}) = (a\text{-}b).q - b(1\text{-}q) \quad (2)$$

When these two equations are equal to each other;

$$(a\text{-}h\text{-}b)q + (f\text{-}h)(1\text{-}q) = (a\text{-}b)q - b(1\text{-}q) \quad (3)$$

$$aq - hq - bq + f - fq - h + hq = aq - bq - b + bq \quad (4)$$

In the final equality, the identical or opposite values on both sides cancel each other out, resulting in equality;

$$-bq + f - fq - h = -b \quad (5)$$

If the constant values are moved to the right side of the equation and the "q" factor is factored out, the equation is represented as;

$$(b + f)q = f - h + b \quad (6)$$

This will result in the q value, which represents the probability of the company choosing to make an unregistered employment decision.

$$q = \frac{f-h+b}{f+b} \quad (7)$$

Equation (7), derived above, calculates the probability of the company choosing registered employment. In this equation, the ratio of the value obtained by subtracting the audit cost from the sum of punishment and incentive expenditures to the total of punishment and incentive expenses gives the probability "q." As the punishments (f), incentives (b), and audit costs (h) rise, the firm's probability of engaging in unregistered employment (1-q) will decrease. This is because increased audit costs reflect more frequent audits and a higher number of auditors employed by the public authority. Conversely, as audit costs decrease, the likelihood of unregistered employment increases, as the company anticipates fewer audits. A reduction in audit costs is associated with less frequent audits and fewer auditors employed by the public authority.

Similarly, the same method must be applied to determine the equilibrium of the company's strategies.

$$EU(Formal) = (v+a+b-w-t)p + (v+a+b-w-t)(1-p) \quad (8)$$

$$EU(Informal) = (v-w-f)p + (v-w+b)(1-p) \quad (9)$$

By setting the two functions equal to each other, equation (10) is derived;

$$(v+a+b-w-t)p + (v+a+b-w-t)(1-p) = (v-w-f)p + (v-w+b)(1-p) \quad (10)$$

By distributing (p) and (1-p) on both sides of the equation and performing algebraic operations, equation (11) is derived.

$$(f+b)p= -a+t \quad (11)$$

As a result of this equation, equation (12) is derived:

$$p = \frac{t+a}{f+b} \quad (12)$$

The "p" value derived from this process represents the probability that the social planner will conduct an audit. In other words, the likelihood of an audit is calculated by dividing the difference between legal obligations (t) and productivity increase (a) by the sum of the punishments (f) and incentives (b) given to the company. As the difference (t-a) decreases, the probability of the social planner auditing will increase. This means that when taxes and premiums are lower, and productivity is reduced, the social planner will have a higher tendency to audit. Conversely, if punishments and incentive rates are higher, the probability of the social planner conducting an audit will decrease, as it is expected that unregistered employment will not be used.

The "p" value derived from this process represents the probability that the social planner will conduct an audit. Specifically, the likelihood of an audit is calculated by dividing the difference between legal obligations (t) and the increase in productivity (a) by the sum of the punishments (f) and incentives (b) provided to the company. As the difference (t-a) decreases, the probability of the social planner auditing increases. This means that when taxes and premiums are lower, and productivity is reduced, the social planner is more likely to conduct an audit. Conversely, when punishments and incentives are higher, the probability of the social planner carrying out an audit decreases, anticipating that unregistered employment will not be used.

Nash Equilibrium Solution of the Model and Findings

To illustrate the application of the results obtained in the model and determine the Nash Equilibrium, the benefit functions of the players can be plotted on a graph by assigning values to the defined parameters. This approach generates the "best response curve" and helps identify the Nash Equilibrium (Goeree and Holt, 2004; Reeves and Wellmann, 2012). The most straightforward and effective method for determining Nash equilibrium in mixed strategy games is by deriving the best response curves.

To begin, the parameters must first be assigned values. Since our parameters are represented as S = {f, v, w, t, a, h, b} in descending order, their corresponding numerical values are assigned as S* = {17, 14, 11, 5, 3, 2, 1}. After distributing the parentheses in equation (1), equation (13) is derived:

$$EU(Audit) = (a-h-b)q + (f-h)(1-q) \quad (1)$$

$$EU(Audit) = aq - hq - bq + f - h - fq + hq \quad (13)$$

The new equation to be obtained at the end of the algebraic process is as follows:

$$EU(Audit) = (f-h) + q(a-b-f) \quad (14)$$

When the parameter values are replaced in equation (14) obtained above;

EU(Audit) = 15-15q (15)

The expected function of the social planner based on the control strategy is derived. If the same steps are applied to the scenario where the social planner does not conduct an audit, equation (2) should be used. Following the algebraic process in equation (2), the result is;

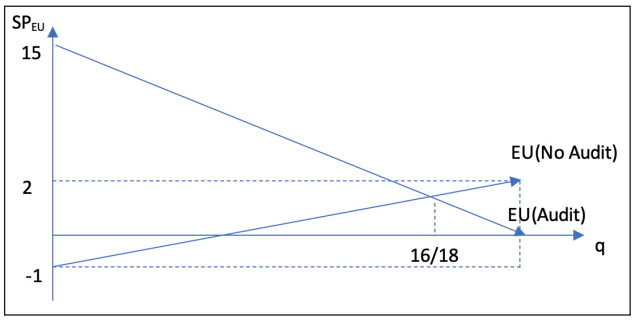
EU(No Audit)) = (a-b)q - b(1-q) (2)

EU(No Audit) = aq-bq-b+bq = aq-b (16)

By substituting the parameter values into the function, we get:

EU(No Audit) = 3q-1 (17)

The expected function is derived. Using the functions (15) and (17) obtained above, the graphical representation of the social planner based on the expected utility functions is as follows.



Graph 1. Social Planner's Response Functions

When Graph 1 is analyzed, the point where the expected utility functions intersect also corresponds to the point where the equation $q = \frac{f-h+b}{f+b}$ is derived. In other words, the probability at this point represents the likelihood of the company employing formal workers, with a probability of 16/18. Conversely, the probability of unregistered employment is 2/18. As shown, the company's response probability is determined from the social planner's utility functions, and the company positions itself and formulates a strategy based on the social planner's potential actions.

To calculate the company's strategy values based on the company's expected benefit function, the "p" values in equation (8) are extracted from the parentheses, and algebraic operations are performed to derive equation (18).

EU(Formal) = (v+a+b-w-t)p + (v+a+b-w-t)(1-p) (8)

EU(Formal) = v+a+b-w-t (18)

By substituting the values and parameters from the S* set into the derived equation, the expected benefit function is obtained as equation (19), which is a constant function.

EU(Formal) = 2 (19)

The expected utility function for the company's unregistered employment strategies is presented in equation (9) above. By applying this equation and removing the probability value "p" from the parentheses, we derive equation (20).

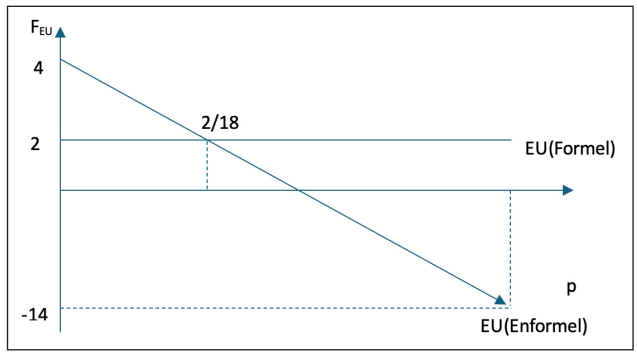
EU(Informal) = (v-w-f)p + (v-w+b)(1-p) (9)

EU(Informal) = (v-w)-p(f+b) (20)

By substituting the values from the S* set for the parameters, the expected utility function for informal employment (EU Informal) is obtained, as shown in equation (21):

EU(Enformel) = 4-18P (21)

In this way, the expected benefit functions for the firm's registered and unregistered employment strategies are derived. At this point, the company's response functions can be represented graphically:

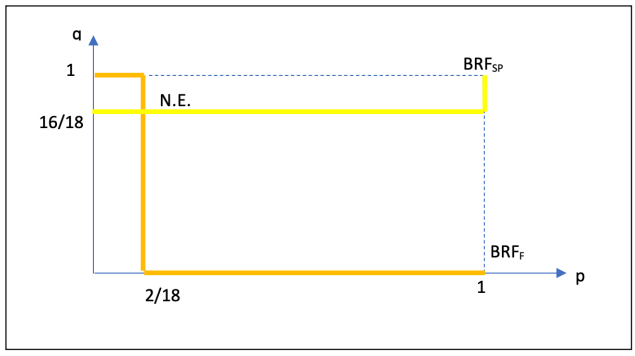


Graph 2. Firm's Response Functions

Graph 2 illustrates the graph derived from the company's expected utility functions. The intersection point of the company's response functions also determines the probability values of the strategies that the social planner will adopt. Specifically, this point corresponds to the equation $p = \frac{t-b}{f+b}$. Based on the values used in the model, the probability that the social planner will conduct an audit is 2/18. In other words, there is a 2/18 chance that the social planner will perform an audit.

After obtaining the expected utility functions for both parties and calculating the "p" and "q" probabilities, the best response curves for both players can be determined. These curves represent the strategies that will maximize each player's utility. To find the Nash equilibrium in the model, the best response functions of the players must be identified. Since the game model in this study is based on mixed strategies, finding the Nash equilibrium cannot be done in the same way as in pure strategy games. However, the best response functions provide a means to identify the Nash equilibrium. Therefore, the point where the "Best Response Curves" of the two parties intersect will indicate the Nash equilibrium (Goeree and Holt, 2004; Reeves and Wellmann, 2012).

As shown in Graph 3, the four pure strategy options (audit, no audit, formal employment, informal employment) do not constitute mutually best responses. As a result, there is no pure Nash equilibrium in the model. Similarly, combinations of the four mixed strategies do not form best responses. However, the intersection of the best response functions, at the point (2/18, 16/18), represents the Nash equilibrium, as it corresponds to the mutual best response Nash equilibrium.



Graph 3. Best Response Functions

From the perspective of the social planner, the optimal choice for the opposing player is to select a value within the range 0<q<1, p=2/18. In this scenario, the social planner remains indifferent to other potential choices. This means that the social planner will opt for an audit decision with a probability of 2/18 and is neutral regarding alternative options.

For the company, if the opposing player picks a value within the range 0<p<1, the ideal value for q would be 16/18. In this case, the decision regarding registered employment will occur with a probability of q=16/18. Consequently, the mixed strategy Nash equilibrium of the game is represented by the pair (2/18, 16/18).

CONCLUSION and POLICY IMPLACATIONS

The findings presented in this article provide insights into how social planners and employers respond to registered versus unregistered employment. Aligned with its objectives, the article models the strategies that social planners and employers adopt in response to employment regulations established by policymakers, as well as their reactions based on these strategies.

When evaluating the results derived from the implemented audit game, the strategic decision value for the social planner is expressed as. The primary goal of the social planner is to ensure that all jobs are registered and productive. Consequently, as the values of f (punishments) and/or b (incentives and rewards) increase, the probability value of p will decrease, leading to a reduced likelihood of the social planner conducting an audit.

In scenarios with high punishments, the social planner anticipates that employers will be deterred from hiring informal workers. Conversely, as the difference between (t-a) —the legal reserve value that includes taxes and insurance premiums— and productivity a increases, the probability of the social planner conducting an audit will rise. This is because low productivity relative to high tax and insurance payments makes informal employment more appealing to employers, ultimately decreasing income from social deductions. As a result, the need for audits becomes more pronounced.

Similarly, the primary objective of the firm is to achieve maximum efficiency from its workers at a low cost while maximizing profit. Consequently, the firm's decisions will influence whether it chooses to employ registered or unregistered workers. The value represents the probability of the employer's decision regarding employment.

As the values of punishments f and incentives b increase, the value of q will also rise, leading to a decreased probability of the employer hiring informal workers (represented by 1 - q). In other words, the employer will be more inclined to hire formal workers. However, if the value of h increases while punishments and incentives remain constant or are perceived as relatively low, then q will decrease. This results in an increase in (1 – q), thereby raising the likelihood that the employer will hire unregistered workers.

In essence, if the social planner reduces inspections due to rising audit costs, this situation may become more appealing for employers considering informal

employment. The social planner's decision to forego inspections could incentivize employers to pursue unregistered workers as a strategy for profit maximization and cost reduction.

The results yield two significant insights. First, if austerity measures implemented during an economic crisis are reflected in audit procedures, a reduction in audit frequency may lead to increased informality. As audit costs rise, the decreased frequency of audits due to these austerity measures will likely encourage employers to hire informally, as the likelihood of being caught by the social planner diminishes.

Second, an increase in public revenues from employment under fiscal policies during crisis periods can also incentivize employers to engage in informal hiring. High legal deductions, such as taxes on wages and social security premiums, raise labor costs for employers, potentially leading them to overlook productivity gains from their workers.

To reduce the frequency of audits and save on audit costs, the social planner should consider increasing penalties for informal employment. If policymakers aim for fewer audits due to limited resources and austerity measures, implementing higher punishments can serve as a deterrent. Additionally, since legal deductions can make informal employment more appealing to companies, high penalties should be employed as a precautionary measure.

Moreover, complementing high punishments with attractive incentives can enhance their deterrent effect. Improved incentives can lead to reduced informality and subsequently increase public revenues.

Conversely, it is evident that policymakers' decisions regarding punishments, incentives, taxes, and social security deductions influence employer behavior while sidelining worker productivity. Employers tend to prioritize their own benefit maximization in their decision-making processes. In other words, in response to the social planner's decisions, employers evaluate their choices based on the costs they will incur and the monetary benefits they anticipate.

As a result, when faced with the choice between informal employment and not hiring, employers often overlook the additional revenue that could be generated from increased workforce productivity. The primary motivation for employers in this decision-making process is to minimize costs and maximize profits, operating under the assumption that production levels will remain constant—meaning they do not expect any increase in productivity. Consequently, their main objective becomes achieving cost minimization and profit maximization.

Furthermore, the findings indicate that the variables established by social planners and policymakers —such as punishments, incentives, taxes, and social security premiums—should be implemented in conjunction with other factors that influence the model, including worker production levels, productivity increases, and control costs. Therefore, policymakers should adopt the optimal values derived from simulations designed to minimize unregistered employment in economic practice.

This article elucidates the behavioral decisions surrounding unregistered employment from the perspectives of both the company and the social planner (state) through mathematical methods based on game theory models. It highlights the necessity for the social planner to make optimal control decisions and implement rational punishments. Efforts should focus on reducing audit costs while developing alternative, lower-cost methods for oversight. Additionally, maintaining continuous control is crucial for preventing unregistered employment.

Following this study, it is anticipated that game theorists will create new models to calculate the optimal number of inspections and determine rational punishments. Furthermore, it is suggested that this model be expanded into a three-dimensional framework that incorporates the interactions between the worker, employer, and social planner, allowing for a revised Nash equilibrium based on this comprehensive approach.

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The Relationship of the Corporate Reputation Attributes That Academics Ascribe to Their Universities with Their Perceptions of Corporate Reputation And Prestige And Organizational Citizenship Behaviors

Gizem TULPAR[1] , Pınar SÜRAL ÖZER[2]

ABSTRACT

The primary determinant of academics' perceptions of reputation towards the institution they work for is the attributes possessed by the institution. Positive perceptions of reputation shaped by these attributes enhance academics' behaviors that support the institution. The current study examines how the corporate reputation attributes ascribed to their institutions by academics working at state universities in Turkey are reflected in their perceptions of reputation and prestige and the effects of this on organizational citizenship behavior. The 'Corporate Reputation Attributes (CRA)' measurement tool, developed specifically for culture and context, was used to test the determinants of reputation. According to the holistic research model that tests perceived corporate reputation with its antecedents and consequences, the (partial) mediating effect of perceived corporate reputation (PCR) and perceived organizational prestige (POP) was determined in the effect of the corporate reputation attributes (CRA) on organizational citizenship behavior (OCB). Furthermore, multiple (full) mediating effects of perceived corporate reputation and organizational prestige were revealed.

Keywords: University Reputation, Corporate Reputation Attributes, Prestige, Citizenship.

JEL Classification Codes: D23, I23, L14

Referencing Style: APA 7

INTRODUCTION

Reputation management is critical for companies as it boosts stakeholder trust, enhances product and service value, increases market share, and aids in attracting and retaining top talent.

The interest in improving corporate reputation has gradually included educational institutions. The interest began with a project initiated by the Carnegie Commission on Higher Education in 1970 (Allesandri et al., 2006).

Universities are among the most important institutions that contribute to society, economic stability, social welfare, the ability of nations to engage in international cooperation and internationalization, and the quality of life in a wide range of economic, social, and cultural terms (Çoban, 2024). Globalization and the growing competition in the education sector have intensified performance pressures on Higher Education Institutions (HEIs). To gain a competitive edge, universities have adopted strategies from profit-driven sectors (Angliss, 2022; Kaushal & Ali, 2020; Olssen & Peters, 2005; Verčič et al., 2016). In today's world where the post-third generation university is being discussed, HEIs should also focus on reputation management regarding interconnected outcomes such as attracting qualified academics and students, creating resources for research projects, and increasing the quality of scientific outputs and education.

The critical question for universities is '*how to do effective reputation management?*' While it seems important for universities to manage their place in reputation rankings, rankings that can become an end in themselves rather than a means are criticized in many ways, primarily in terms of their methodology, validity and reliability, etc. (Adler & Harzing, 2009; Longden, 2011; Safón, 2013; Teichler, 2011). These criticisms have led some institutions, such as the University of Zurich, to withdraw from rankings like Times Higher Education (THE), citing reductive quantitative criteria that yield misleading results (swissinfo.ch 2024; UZH to No Longer Provide

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* This study has been reported from the doctoral thesis of Bilginer (2024). "The relationship of the corporate reputation attributes that academics ascribe to their universities with their perceptions of corporate reputation and prestige and organizational citizenship behaviors."

Data for the Ranking 2024). Despite the heterogeneity of postsecondary systems, institutions, norms, and policies worldwide, there an inevitable convergence and normalization in rankings (Pusser & Marginson, 2013). Nowadays, it is noticeable that discussions and publications about the cultural prejudices and hegemony contained in the World University Rankings (WURs) have also begun to come to the forefront (Bellantuono et al., 2022; Wen et al., 2023; Shahjahan & Bhangal, 2024). Predictions indicate that the international ranking landscape will change significantly soon (Holmes 2024).

Given academia's distinct operational dynamics, measuring university reputation requires a tailored approach (Verčič et al., 2016). The lack of differentiating factors among universities has increased similarity and diminished competitiveness (Qazi et al., 2022). It is emphasized in the literature that it would be more meaningful and effective for universities to position themselves according to their unique characteristics with a strategic approach by going beyond the framework of rankings (Suomi, 2014; Vidaver-Cohen, 2007). Despite its importance, research on institutional reputation in higher education remains limited and underdeveloped compared to the corporate sector (Angliss, 2022).

The reputation of universities is affected by the experiences of their internal and external stakeholders. The expectations and perceptions of each stakeholder group and the university's behavior toward its stakeholders are the main determinants of reputation perceptions (Bilginer & Özer, 2023; Suomi, 2014; Verčič et al., 2016; Vidaver-Cohen, 2007).

Enhancing reputation requires more than measuring perceptions. It goes beyond measuring perceptions and involves identifying key factors that influence these perceptions and implementing continuous improvements (Fombrun et al., 2015; Ponzi et al., 2011).

This study includes the last research of the work, which consists of two phases and three research studies. Reputation was examined in terms of academics, who are key internal stakeholders of universities. Although the reputation literature initially used the external stakeholder perspective, the Stakeholder-Focused Approach to Reputation has developed since the 1990s, and consistent with Freeman's (1984) Stakeholder Theory, the roles of employees who play a key role in the success of the institution and their capacity to influence public perceptions of reputation through their communication behaviors have increased the interest in studies addressing the perspectives of internal stakeholders on reputation in the literature (Lee & Abdullah, 2023 ; Money et al., 2017). Enhancing academics' reputation perceptions is vital for effective corporate reputation management, as it directly influences the development of reputation factors in the eyes of other stakeholders.

'*How are the reputation perceptions of academics shaped?*' is the main question of the study. The main objective of the study is to question how the determinants of corporate reputation perceptions (*corporate reputation attributes they ascribe to their institution/university - CRA*) of academics working at state universities in Turkey shape their corporate reputation (PCR) and prestige perceptions (POP) and how these are reflected in organizational citizenship (OCB), which is one of the behavioral outcomes.

The Reputation Quotient (RQ) scale of Fombrun (2000), which is frequently used in the literature, complicates the understanding of reputation by considering the antecedents of reputation together with the structure itself. The Reptrak System Model (Fombrun et al., 2015), which is a model developed to solve the problem (Fombrun, 2006), measures pure reputation perception (Reptrak Pulse) in the emotional appeal subscale (Ponzi et al., 2011) and corporate attributes (RepTrak Index), which are the antecedents of reputation perception, in the rational appeal subscale (reputational attributes), is becoming more widely used and is recommended for use in universities as well (Vidaver-Cohen, 2007). However, the reputation-driving factors vary depending on culture and context. The universality claims of RQ and Reptrak Index may undermine the validity of studies conducted in different cultures and contexts. It is thought that it is not appropriate to translate these tools, which were not developed specifically for universities, into the target language and use them directly. In this way, the measurement ignores the universities' roles in education, research, and community service and the contextual differences in perceptions regarding the driving factors of reputation (Bilginer & Özer, 2023).

As indicated by the findings of the meta-analytic study by Ali et al. (2015), practitioners need to be very careful about the reputation measurement selected depending on cultural differences and the focused stakeholder group in their efforts to improve corporate reputation.

Based on these reasons, in the first phase (Bilginer & Özer, 2022; Bilginer & Özer, 2023), a measurement tool was developed for the reputation-driving antecedents from an emic perspective. In the second phase, the measurement tool was tested within the holistic model of this study.

THEORETICAL BACKGROUND and HYPOTHESES DEVELOPMENT

Corporate Reputation

Corporate reputation is an abstract and complex concept studied across various fields (Chen & Otubanjo, 2013; Chun, 2005; Fombrun & Van Riel, 1997). However, there is considerable confusion regarding its definition and measurement (Ali et al., 2015; Barnett et al., 2006; Dowling, 2016; Fombrun et al., 2015; Lange et al., 2011; Walker, 2010; Wartick, 2002). To enable robust research, it is essential to define corporate reputation clearly and to distinguish its antecedents and consequences. Measurement tools should then align with this definition.

From a historical perspective, corporate reputation is defined as a "strategic intangible asset" or "perception," viewed from company-centric or stakeholder-centric perspectives (Money et al., 2017). It can be categorized into four groups, as shown in Figure 1 (Saraeva, 2017).

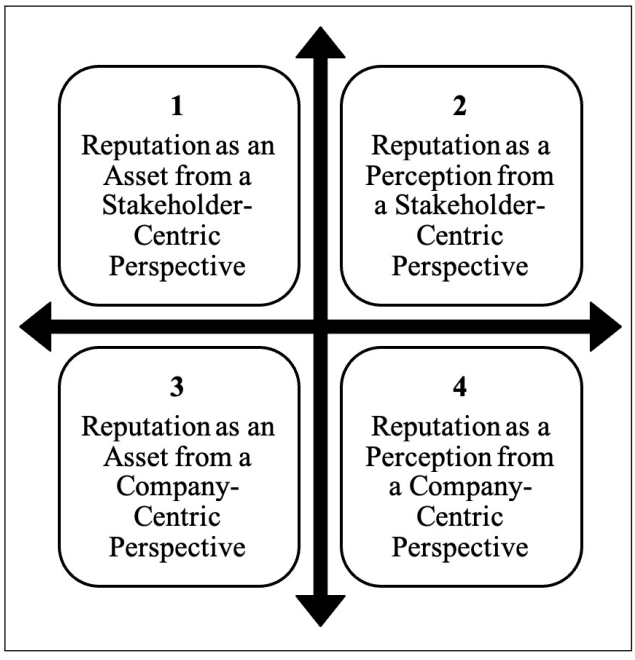

Figure 1: Grouping of Corporate Reputation Definitions

Source: Created by the author based on the studies of Money et al., 2017 and Saraeva, 2017.

From a stakeholder-centric viewpoint, corporate reputation is defined as the company's ability to deliver value-creating products and services, with evaluations based on predictions of future offerings (Bartikowski et al., 2011; Fombrun et al., 2000). It is shaped by stakeholders' experiences, feelings, and perceptions of the company's appeal (Chun, 2005; Coombs, 1999; Fombrun, 2012; Helm, 2005; Helm, 2011; Luoma-aho, 2007; MacMillan et al., 2005; Money & Hillenbrand, 2006; Omar & Williams, 2006; Ponzi et al., 2011; Walsh & Beatty, 2007). Over time, these perceptions evolve based on the mutual relationships between stakeholders and the company, particularly in how well the company meets stakeholder expectations.

From a company-centric perspective, reputation is seen as an intangible asset and strategic resource that enhances financial performance and competitive advantage (Brønn & Brønn, 2005; Carmeli & Tishler, 2005; Fombrun & Shanley, 1990; Mailath & Samuelson, 2001; Petrick et al., 1999; Roberts & Dowling 1997, 2002; Shrum & Wuthnow, 1988; Teece et al., 1997; Weigelt & Camerer, 1988). Corporate reputation involves stakeholders evaluating the company's activities as superior compared to competitors (Christian, 1959; Fombrun, 1996; Chun & Davies, 2001; Goldberg et al., 2003; Argenti & Druckenmiller, 2004; Rindova et al., 2005; Wiedmann & Buxel, 2005; Rhee & Haunschild, 2006). This perception positively influences the company's goals and long-term sustainability.

In the present study, Perceived Corporate Reputation (PCR) is addressed in the '*perception*' category from a '*stakeholder-focused*' perspective: PCR as a reflection of stakeholders' experiences and feelings about the company's past actions and their perceptions of its potential predicted for the future, is a representation of how they evaluate the company's overall attractiveness compared to its competitors, and a result of the stakeholder-company interaction.

Dowling (2016), within the framework of 50 definitions he examined in his study, draws attention to the fact that corporate reputation can be considered as beliefs about what the company is known for, its distinctive features and behaviors, signals expressing the reflection of known features about the company on unknowns, status explaining the position of the company compared to its competitors or the likability of the company in the eyes of stakeholders, general evaluations about its attractiveness, and its construction can be defined individually, collectively or socially.

In the present study, PCR is considered as an '*individual evaluation*' according to Dowling's (2016) distinction, considering that the dimensions and expectations that are prioritized in the evaluations of each stakeholder differ and is conceptualized as the feelings/beliefs of the stakeholder group regarding the extent to which their expectations are met within the scope of their observations and interactions with the institution in a certain period of time (Dowling, 2016; Fombrun et al., 2015; Lange et al., 2011; Money et al., 2017; Ponzi et al., 2011; Walker, 2010; Wartick, 1992; Wartick, 2002).

In the functional definition that will validate the measurement of the concept of corporate reputation (Dowling & Gardberg, 2012; MacKenzie, 2003; Rossiter, 2002), the following should be specified: (1) The organization to be measured, (2) The characteristics of the judgment, (3) The stakeholder(s) making the evaluations, (4) The conceptual theme, (5) Differences between structural levels, if any, e.g. different types of companies, stakeholder groups, contexts (countries) and time (pre- and post-crisis), etc. In addition, the definition should not include (6) Other -antecedent and consequence-variables (Dowling, 2016).

In the study, the functional definition was made to include the mentioned elements: '(1) *Emotions and beliefs formed by the observations of academics* (4) *working in the Faculties of Economics and Administrative Sciences and Business Administration* (3) *at state universities in Turkey and their experiences developing within the scope of their interactions with the institution they work for* (2).'

A strong perception of corporate reputation positively affects many outcome variables (Fombrun et al., 2015; Money et al., 2017). Academics' positive perceptions of their university's reputation are expected to influence their performance and contribute to educational, scientific, and service-related outcomes, as these perceptions are reflected in their intentions and behaviors.

Corporate Reputation Attributes (CRA)

Studies focusing on PCR in organizational behavior in terms of internal stakeholders are based on the definition of '*employees' interpretation of their experiences* (Fombrun & Van Riel, 1997)'. Based on this definition, the most critical point is determining experience areas.

In the first qualitatively designed research of the first phase of the study (Bilginer & Özer, 2022), the experience areas that are effective in shaping the corporate reputation perceptions of academics working in the basic field of Social, Human and Administrative Sciences at state universities in Turkey were revealed as '*functions of the institution*', '*relationship developed with the institution*', and '*third-party opinions about the institution*'.

The first experience area related to the corporation's functions, defined as '*Corporate Reputation Attributes (CRA)*', is also the most frequently researched antecedent of reputation perception in literature (Lee & Abdullah, 2023; Money et al. 2017). This experience area is also compatible with the subscales of the reputation scales developed by Fombrun et al. and covers only the '*functional antecedent*' (Fombrun et al., 2015; Ponzi et al., 2011), free from the problems arising from the intertwining of the antecedent and the pure structure of reputation.

In their studies focusing on university reputation, Angliss (2022), Bratus and Sydorov (2021), Verčič et al. (2016), Suomi (2014), Sontaite and Bakanauskas (2011), and Vidaver-Cohen (2007) also emphasized the reputation attributes of universities.

Since this antecedent is related to the corporation's functions, it is known that the corporation has the highest control power and that the perceptions of each stakeholder group are shaped similarly. Considering that the stakeholders' perceptions in other experience areas are diversified, and the control power of the institution is reduced, it is suggested that institutions that aim to strengthen their reputation should focus primarily on this experience area (Bilginer & Özer, 2022).

In CRA, 'Pioneering in the Field' refers to leadership and innovation, while 'Qualified Outputs' refers to education, training, and service outputs. The third category covers the working environment and management function, which are critical to the quality of outputs.

In the second research of the first phase (Bilginer & Özer, 2023), a culture and context-specific measurement tool for CRA was developed. The discovered and validated subscales of CRA are shown in Figure 2.

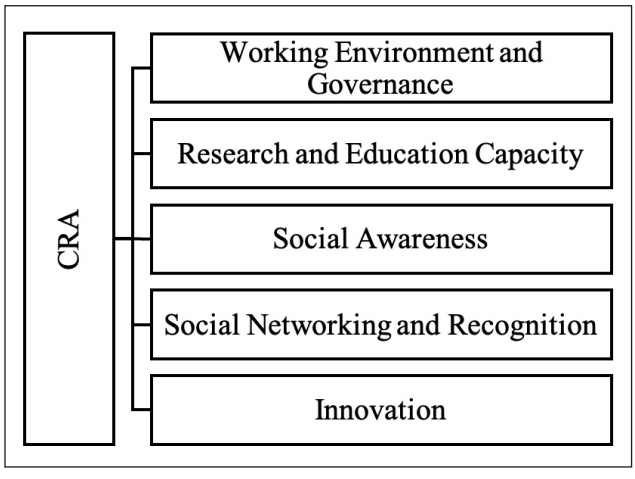

Figure 2: Corporate Reputation Attributes (CRA)

Strategic decisions and actions of universities influence their reputations, shaping perceptions of prestige and key characteristics of their institutional functions (Fombrun et al., 2015; Ried & Ried, 2021; Sweitzer & Volkwein, 2009; Volkwein & Sweitzer, 2006).

Like PCR (Chun, 2005; Fombrun et al., 2015; Lee & Abdullah, 2024; Ponzi et al., 2011; Vidaver-Cohen, 2007), CRA also affects Perceived Organizational Prestige (POP). As Sung and Yang (2008) highlight, perceived external prestige is typically considered an individual-level variable. It pertains to individuals' interpretations and evaluations of a company's prestige based on their exposure to information about the organization. Although members' prestige perceptions are shaped by others' perceptions, at a fundamental level, they derive from what their organization does or does not do (Carmeli, 2005)

H1: CRA positively influences PCR.

H2: CRA positively influences POP.

Perceived Organizational Prestige (POP)

Although studies conducted over the years have purified corporate reputation from the concepts it interacts with, it is still confused with similar concepts, or the concepts are used interchangeably. One of these is Perceived Organizational Prestige (POP) (Shrand & Ronnie, 2021).

While those within the organization shape their opinions and perceptions, they evaluate how outsiders see the corporate reputation and interpret it with their own values (Carmeli, 2005; Sung & Yang, 2008). POP is shaped by the reflection of '*how the corporate reputation appears from the outside*' and '*the beliefs and opinions of others about the institution*' on the perceptions of internal stakeholders (Bhattacharya et al., 1995; Mael & Ashforth, 1992).

In many studies on university reputation (Freid, 2005; Ried & Ried, 2021; Simiyu et al., 2019; Stephen, 2009; Sung & Yang, 2008; Sweitzer & Volkwein, 2009), PCR and POP have been considered together in the context of the existence of common antecedents (*one of which is the corporate reputation attributes*), their structural similarities (Kang & Bartlett, 2013) and/or their reciprocal cyclical relationships (Zabala et al., 2005).

As pointed out by Zabala et al. (2005: 68), *'the corporate reputation of an enterprise is the prestige maintained through time which, based on a set of shared values and strategies and through the eminence achieved with each stakeholder, assures the sustainability and differentiation of the company via the management of its intellectual capital (intangibles).'*

In literature, the prestige created by the organization's social system and stakeholders' experiences related to the organization's culture (Angliss, 2022; Fombrun & Van Riel, 1997; Shapiro, 1987) are also accepted as ways to measure reputation. The PCR of external stakeholders explains the POP of internal stakeholders (Freid, 2005; Ried & Ried, 2021).

In the studies in question, the relationship between the two variables was examined within the framework of different models, and the outcome variables affected by both variables were discussed. It was found that PCR affected the outcome variables through its relationship with POP (Sung & Yang, 2008; Sweitzer & Volkwein, 2009).

H3: PCR and POP are correlated.

It is expected that POP, which is expected to be affected by the functional antecedent (CRA) like PCR, will predict outcomes that will positively reflect the institution's performance, and the evaluation of the joint effects of both perceptions will provide a holistic framework for strengthening performance.

Organizational Citizenship Behavior (OCB)

Organ's studies were used to conceptualize Organizational Citizenship Behavior (OCB) in the study. OCB is an optional individual behavior that is not directly and clearly defined by the formal reward system and contributes to the organization's performance by supporting its effective operation (Borman & Motowidlo, 1997; Organ, 1988; Podsakoff et al., 2000).

Job performance is a multidimensional concept influenced by employees' work behaviors. It is increasingly understood to encompass constructs like organizational citizenship behavior (OCB) and counterproductive work behavior (CWB) (Dalal, 2005). OCB is considered one dimension of job performance. Positive behaviors associated with duties and responsibilities are OCB, which constitutes voluntary behaviors in performing tasks (Reyhanoğlu & Akın, 2020).

The literature on Organizational Citizenship Behavior (OCB) highlights several key antecedents. These include individual characteristics, such as role perceptions and job characteristics; organizational factors, like perceived organizational support; and leadership behaviors, specifically supportive and transformational leadership styles (Podsakoff et al., 1990; Podsakoff et al., 2000; Schaarschmidt et al., 2015).

Individuals who have a positive perception of their institutions tend to experience a strong person-organization fit (Kristof, 1996), which significantly

predicts organizational citizenship behavior (OCB) (Chuang et al., 2016; Gorostiaga Manterola et al., 2022; Lin, 2008; Newburry, 2010). Additionally, the attributes of corporate reputation associated with these institutions can influence perceptions of person-organization fit (Kristof, 1996; Venkatesh, 2017).

The literature highlights the significance of universities positioning themselves based on their unique traits to enhance their reputation (Suomi, 2014; Verčič et al., 2016; Vidaver-Cohen, 2007). Corporate reputation attributes that reflect these distinctive characteristics can affect the actions of academics who support the institution, as these attributes are often perceived as quality indicators (Carmeli & Tishler, 2006; Rashid & Mustafa, 2021). In this context, the unique features of the institution can serve as a foundation that guides behavior.

H4: CRA positively influences OCB.

Employees' strong perceptions of reputation have been linked to positive employee behaviors (Helm, 2011; Danaei & Iranbakhsh, 2016; Fu et al., 2014; Lee & Abdullah, 2023; Mehtap & Kökalan, 2013). One of the prominent behavioral outcomes of PCR is OCB. It is predicted that employees with strong perceptions of corporate reputation will have a stronger fit with the organization (person-organization fit) and will be more likely to exhibit supportive behaviors towards the institution (Newburry, 2010). PCR may serve as an important antecedent of OCB because it complements role-related antecedents such as job characteristics (Schaarschmidt et al., 2015). Employees who perceive the reputation of their organization as strong will exhibit more OCB (Helm, 2011; Danaei & Iranbakhsh, 2016; Fu et al., 2014; Mehtap & Kökalan, 2013)

H5: PCR positively influence OCB.

On the other hand, strong POP also positively affects OCB (Boğan & Dedeoğlu, 2020; Carmeli, 2005; Costa et al., 2017; Helm, 2013: Lin, 2008; Schaarschmidt et al., 2015; Schaarschmidt & Könsgen, 2020; Schaarschmidt, 2016; Wang et al., 2019).

H6: POP positively influence OCB.

The reasons affecting PCR (Thought) develop emotional bonds (Emotion) and perceptions in stakeholders. As a result, stakeholders make behavioral decisions (Behavior) that increase the performance of the institution (Dolphin, 2004; D'Souza et al., 2013; Fombrun & Rindova, 1996; Money et al., 2017; Newburry et al., 2014; Vidaver-Cohen & Brønn, 2013).

CRA explains the driving attributes that affect PCR and POP. The stakeholder's perception and emotional bond towards the institution develops due to his/her intellectual evaluations of the institution's attributes. The stakeholder's inclination to engage in behaviors that enhance the institution's performance stems from their positive perceptions and emotions toward it. Therefore, a direct relationship is predicted between CRA and OCB, and thoughts toward CRA are expected to be reflected in behavior through perceptions of the institution.

H7: PCR mediate the relationship between CRA and OCB.

H8: POP mediate the relationship between CRA and OCB.

Within the framework of the definitions taken as a basis within the scope of the study, PCR is the feelings and beliefs formed by the stakeholder's observations and experiences developing within the scope of their interactions with the institution. In contrast, POP is shaped by the reflection of the beliefs and thoughts of others about the institution on the perceptions of internal stakeholders. The stakeholders' thoughts about the corporate reputation attributes are expected to be reflected in their behaviors and the perceptions originating from themselves and others.

As indicated in the study by Kang and Barlett (2013), POP may not be sufficient to strengthen OCB. It is expected that the institution (managers) will strengthen the CRA, which is the antecedent of PCR, reinforce the cognitive acceptance of POP by employees, and both perceptions (PCR and POP) will predict organizational citizenship behaviors more strongly through the multiple mediation effect.

H9: PCR and POP multiply mediate the relationship between CRA and OCB.

Figure 3 shows the model developed based on conceptual discussion and theoretical foundations in accordance with the research objective.

Created based on Fombrun et al. 2015; Money et al. 2017; Rindova et al. 2005; Sweitzer and Volkwein 2009; Vidaver-Cohen 2007.

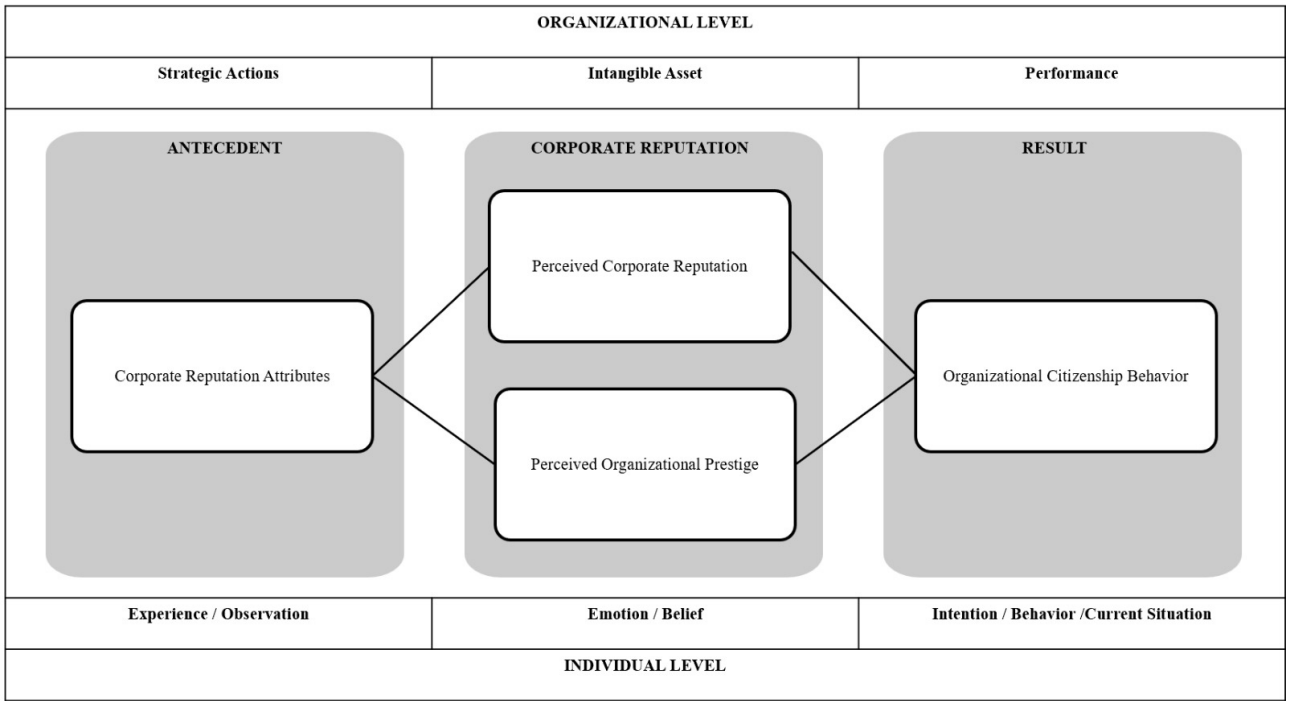

Figure 3: Research Model

RESEARCH METHODOLOGY

The research received ethical approval from the DEU Ethics Committee on August 7, 2022. This study used a quantitative research design focused on a causal approach. Data was collected using surveys and analyzed with SPSS Statistics 25 and AMOS Graphics software.

Data Collection and Instrumentation/Measures

The form link was sent to individuals who positively responded to the application invitation emailed to a selection of universities determined through a random sampling method. This selection targeted academics in state universities' Faculties of Economics, Administrative Sciences, and Business Administration[1]. Data was collected from 412 academics across 33 universities between March and June 2023. After eliminating incomplete and incorrect submissions, data from 370 valid forms were included in the analysis.

In this study, 53% of participants were male and 47% were female. The titles included 29.5% Professors, 21.1% Associate Professors, and 22.2% Dr. Faculty Members, among others. Most participants (49.7%) had over 16 years of work experience. Additionally, 17.6% had 11-15 years, 14.1% had 6-10 years, and the rest had 5 years or less. Regarding their time at the current university, 33.2% had been employed for over 16 years, 19.5% for 11-15 years, 18.9% for 6-10 years, and the remainder for 5 years or less. Most participants (49.7%) had more than 16 years of work experience. Additionally, 17.6% had 11-15 years, 14.1% had 6-10 years, and the rest had 5 years or less of experience. 33.2% of the faculty have been employed at their current university for more than 16 years. Additionally, 19.5% have worked there for between 11 and 15 years, while 18.9% have been there for between 6 and 10 years. The remaining faculty members have been with the university for 5 years or less.

The study utilized several measurement instruments to assess the variables. These included Mael and Ashforth's (1992) single-dimensional scale, an 8-item POP measurement tool, Ponzi et al.'s (2011) single-dimensional scale, a 4-item PCR-RepTrak Pulse measurement tool, a CRA measurement tool developed by the researcher, and Podsakoff et al.'s (1990) five-sub-dimensional scale, which consists of 24 items for measuring OCB. All measurement tools were structured in a 5-point Likert format.

The measurement tools were translated from the source language to the target language using a forward translation method by the researcher and two language experts: one native English speaker and one Turkish expert from the School of Foreign Languages. Three

[1] There are notable structural differences between state and foundation universities in Turkey. Therefore, this study focused exclusively on state universities. The study's population was restricted to academics actively working in the Faculties of Economics and Administrative Sciences and the Business Administration Faculties of state universities to ensure familiarity with corporate reputation and a strong understanding of relevant concepts.

Table 1: Validity and Reliability of Measurement Tools

Measurement Tool	Goodness of Fit Values	Validity Convergent/Discriminant	Reliability CA
CRA	CMIN=760.025 CMIN/df=3.220 RMSEA=.078 CFI=.95 GFI=.858	CR > AVE AVE > .5 Square roots of AVE > Inter-Factor Correlations AVE > MSV	.972 .894 .938 .910 .935
POP	CMIN=53.080 CMIN/df=2.949 RMSEA=.073 CFI=.981GFI=.965		.917
PCR	CMIN=3.012 CMIN/df=1.506 RMSEA=.037 CFI=.999 GFI=.996		.943
OCB	CMIN=2844.397 CMIN/df=2.935 RMSEA=.072 CFI=.900 GFI=.899		.806 .715 .807 .623 .817

faculty members from the Department of Management and Organization evaluated the translations' equivalence. After considering their feedback on the items' form and meaning, corrections were made, and two Turkish Language and Literature experts reviewed the final versions.

In the first-level multifactor model, CRA with 5 subscales of Working Environment and Governance (WEG), Social Awareness (SAW), Research and Education Capacity (REC), Innovation (INO), Social Networking and Recognition (SNR) and 24 items, single dimensional POP with 8 items, single dimensional PCR with one subscale and 4 items, OCB with 5 subscales of Altruism (ALT), Civic Virtue (CVC), Conscientiousness (CON), Sportsmanship (SPR), Courtesy (COU) and 19 items were verified. They have convergent and discriminant validity and reliability.

Table 1 shows that the values obtained from the analyses effectively represent the latent variables.

RESULTS AND DISCUSSION

Hypotheses Testing

The normality of the data collected in the study was assessed through descriptive statistics and normality assumption analyses. The skewness-kurtosis values ranged between ± 1.5, indicating a normal distribution, with arithmetic means close to each other and score distributions resembling a bell curve. Multicollinearity analysis revealed tolerance values below 1.00 and VIF values under 10, confirming the absence of multicollinearity (Field 2009; Tabachnick & Fidell, 2001). The descriptive statistics and correlation analysis results for all variables are provided in Table 2.

The mean values of the evaluations made for the corporate reputation attributes are, from the lowest to the highest, 2.86 for working environment and governance, 3.21 for social networking and recognition, 3.33 for innovation, 3.34 for research and education capacity, and 3.45 for social awareness. The mean values of the evaluations made for organizational citizenship behavior are, from the lowest to the highest, 3.92 for civic virtue, 4.08 for sportsmanship, 4.14 for conscientiousness, 4.50 for altruism, and 4.63 for courtesy with the highest value. The mean value of perceived corporate reputation is 3.35 and the mean value of perceived organizational prestige is 3.25.

There was a moderate correlation between CRA and POP (β=.63, p=.000), a strong correlation between CRA and PCR (β=.80, p=.000), a moderate correlation between PCR and POP (β=.56, p=.000), a weak correlation between CRA and OCB (β=.49, p=.000), a weak correlation between POP and OCB (β=.42, p=.000), and a weak correlation between PCR and OCB (β=.47, p=.000), and H3 was supported.

In the analyses reporting direct effects in Table 3, positive and significant effects of CRA on OCB (β=.49, p<0.001), PCR (β=.80, p<0.001) and POP (β=.64, p<0.001) were found, and H6, H1 and H2 were supported.

Table 2: Descriptive Statistics and Correlation Analysis Results for Main Variables

		Min.	Max.	Mean	Std. Dev.	CRA	POP	PCR	OCB
CRA	WEG	1.00	5.00	2.86	1.154	1			
	SAW	1.00	5.00	3.45	.991				
	REC	1.00	5.00	3.34	.954				
	INO	1.00	5.00	3.33	1.082				
	SNR	1.00	5.00	3.21	1.017				
POP		1.00	5.00	3.25	1.112	.635***	1		
PCR		1.00	5.00	3.35	1.044	.802***	.563***	1	
OCB	ALT	2.00	5.00	4.50	.617	.489***	.420***	.475***	1
	CVC	1.50	5.00	3.92	.729				
	CON	2.25	5.00	4.14	.652				
	SPR	1.50	5.00	4.08	.719				
	COU	3.33	5.00	4.63	.451				
***p<.000									

Table 3: Direct Effects Analysis

	β Effect	β Non-Std. Path Coefficient	SH
CRA OCB	**.49**	.166***	.030
R2		.236	
CRA PCR	**.80**	1.072***	.065
R2		.642	
CRA POP	**.64**	. 891***	0.70
R2		.404	
PCR OCB	**.47**	.118***	0.21
R2		.221	
POP OCB	**.41**	.100***	.019
R2		.171	

Positive and significant effects of PCR on OCB (β=.47, p<0.001) and POP on OCB (β=.41, p<0.001) were found, and H4 and H5 were supported.

The mediation test employed the bootstrap methodology, considered statistically robust (Efron & Tibshirani, 1993; Shrout & Bolger, 2002; Hayes, 2018; Zhao et al., 2010). In the structural equation modeling analysis, 5,000 bootstrap samples (n=370) were generated, along with a 95% confidence interval. The results, including the total, direct, and indirect effects, are presented in Table 4.

With the inclusion of PCR in the model for the effect of CRA on OCB, the effect of CRA on OCB decreased (β=.30, p<0.05) but did not lose its significance. The power of the partial mediation detected is high (Preacher & Kelly, 2011), indirect effects are significant [β=.186, p<0.05, 95%CI (BC: .030, .348)], and H7 is supported.

With the inclusion of POP in the model for the effect of CRA on OCB, the effect of CRA on OCB decreased (β=.37, p<0.05) but did not lose its significance. The power of the partial mediation detected is high (Preacher & Kelly, 2011), indirect effects are significant [β=.116, p<0.05, 95%CI (BC: .006, .082)], and H8 is supported.

In the effect of CRA on OCB shown in Figure 4, with the inclusion of PCR and POP in the model together (multiple

Table 4: Indirect Effects Analysis

	β Effect	β Non-Std. Path Coefficient	SH	Goodness of Fit Values
CRAPCR OCB	.301	.100**	.038	CMIN=120,097 CMIN/df=2,859 RMSEA=0.07 GFI=0.94 CFI=0.96
		.058*	.026	
R2	.257			
Total Effect	.49			
Direct Effect	.30			
Indirect Effect	.186* (p=.018) (BC:.030- .348)			
CRAPOP OCB	.372	.123***	.031	CMIN=151,096 CMIN/df=3,598 RMSEA=0.08 GFI= 0.93 CFI= 0.94
		.043*	.019	
R2	.258			
Total Effect	.49			
Direct Effect	.37			
Indirect Effect	.116* (p=.029) (BC:.014-.230)			
CRAPCR/POP OCB	.219	.071 (P=0,064)	.039	CMIN=155.646 CMIN/df=3.113 RMSEA=0.07 GFI= 0.93 CFI=0.95
		.051*	.026	
		.038*	.018	
R2	.274			
Total Effect	.49			
Direct Effect	.22			
Indirect Effect	.270** (P=.008) (BC:.068-.490)			
	*p<.05, **p<.001, ***p<.000			

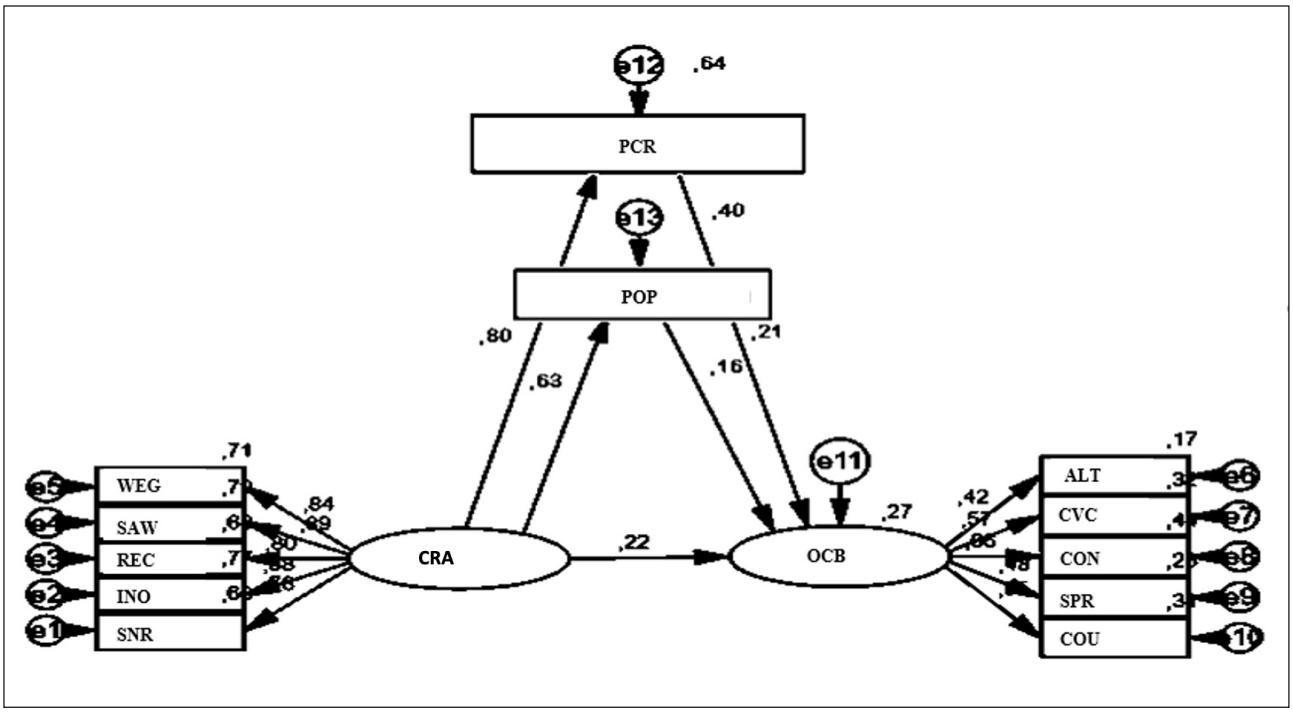

Figure 4: Mediating Effect of PCR and POP in the Effect of CRA on OCB

mediators), the effect of CRA on OCB decreased and lost its significance (β=.22, p=.064, p>.005). The power of the multiple full mediation detected is high (Preacher & Kelly, 2011), the indirect effects are significant [β=.270, p=0.008, 95%CI (.068-.490)], and H9 is supported.

DISCUSSION

CRA predicts both PCR and POP, consistent with studies indicating that CRA significantly influences individuals' perceptions of reputation and prestige (Fombrun et al., 2015; Ponzi et al., 2011; Sweitzer & Volkwein, 2009; Vidaver-Cohen, 2007). The positive correlation observed between PCR and POP, stemming from their shared antecedents and similar content structures, reinforces previous research findings (Sung & Yang, 2008; Sweitzer & Volkwein, 2009). The finding of the positive correlation between PCR and POP, which were considered together due to the existence of common antecedents and similar structures in terms of content (Sung & Yang, 2008; Sweitzer & Volkwein, 2009), is consistent with the literature.

The findings validated the (partial) mediating roles of PCR and POP in the relationship between CRA and OCB. Literature indicates that perceptions derive from thoughts, which subsequently affect behaviors (Dolphin, 2004; D'Souza et al., 2013; Fombrun & Rindova, 1996; Money et al., 2017; Newburry et al., 2014; Vidaver-Cohen & Brønn, 2013). This study analyzes the effect of CRA on OCB through a parallel mediation model involving PCR and POP. The finding that perceptions of reputation and prestige serve as partial mediators when considered separately but function as full mediators when evaluated together underscores the necessity of assessing both variables in an integrated manner (Kang & Bartlett, 2013) to fully comprehend their impacts. One key contribution of this study is exploring this multiple moderation effect.

The finding that PCR and POP predict OCB aligns with the literature. Research has shown that employees who perceive a strong reputation for their organization tend to exhibit higher OCB (Carmeli, 2005; Fu et al., 2014; Helm, 2011; Mehtap & Kökalan, 2013). Studies (Boğan & Dedeoğlu, 2020; Carmeli, 2005; Schaarschmidt et al., 2015; Schaarschmidt & Könsgen, 2020) have also highlighted that high POP reinforces OCB.

CONCLUSION and IMPLICATIONS

Effectively managed and strengthened PCR positively affects many outcome variables and increases corporate performance. Due to the competitive advantages it creates, there is an increasing focus on strategies to enhance reputation in the business world.

Alongside these developments, academic interest in the field across various disciplines is also growing. Publications on measuring and enhancing reputation are increasing, and the models developed are being applied in practice.

Universities have also focused more visibly on reputation management throughout their historical development processes.

Rankings that prioritize quantitative and qualitative reputation subscales have strengthened the competitive environment in higher education. However, rankings are being questioned regarding their methodology. Universities can improve their reputation management by developing strategies beyond the scope of rankings.

The first step in strengthening reputation is to determine the current situation. Reputation measurement in the field of higher education is problematic in various ways. The literature discusses the failure of the measurement tools used to distinguish the antecedents and consequences of reputation and the claim of universality as the main problems.

In the Turkish Higher Education System, universities have long monitored their rankings and carried out studies to improve their reputation. This study aims to raise awareness and motivate universities to undertake special efforts and projects that highlight their unique attributes.

Each stakeholder's perception of corporate reputation varies due to his/her unique expectations and experiences. In this context, determining the priority stakeholders, revealing the antecedents of reputation for the determined stakeholder group, and then questioning the target stakeholder's perceptions of their experiences with appropriate tools will create an appropriate framework for reputation management.

The important roles that internal stakeholders play in building and strengthening reputation are effective in evaluating them as key stakeholders in terms of corporate reputation management. For the same reason, in the present study, we focused on how academics' reputation perceptions are shaped.

According to the holistic research model that tests PCR and POP with their antecedents and consequences, which examines the influence of CRA on OCB by using a parallel mediation mechanism of PCR and POP, PCR and POP were (partial) mediators in the effect of CRA on OCB, and multiple (full) mediating effects of PCR and POP were revealed.

The CRA measurement tool has been developed to be culturally and contextually sensitive, effectively distinguishing between perceptions of reputation and their underlying factors. This tool is expected to be a

valuable method for assessing the status and standing of universities. When building a reputation, CRA can be metaphorically like 'blood tests' used in medical diagnosis processes to determine the roadmap (treatment) by making the necessary determinations in planning priorities, strategies, and actions.

Improving the perceived reputation and rankings of universities can be achieved through several key enhancements. These include increasing the quality of education and research, producing competent graduates, and enhancing the working environment and governance to meet stakeholder expectations. Additionally, strengthening visible social contributions and fostering innovative practices can also contribute significantly to improving a university's reputation.

One of the research calls in the literature is to test PCR antecedents and results using holistic models. The study questions the comprehensive relationships between PCRs and POPs of employees, who are key stakeholders in the cyclical relationship of reputation, and OCB, one of the behavioral results strengthened by these perceptions, also responds to the calls in question.

The present study is expected to contribute to the field by testing the joint effect of PCR and POP, which are addressed together in the literature but are discussed to a limited extent in terms of their multiple effects on the outcome. This study contributes to the existing literature by examining the multiplicity effect.

Further studies should concentrate on developing measurement tools for the two additional factors that influence academics' perceptions of reputation (perceptions regarding the relationship developed with the institution and third-party opinions about the institution). Future research should focus on testing the CRA on samples representing academics from various fields of expertise. Additionally, a similar systematic approach should be applied to internal and external stakeholders beyond academics to clearly define the key attributes of reputation for each stakeholder group.

These suggestions will address existing gaps in the literature, elucidate the essential dimensions involved in the development of reputation in practice, evaluate the comprehensive perceptions of institutional reputation, and delineate actionable steps supported by effective strategies.

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The Impact of Tax Revenues and Revaluation Rates on Poverty in Türkiye: Artificial Neural Network Approach

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ABSTRACT

The main objective of this study is to analyze the relationship between poverty, total tax revenues and revaluation rates, which indicate the increase rates of some fixed taxes each year and to test the effect of total tax revenues and revaluation rates on poverty between 1991 and 2021 in Türkiye. In this framework, income poverty data calculated by us based on per capita income data using the Hodrick-Presscot filter is used in this study. The relationship between the variables are tested with the artificial neural network method, which is used to obtain more realistic and resistant results, unlike the time series models used in the economic literature recently. Therefore, according to the weight values obtained from the output data in the 4-layer and 7-neuron artificial neural network model, it is concluded that a 1% increase in total tax revenues increases income poverty by 1.20% and a 1% increase in revaluation rates increases income poverty by 0.61%.

Keywords: Poverty, Tax Revenues, Revaluation Rate, Income Poverty, Artificial Neural Networks.

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INTRODUCTION

Tax revenues are the most important resources used by the state to finance public expenditures. Taxes can be used for many fiscal or non-fiscal purposes. First of all, taxes have the important function of financing public expenditures. In addition, taxes also have economic and social functions. Taxes can be used as a tool to achieve many objectives such as ensuring economic growth and economic stability, combating unemployment and inflation, ensuring fairness in income distribution (Yılmaz & Batı, 2023), and directing consumer behavior. In this respect, tax policies may directly or indirectly affect social, economic and demographic factors. The composition of taxes is also of great importance in this effect. The composition of direct and indirect taxes is still important today. Atkinson and Stiglitz (1976) were the first to address the interaction of direct and indirect taxes in achieving efficiency and equity objectives. According to Atkinson and Stiglitz, under certain assumptions, an optimal tax system for public sector financing or redistribution should be based solely on direct taxation and not on indirect taxes. From an economic growth perspective, the neoclassical framework suggests that tax composition does not have a permanent effect on the growth rate, while endogenous growth models suggest that stable tax structures can affect the growth rate. In this context, it is understood that tax composition and structure affect issues such as economic growth, economic stability and income inequality (Martinez-Vazquez et al., 2011).

In this framework, the relationship between taxes and poverty cannot be ignored in light of their effects on income distribution. In the most general definition, poverty is defined as the inability of individuals in a society to reach the level of income or consumption that can provide minimum living standards. In this framework, individuals who cannot have a decent and socially acceptable standard of living are considered to be in poverty. Individuals in poverty may experience unemployment, low income, housing problems, inadequate health care and many other social and cultural disadvantages (European Union, 2004). In this context, it can be said that poverty encompasses not only low income and consumption but also low achievement in education, health, nutrition and other areas of human development (World Bank, 2014). This broad meaning

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of poverty shows that poverty alleviation cannot be achieved only through economic policies and requires comprehensive and well-coordinated policy measures. In this context, taxes, one of the fiscal policy instruments, can be considered to have a significant impact on poverty (Ames et al., 2001).

There is a complex, multifaceted relationship between tax and poverty. The impact of tax policy on poverty in a country varies according to the economic, social and political conditions of the country. Firstly, tax policies implemented by governments may have effects on poverty. Low tax rates or tax rebate policies for low-income individuals and families may be effective in reducing poverty. In addition, direct taxes are subjective and taxation is made by taking into account the personal situation of taxpayers. Therefore, focusing tax policies on direct taxes may have positive effects on poverty. However, indirect taxes, which constitute a large portion of tax revenues in many countries, lead to an increase in poverty increasing the price of goods and services consumed by poor households (Anderson et al., 2018).

In addition, it is important to explain the revaluation rates used in this study which are different from the practices in other countries, for a better understanding of the analysis. The revaluation rate is a rate that shows how much the fixed amounts in the tax laws are increased in the next calendar year in Türkiye. With the revaluation rate, the fixed amounts in the tax laws are updated every year and the erosion of tax revenues is prevented against inflation. The decrease in the real value of money, especially in periods of high inflation, makes it necessary to update the amounts of taxes, fees and fines. The revaluation rate is the average price increase rate in the general index of domestic producer prices (PPI) in October of each year compared to the same period of the previous year (Tax Procesure Law (No. 213), repeated Article 298/B). The revaluation rate is published in October each year and applied for the following year. Fixed property tax, special communication tax, motor vehicles tax, stamp tax amounts are increased every year by the revaluation rate. In addition, fees paid for the use of various government services (such as passport and license fees) are also increased every year by the revaluation rate. The tax brackets in the tax laws and the amounts such as tax exemptions and tax penalties are also increased every year by the revaluation rate. In this respect, the revaluation rate directly affects how much revenue the state will receive from taxes, which is one of the most important sources of revenue for the state.

In this framework, this study aims to analyze the taxes that affect household poverty in Türkiye and the impact of revaluation rates, which cause an increase in certain taxes at certain rates each year, on poverty. The tax data used in the analysis refers to the total tax revenues collected by the public authority. In the analysis, the revaluation rate is included in the analysis as a separate data. Therefore, the effect of both total tax revenues and revaluation rates on poverty can be observed separately. The main point of the study is to emphasize the effect of revaluation rates on poverty. However, total tax revenues are included in the analysis as a variable that causes poverty and contributes to more consistent results.

LITERATURE

The relationship between tax and poverty is the subject of many studies in the literature. Friedman (1962) defended the negative income tax as a way to reduce poverty. Angyridis and Thompson (2016) analysed the effects of negative income tax on inequality and poverty using the neoclassical growth model with heterogeneous agents and found that increasing the demogrant-to-output ratio leads to a significant reduction in both absolute and relative poverty. Gallaway (1966), on the other hand, was sceptical that a negative income tax would contribute to improving the income situation of very low income earners and stated that it was not clear that it would contribute to increasing income (Gallaway, 1966).

Another area of research on tax and poverty is the effects of changes in tax systems and taxation preferences on poverty. Kamin (2013) found that changes in the tax system affect poverty more than inequality. Besley and Kanbur (1988) analysed commodity tax/subsidy rules for poverty reduction in the absence of income tax. Tanzi and Zee (2001) and Keen and Simone (2004) analysed the optimal tax structure that minimises poverty and generates high tax revenues in various developing countries. Schechtl (2022) analysed the relationship between consumption taxes and disposable income poverty and consumption tax-induced poverty across household types in 11 OECD countries and found that the increase in poverty due to indirect tax payment varies significantly across countries and household types, with higher increases in poverty rates for extended families and single parents in most countries. Pirttilä and Tuomala (2004) showed that relatively low commodity tax rates should be imposed on goods included in the poverty measure. Leventi *et al.* (2018) examined how income poverty is affected by changes in tax-benefit policies and which policies are cost-effective in reducing poverty or limiting its increase in 7 EU countries.

Adukonu and Ofori-Abebrese (2016) revealed that the increase in indirect tax policies increases poverty in Ghana (1984-2013), while the increase in direct tax policies has a mitigating effect on poverty in the long run and a reducing effect in the short run. Ramirez *et al.* (2017) found that taxes increased by local governments in Colombia increase poverty more and that policies implemented in different ways regionally are more effective in reducing poverty. Lustig *et al.* (2013) analyse the effect of social expenditures, subsidies and taxes on poverty reduction in Latin American countries. The study revealed that direct taxes reduce poverty less in Bolivia, Mexico and Peru than in Argentina, Brazil and Uruguay.

In addition to the relationship between taxation and poverty, many studies have also been conducted on the relationship between taxation and income distribution. As a matter of fact, the imbalance in income distribution significantly affects the level of poverty, and reducing the inequality in income distribution allows for a reduction in poverty. Therefore, studies examining the relationship between taxation and income distribution can be instructive in analyzing the relationship between taxation and poverty. In this context, Balseven and Tugcu (2017) analyzed the impact of fiscal policy on income distribution in 30 developed and 17 developing countries for the period 1990-2014 using panel data estimation techniques and concluded that tax revenues positively affect income inequality in developing countries. Martorano (2018) concluded that direct taxes reduce inequality in a panel data analysis of 18 Latin American countries for the period 1990-2015. Kanca and Bayrak (2019) analyzed the impact of direct and indirect taxes on income distribution using panel data analysis using 1990-2017 data of 36 OECD countries and concluded that direct and indirect taxes have a negative impact on income distribution. Contrary to the findings of Obaretin *et al.* (2017) that the effects of direct-indirect taxes on income distribution in Nigeria are insignificant with data for the period 1981-2014; Oboh and Eromonsele (2018) concluded that indirect taxes have a negative impact on income inequality in their analysis using time series data for the period 1980-2014 in Nigeria. Eydam and Qualo (2023) analyzed the relationship between income inequality and personal income tax for 61 selected countries for the period 1981-2005 using multivariate regression analysis and concluded that there is a negative relationship between progressivity of income tax and income inequality.

The studies on the relationship between taxation and poverty in Türkiye are mostly focused on analyzing the issue from a theoretical perspective. In these studies, theoretical evaluations are made on how tax policies are used to reduce poverty, how the indirect-direct tax structure affects poverty, and tax policy recommendations are made (Aydın & Türgay, 2011; Didinmez, 2021). Empirical studies are mostly on the relationship between income distribution and taxation. In their studies covering different periods, Albayrak (2010) and Akkoç *et al.* (2024) concluded that indirect taxes increase income inequality in Türkiye. Demirgil (2018) analyzed the relationship between indirect and direct taxes and the gini coefficient in Türkiye between 1980-2014 using the ARDL bounds test approach and concluded that increases in indirect taxes increase the gini coefficient and increases in direct taxes decrease the gini coefficient. Similarly, Günel (2019) analyzed the relationship between direct-indirect taxes and gini coefficient in Türkiye between 1987 and 2016 using Johansen cointegration test and concluded that increases in indirect taxes negatively affect income distribution, while increases in direct taxes improve income distribution. Hayrullahoğlu and Tüzün (2020) analyzed the relationship between tax revenues and income distribution between Türkiye and selected OECD countries between 2002-2019 using Panel ARDL model and concluded that an increase in total tax revenues reduces income inequality. Eser and Genç (2020) analyzed the relationship between income and wealth taxes and income distribution in OECD countries between 1997-2017 using panel regression method and concluded that income and wealth taxes have a corrective effect on income distribution. Kılınç Savrul and Taşkın (2020) analyzed the effect of tax structure on income distribution using the Kernel Regression Method using data for the period 2016-2018 and concluded that indirect taxes have a negative effect on income distribution fairness, while direct taxes have a positive effect. In addition to all these, Gemicioğlu *et al.* (2024), in their study based on data from 2003-2019, found that changes in indirect taxes worsen the distribution of real consumption in Türkiye. Thus, income inequality becomes more pronounced.

Studies on the revaluation rate consist of theoretical explanations on the definition, calculation and application of the revaluation rate and there are no empirical studies. We believe that this study will contribute to the literature since the relationship between taxation and poverty in Türkiye has mostly been addressed from a theoretical perspective, empirical studies have focused on taxation and income distribution, and the revaluation rate has not been used before in the relationship between taxation and poverty.

DATA SET AND MODEL

In this study, the effect of tax revenues and revaluation rates on income poverty in Türkiye between 1991-2021 is analysed using artificial neural networks regression method. The reason for using artificial neural network regression in the analyses is that this method can model complex relationships between variables, produce stable results in the presence of problems such as normal distribution, changing variance and autocorrelation in the series, and learn by taking into account the trend seasonality features in the series.

The total tax revenues used in the study are obtained from the World Development Indicator database and the revaluation rate data are obtained from the Ministry of Treasury and Finance database. The income gap ratio data, which expresses income poverty, is calculated by us based on per capita income data. Per capita income data is obtained from the World Development Indicator database. The equation used in the calculation of the income gap is as follows:

$$igap = \frac{pci_t - pci_t^*}{pci_t} \quad (1)$$

The potential per capita income data used in the calculation is obtained by utilising the Hodrick-Prescott filter. The course of the potential per capita income obtained from the Hodrick-Prescott filter is presented in the graph.

The $pci_t - pci_t^*$ in Equation 1 refers to the per capita income gap. The obtained income gap ratio represents the dependent variable in the study. The independent variables used in the study are tax revenues and revaluation rate. The linear model established in this framework is as follows:

$$igap = \beta_0 + \beta_1 tax + \beta_2 rr + \varepsilon_i \quad (2)$$

In the equations, *pci* is defined as per capita income, *igap* as income gap ratio, *tax* as total tax revenues and *rr* as revaluation rate. The artificial neural network model used in the analysis is explained below.

ARTIFICIAL NEURAL NETWORK

Artificial Neural Networks (ANN) are defined as a machine learning model, which is expressed as a mathematical model and computational structure inspired by human biological nerve cells (neurons). The main purpose of ANN is to learn the complex relationships in the data and to predict or classify the data obtained as a result of learning. ANN is frequently preferred in analysing economic data since it has a comprehensive function structure. Since ANN models are less sensitive to the assumptions made about the error term, they can produce better results in analyses with complex and higher data volume. In addition, since ANN models complete the weighting and learning processes based on the characteristics of the input data, there is

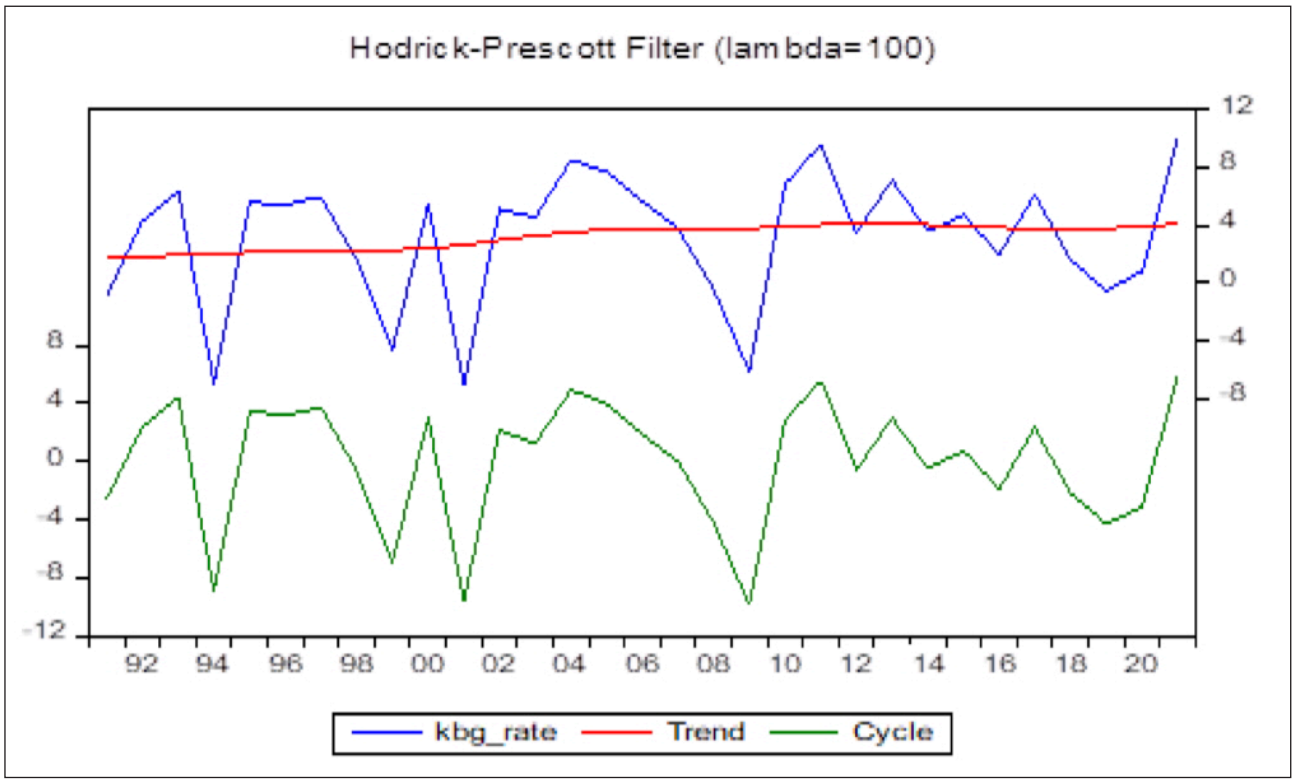

Figure 1: Hodrict-Presscott Filter Graphics

no need to define a specific model structure in these analyses. There is no need for a theoretical background in analysing economic data. Therefore, tests such as stationarity, seasonality and autocorrelation, which are used as a priori tests in macroeconomic time series, are naturally taken into account in ANN models (Chuku et al., 2019). It is suggested that a network structure designed in this way forms are the basis of deep learning models (deep neural networks) and enables great success in many application areas.

ANN structure is generally organised in layers. In ANN model, the first layer is the input layer and the last layer is the output layer. The layers in between are called hidden layers. The input layer consists of data provided from external sources loaded into the network structure. The first step of the artificial neural network model is realised by loading the data to the input layer. Data transfer from the input layer to the hidden layers is provided through artificial neurons by calculating certain weight coefficients. With the transfer of the data to the hidden layers, network training takes place. As the network is trained, data and weight values vary. This process is called the learning process in the artificial neural network model.

As a result of the completion of the learning process in the hidden layer, the data in the hidden layer are transferred to the output layer via neurons. ANN tries to improve the learning process by utilising the back propagation effect in each learning process. Thanks to this process, the data used in the input layer are learnt in the hidden layers with the back propagation effect and optimum results are obtained in the output layer (Chiang &Urban, 1995). In other words, this process continues until the data coming to the output layer generates its own activation function (Chuku et al., 2019). In this way, it is aimed to minimise the errors due to the back propagation effect between layers (Chiang & Urban, 1995).

ANN consists of simple computational units called artificial neurons or perceptrons. Each artificial neuron in the network structure multiplies the defined inputs by certain weights and transfers the multiplied input and weight values to an activation function. The weight values in the network structure represent the learning and adaptation of the model. Here, each input is multiplied by a weight value and the activation function is obtained by summing them in the neuron. From this activation function, the process of obtaining output is realised. In other words, the activation function shows the output level obtained from the neuron. The relationship between inputs *(*and output *()* in artificial neural networks is generally shown as follows:

$$y_t = w_0 + \sum_{j=1}^{q} w_{j.S}(w_{0J} \sum_{i=1}^{P} \Omega_{ij} x_{t-i}) + \varepsilon_t \quad (3)$$

The values $w_j, J = 0,1,\ldots,q; \Omega_{ij}, j = 0,1,\ldots,q;$ i=0, 1,…,p in the equation represent the weight parameters between the links in the model. The parameter w_j represents the weight values from the hidden layer to the output layer. Ω_{ij} parameter represents the weight values between the input layer and hidden layers. The p value in the equation indicates the number of input neurons. The *q* value in the equation is considered as the number of units in the hidden layer. In the equation, *S* represents the activation function and ε_t represents the error term. The activation function in the model is used to define the non-linear relationship between inputs and output in the network (Chuku et al., 2019). Based on this representation of artificial neural networks, the algebraic form of the artificial neural network regression used in the model established in the analyses is as follows:

$$f^{ANN}(w^0, w^1, x_i) = \sum_h w_h^1 (1 + exp(-\sum_j w_{jh}^0 X_{ij}))^{-1} = \sum_h w_h^1 \varphi(\sum_j w_{jh}^0 X_{ij}) \quad (4)$$

φ in the equation denotes the sigmoid function. The parameters w_h^1 *and* w_{jh}^0 are called weight coefficients. Weight coefficients express how much weight one neuron imposes on the next neuron. The full regression function obtained from the artificial neural network is as follows:

$$y_i = \sum_h w_h^1 \varphi\left(\sum_j w_{jh}^0 X_{ij}\right) + y_i \quad (5)$$

Here, the value of the output neuron is obtained from a certain combination of hidden neurons. At the same time, lagged values of the dependent variable are also included in the input layer. Therefore, including the lagged value of the dependent variable in the input layer allows the linear relationship to be obtained directly (Jahn, 2020).

ARTIFICIAL NEURAL NETWORK APPLICATION RESULTS

In this study analyzing the impact of tax revaluation rates and total tax revenues on income poverty, artificial neural network regression based on the linear artificial neural network model has been used. In the artificial neural network model, the regression algorithm works in a different structure than the classification algorithm. ANN regression is basically considered as a function of the explanatory variables in linear regression. ANN regression and traditional regression approaches are considered to be similar and there are no specific and different structures between them (Jahn, 2020). In this

framework, the linear model code in which artificial neural network regression is analyzed is as follows:

{ANN <- neuralnet(ann_formul, data = training,
hidden = c(7,7,2), err.fct = "sse", threshold = 0.05, linear.output = TRUE)} (6)
{plot(ANN)}

The coding of the neural network regression in the equation shows that the variables are tested according to the 5% threshold value and the model is tested in linear form different from the classification algorithm. The artificial neural network model with 4 layers and 7 neurons and the network structure are shown in the Figure 2.

value is 3.70 and the mean absolute error (MAE) value is 3.02. In the forecasting stage, RMSE is 1.17 and MAE is 0.88. Therefore, the decrease in the error squares shows that the model produces stable and accurate results. At the same time, it is seen that the R-Square value obtained from the model has also increased. This shows that the explanatory variables in the model are increased the explanatory power of the dependent variable. In addition, the evaluation criteria of Lewis regarding test and prediction errors are important. Accordingly, if the RMSE is <10%, these models are called very good models, models between 10% and 20% are called good models, and models between 20% and 50% are called acceptable models. According to Lewis' evaluation criteria, it is

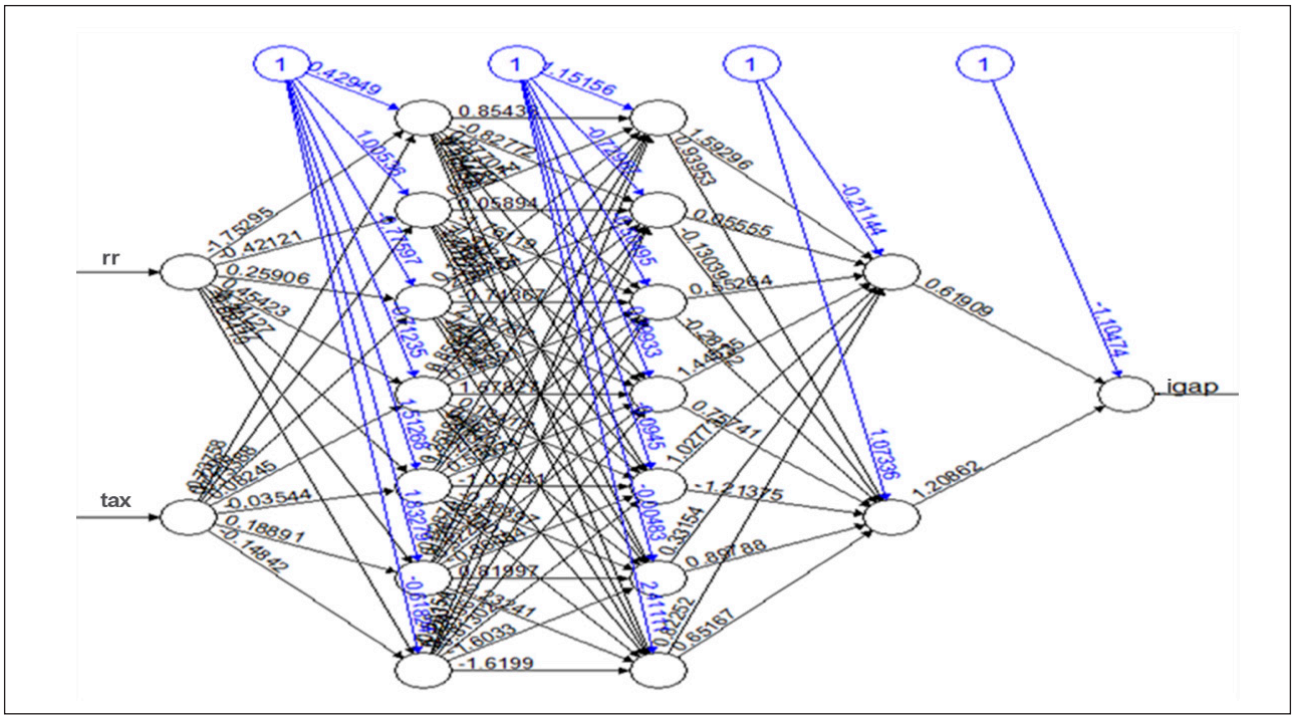

Figure 2: Artificial neural network structure obtained from analyses

According to the weight values obtained from the output data in the artificial neural network model with 4 layers and 7 neurons, 1% increase in total tax revenues increases income poverty by 1.20% and 1% increase in revaluation rates increases income poverty by 0.61%. These results obtained from the artificial neural network model were calculated based on the test and prediction error values. Accordingly, by comparing these results with the results obtained from the error squares, inferences can be made about the reliability of the model. Test and prediction error values is given below in Table 1.

It is observed that the test and prediction error values decreased in the ANN model. Accordingly, in the test error model, the root mean square error squared (RMSE) observed that the established model is a "very good" model, that is, a stable model.

It is clear from the test and prediction error data in Table 1 that the ANN model, which is a learning algorithm, minimizes the error squares. Accordingly, the minimization of errors suggested in basic statistical models is also obtained concretely from the ANN model. Therefore, the ANN model differs from the classical basic econometric and statistical models in terms of producing more stable and consistent coefficients by further minimizing errors and is considered as a better model.

Table 1. Test and Prediction Error Values Obtained from ANN Model

Model	RMSE	Rsquared	MAE
Test Error	3.706728	0.182419	3.027292
Prediction Error	1.1712651	0.9521816	0.8857793

CONCLUSION

According to the weight values obtained from the output data in the 4 layers and 7 neurons ANN model established in this study, which analyses the effect of revaluation rates and total tax revenues on income poverty in Türkiye, 1% increase in total tax revenues increases income poverty by 1.20% and 1% increase in revaluation rates increases income poverty by 0.61%. According to the artificial neural network results obtained from the study, tax revaluation rates and total tax revenues affect income poverty. In particular, the fact that the increase in total tax revenues increases income poverty and supports tax revaluation rates is important in terms of revealing the reliability of the study results. From this point of view, reassessment of tax policies may be important in terms of policy success in order to prevent income poverty in Türkiye and to ensure more effective results of anti-poverty policies. In this framework, an analysis of the structure of total tax revenues in Türkiye reveals that the share of indirect taxes in tax revenues is high. Therefore, collecting a single type of tax by ignoring the income of individuals may cause the tax burden to be felt more severely on the poor. This may result in further impoverishment of individuals or households with low incomes. Likewise, the application of revaluation rates in the form of indirect taxes regardless of income status is important as a reason that increases income poverty as in total tax revenues.

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Solving Queue Problems in a Campus Dining Service with Discrete Event Simulation

Furkan Onur USLUER[1]

ABSTRACT

Waiting in long queues is a common experience. Prolonged waiting times inevitably result in the formation of queues. While queues are a natural part of service systems, excessive waiting times can reduce customer satisfaction. Campus dining service (CDS) facilities are particularly susceptible to queuing issues when their capacity is insufficient. Long wait times can negatively affect customer experience, making effective queue management essential. To enhance operational efficiency and improve the dining experience, appropriate measures should be implemented to reduce congestion. In this research, a discrete event simulation model of a CDS was developed and analyzed. The study aims to devise low-cost solutions for queue problems through scenario-based analysis. Hypotheses were derived from existing literature and adapted to the specific characteristics of the system under study. Various scenarios were tested to assess the effectiveness of different queue management strategies. The results indicate that capacity reallocation strategies are the most effective in mitigating long queues and improving overall system performance. The findings provide practical recommendations for optimizing CDS operations, offering insights that can be applied to similar service environments facing queuing challenges.

Keywords: Discrete Event Simulation, Campus Dining Service, Operations Research, Queue Management, Capacity Reallocation.

JEL Classification Codes: C15, C44, C61

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INTRODUCTION

Queues are a common part of daily life, yet they often cause frustration and dissatisfaction. In some cases, customers may even abandon the queue and seek service elsewhere. Prolonged waiting can lead to anxiety (Osuna, 1985). Queue systems have a significant impact on customer satisfaction (Firmansyah & Saputra, 2021). These factors highlight the importance of minimizing waiting times. While queues may be unavoidable in resource-limited and time-intensive services, analyzing them and implementing strategic solutions is essential for both operational efficiency and customer satisfaction.

University student enrollments in Turkey have increased in recent years (Habibi, 2017). This rise has exacerbated capacity constraints in campus facilities, including dining services. Student satisfaction with campus dining services (CDS) plays a crucial role in their overall university experience (Wooten et al., 2018). To accommodate growing demand and reduce long queues, CDS must implement strategies that enhance efficiency and service quality.

Campus Dining Services (CDSs) are common on university campuses worldwide, regardless of whether they are publicly or privately operated. These services play a vital role in meeting students' nutritional needs while operating within budgetary constraints, typically on a cost-recovery basis with affordable pricing. Studies have shown that factors such as food quality, service quality, value for money, and ambiance significantly influence students' satisfaction with on-campus dining services, which in turn affects their dining frequency (Smith et al., 2020). Balancing service quality and cost efficiency presents a significant challenge for CDSs, particularly as demand continues to grow. Therefore, understanding and optimizing queue management in these facilities is essential to improving student satisfaction.

Personnel are a crucial component of the CDS system, including cooks who prepare meals, staff who oversee payments, assist with electronic card issues, and ensure smooth daily operations. Effectively utilizing personnel within the broader system is key to achieving both operational efficiency and service quality.

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Long queues at CDSs directly influence students' overall satisfaction with their university experience. Several studies propose various approaches to addressing long queue problems in CDSs (Ning et al., 2023). Given that students expect a certain level of service, effective management of CDSs is critical in shaping their overall experience.

Many CDSs charge students a reasonable fee and serve as affordable dining options. A primary objective of these services is to offer affordable meals to students. However, excessively long queues may discourage students from using these services, thus hindering their effectiveness.

To enhance student satisfaction, achieve the goals of CDSs, and ensure effective service delivery, it is crucial to conduct a thorough analysis of potential queues and implement strategic decisions based on the findings.

Facilities facing similar problems may not always employ analytical methods for problem-solving, often relying on managerial intuition instead. However, existing literature challenges this approach, emphasizing analytical techniques while largely disregarding or excluding intuitive methods. This study seeks to bridge the gap between these perspectives by exploring how scientific approaches can be integrated without completely rejecting intuition. In doing so, this research contributes to the literature by proposing a methodological approach for addressing similar challenges in service facilities.

This study examines queue problems caused by capacity constraints and high demand in a campus dining service (CDS) operating in Turkey. The sources and locations of queues were analyzed, and potential low-cost solutions were explored. A discrete event simulation model of the CDS was developed using JaamSim version 2023-02. Findings were derived from scenario-based analysis.

LITERATURE REVIEW

Simulation studies on CDSs vary in scope, problem-solving methods, and analysis techniques. This section systematically examines and presents these differences.

Kambli et al. (2020) developed a discrete event simulation model of a CDS. They emphasize that effective resource management is crucial due to high labor costs in developed countries. Their study applied the DMAIC (Define, Measure, Analyze, Improve, and Control) methodology and proposed recommendations to enhance service efficiency. Additionally, they introduced resource reallocation strategies to optimize operations.

Resource allocation solutions have gained increasing attention in the literature. Ghaleb et al. (2015) developed a CDS simulation model using Arena. Their study analyzed queues using scenario-based methods, measuring average waiting times and providing recommendations for future research.

The impact of class scheduling on queues in CDSs and other student dining environments is a significant topic in the literature. Studies on class scheduling yield varying and sometimes contrasting results. Ivan (2021) exemplifies this research, analyzing the efficiency of a college dining hall using a discrete event simulation model. The study utilized Simio simulation software and identified a correlation between class schedules and peak hours, providing recommendations based on this finding. Research analyzing balanced student arrival scenarios falls within this category. Aslan and Özderir (2021) emphasize that addressing queue problems requires systematic improvements in the CDS system.

Some studies employ measurement methods beyond total average waiting time. Sensitivity analysis is commonly used as a measurement tool. Lillo et al. (2022) exemplifies this approach, modeling a campus dining hall using a discrete event simulation. The researchers analyzed the dining hall's capacity and concluded that it sufficiently meets demand. Additionally, they found that waiting in queues induces anxiety.

CDSs are sometimes explored as project topics. For example, Curin et al. (2005) developed a campus cafeteria simulation model as part of an engineering project. Their study focused on resource utilization and employed a scenario-based analysis.

METHODOLOGY

Discrete Event Simulation

Simulation provides a representation of a system based on defined analytical rules. This method can reveal new ways to improve a system by uncovering hidden features not easily observed by other investigative methods. Simulation is widely used to redesign processes across various fields, including manufacturing, defense, healthcare, and management (Pidd, 2004).

Discrete models form the foundation of discrete event simulation. These models primarily focus on examining waiting times and queue lengths (Taha, 2018). The discrete nature of the method arises from the simulation's time progression, where time moves from one event to the next (Raczynski, 2022). An 'event' serves as the main

component of a discrete event simulation model, with the sequence of events being a critical element in its operation. Entities in a discrete event simulation model resemble materials moving along a production line, progressing sequentially from one event to the next until they reach the final stage, akin to becoming the finished product. At each event, they spend a specified amount of time, based on the parameters defined by the researcher. Data from each event are recorded and analyzed.

In this research, the discrete event simulation method was used as a modeling approach.

Software

The simulation model was developed using JaamSim, an open-source discrete event simulation software (Harrison et al., 2016; King & Harrison, 2013). The software version used in this study is 2023-02 (64-bit). (Lang et al., 2021) compared open-source and commercial simulation software, highlighting JaamSim as a viable alternative to commercial options. JaamSim provides a user-friendly interface and 3D modeling capabilities, enabling the efficient creation of complex models. Its open-source nature offers users greater control over the software, making it a flexible and powerful tool for this kind of study.

Hypotheses

The goal of this study is to identify low-cost solutions for queue problems through scenario-based analysis. Hypotheses are formulated based on existing literature and tailored to the specific systems targeted for improvement.

H_1: Capacity reallocation solutions are effective in reducing queue problems in a CDS.

H_2: Class scheduling solutions are effective in reducing queue problems in a CDS.

H_3: Combining capacity reallocation solutions can decrease the effectiveness of a solution in a CDS.

System Description

The system investigated in this study is a campus dining service (CDS) facility. Approximately 3,000 to 3,500 students use this facility between 11:00 AM and 2:00 PM on working days. Students are required to use their student cards to access the service. If a student's card balance is insufficient, funds can be added through card machines located at the facility entrance. Four card machines are available within the facility, with additional machines located around the campus. Despite this, many students arrive at the facility without sufficient funds on their cards. To reduce queue times, the administration installed four card machines at the facility. Approximately 80 percent of students use these machines before lunch to top up their cards.

The CDS facility is a two-story building. Students with sufficient balance on their cards can join the lunch queues on either floor. A majority of students prefer to have lunch on the first floor, with approximately 60 percent choosing this floor, while 40 percent opt for the second floor.

Students must use a card reader machine with their student cards to select where to have lunch. When a card is processed by the reader, it releases a barrier, allowing one student to pass through. To ensure proper use of the cards, a worker is stationed at each card reader. In total, two workers are assigned to this task.

After the card reading process, students collect their trays and join the lunch queue. Cooks provide the daily menu to students, with one cook required to be available for each student. The facility employs a total of 12 cooks.

After receiving the menu, students move to the dining area, where they sit on a chair to have lunch. The facility

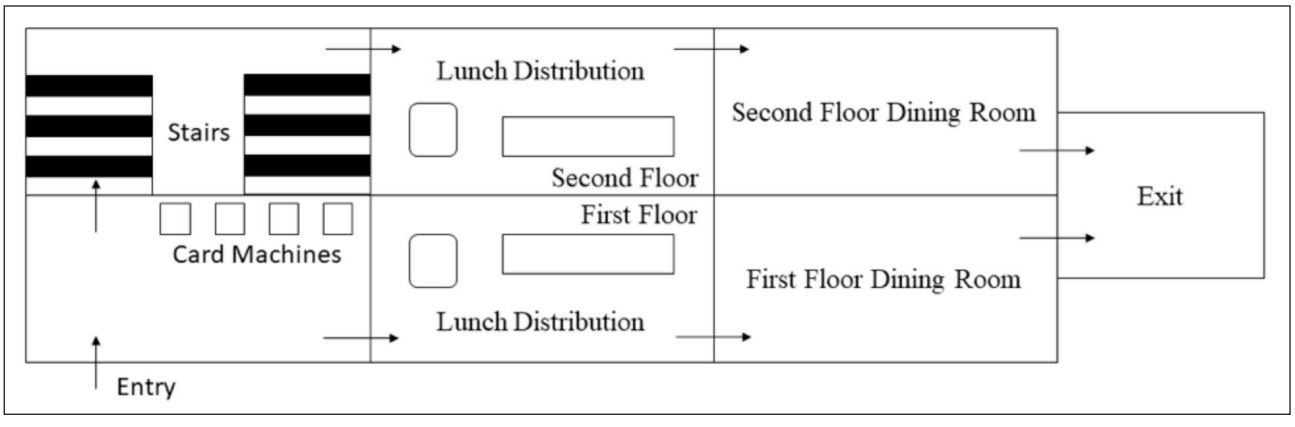

Figure 1: Layout of the CDS Facility

has a total of 870 chairs. If no chairs are available, students must wait until one becomes free. After finishing their meal, students leave the facility.

Data

The system under investigation is a CDS. Data related to the system were collected through interviews with workers and managers, as well as direct observations. Additionally, limited capacity data were sourced from the internet and considered during model development. Observational data were gathered by examining the facility and conducting focus group discussions.

Model

As shown in Figure 2, 80% of students visiting the facility proceed to use the card machines. Each student (or entity) utilizes one card machine, with transaction times following a triangular distribution of (9, 15, 17) seconds. Once the transaction is complete, students select the floor where they will have lunch. There is a 60% probability of choosing the first floor and a 40% probability of choosing the second floor. Arrival times at the first-floor card reader are 20 seconds, while arrivals at the second-floor card reader take 60 seconds. Upon arrival at the card reader, a student joins the queue to use the card, requiring both a worker and a card reader machine. After this, students proceed to the lunch queue. When their turn arrives, they receive their lunch from a cook. The time to receive lunch follows a triangular distribution of (30, 40, 45) seconds. If a chair is available, students begin their meal; if no chair is free, they wait until one becomes available. The time to have lunch follows a triangular distribution of (25, 30, 60) minutes. After finishing their meal, the student leaves the facility.

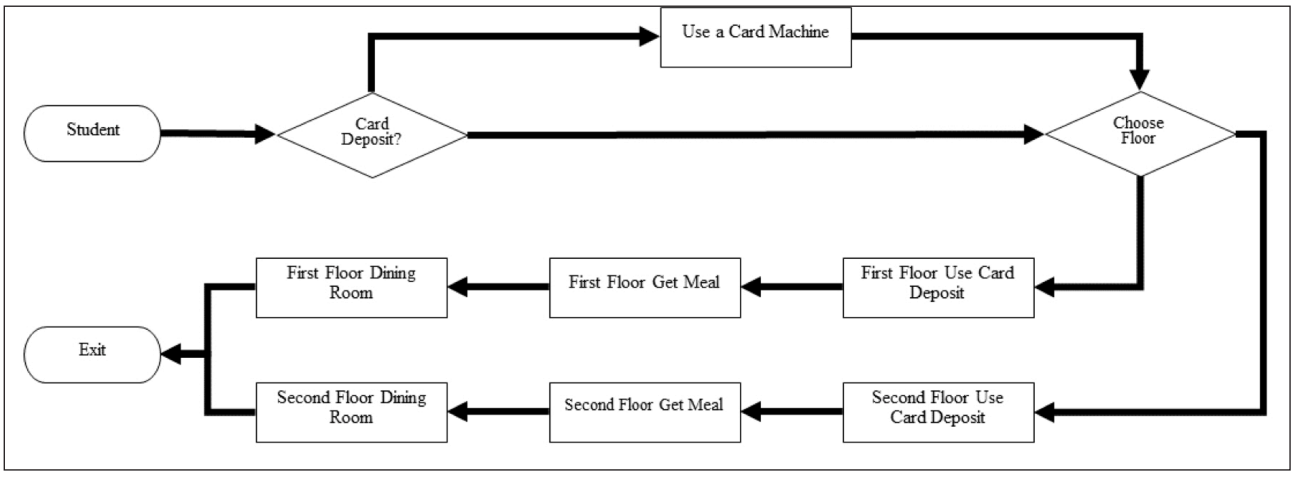

Figure 2: Flowchart of the System

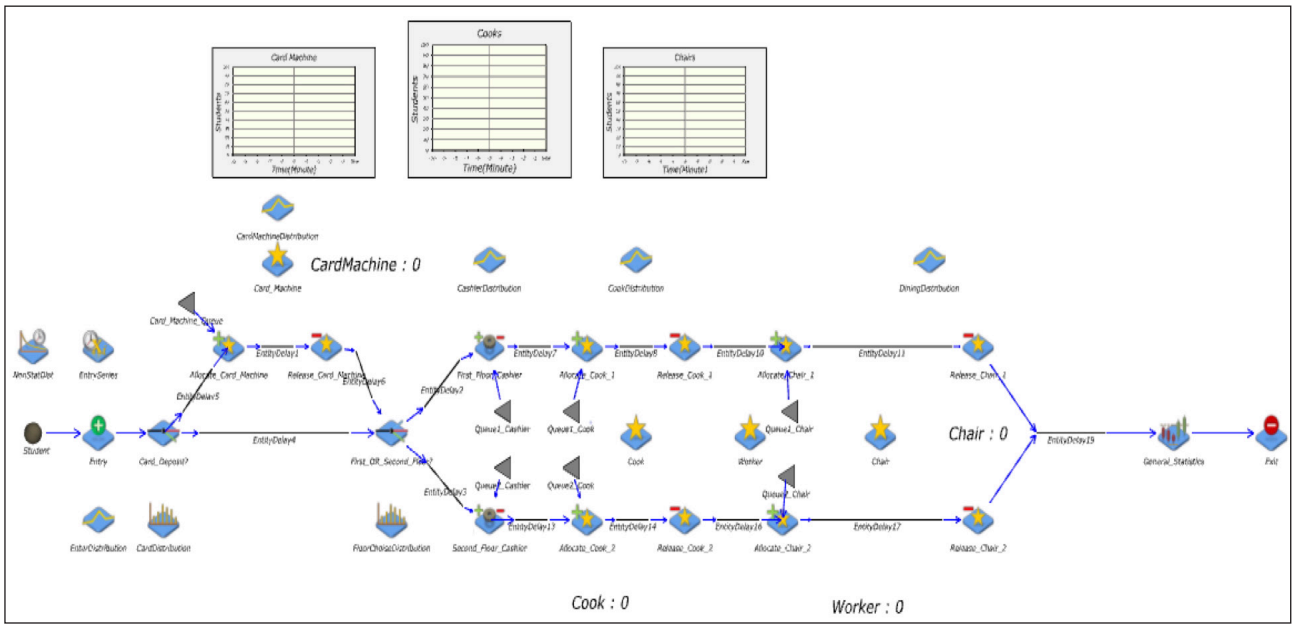

Figure 3: Processes Flow of the System with JaamSim

Model Verification, Validation

Advancements in technology and the availability of affordable computing resources have made simulation models more accessible. However, validating these models is crucial to ensure they accurately reflect the dynamics of real-world systems. Without proper validation, simulation studies may be deemed questionable, as there could be a significant gap between the modeled system and the actual system it aims to represent. Validation helps to bridge this gap, thereby improving the model's credibility and reliability.

A study discussing validation methods in terms of different eras is presented by Sargent and Balci (2017). In this study, the baseline model was shown to experts and managers at the facility through interviews, and they were asked whether the model accurately represented the system. Their feedback was positive. Furthermore, the model's student arrival data for the hours between 11:00 and 14:00 were 1500, 1200, and 600, respectively. The total number of arrivals in the facility on a typical day is approximately 3500. Although variations in the arrival rate exist during each active hour, specific data on these fluctuations were not available. A t-test revealed no significant statistical differences between the observed and modeled arrival numbers.

Baseline Model & Proposed Scenarios

The baseline model represents the current system, which is subject to improvements. This model incorporates all the features described in previous chapters. In the baseline model, there is no queue for chairs, indicating that the chair resource is sufficient for the system. Similarly, there are no queues for card reading processes, as the number of workers is adequate for this task. However, queues do form at the card machines and for the cooks. Due to the design of the system, any improvements made to reduce card machine queues would lead to longer queues at the cook stations. As shown in Table 1, the total average waiting time across all queues in this model is 14,429 minutes.

Scenario 1 examines the effects of reduced reliance on card machines within the system. Although card machines are available across the campus, many students prefer to use them at the facility just before lunch. In this scenario, it is assumed that the university launches a campaign to encourage students to use card machines outside of lunch hours by offering incentives such as bonuses and advertisements. As a result, the usage rate of card machines decreases from the baseline model's 80 percent to 50 percent.

Scenario 2 explores the situation in which an additional card machine is added to the facility. There is sufficient space available in the location of the card machines to accommodate another one. Some card machines on campus are infrequently used, and it is assumed that one of these rarely used machines is relocated to the facility.

Scenario 3 examines the impact of changes in students' behavior regarding their floor choices. Generally, students tend to prefer the first floor of the facility. The assumption is that, with proper guidance, the distribution of students across the floors would become evenly split, with 50 percent choosing each floor.

Scenario 4 explores a capacity-reallocation approach. In the baseline scenario, two workers are assigned to the card reading machines to ensure every student uses their card properly. Since almost all students use their cards, the income generated from these processes is low. In this scenario, the workers are reassigned to assist the cooks with lunch distribution. The need for workers at the card reading machines is removed, and the number of cooks is increased to 14.

Scenario 5 examines the impact of class scheduling on facility demand. The total number of students per week ranges from 3,300 to 3,500, but student arrivals vary significantly throughout the day. The peak hour is between 11:00 and 12:00, during which the facility's capacity is insufficient to meet demand in such a short time. The assumption is that students arrive at the facility immediately after their classes end. In this scenario, all university classes are rescheduled so that students' arrivals at the facility are evenly distributed across different hours.

Scenario 6 combines Scenario 2 and Scenario 4 to analyze the effects of all capacity reallocation scenarios simultaneously.

ANALYSIS

To address the queue problems in the facility, some proposed scenarios focus on capacity reallocation (Scenarios 2 and 4), others aim to change students' behavioral intentions (Scenarios 1 and 3), and one targets class scheduling (Scenario 5).

Although there is a dramatic decrease in waiting times at the card machine queues in Scenario 1, there is almost no change in the total average waiting time. As shown in Table 1, the total average waiting time in the queues

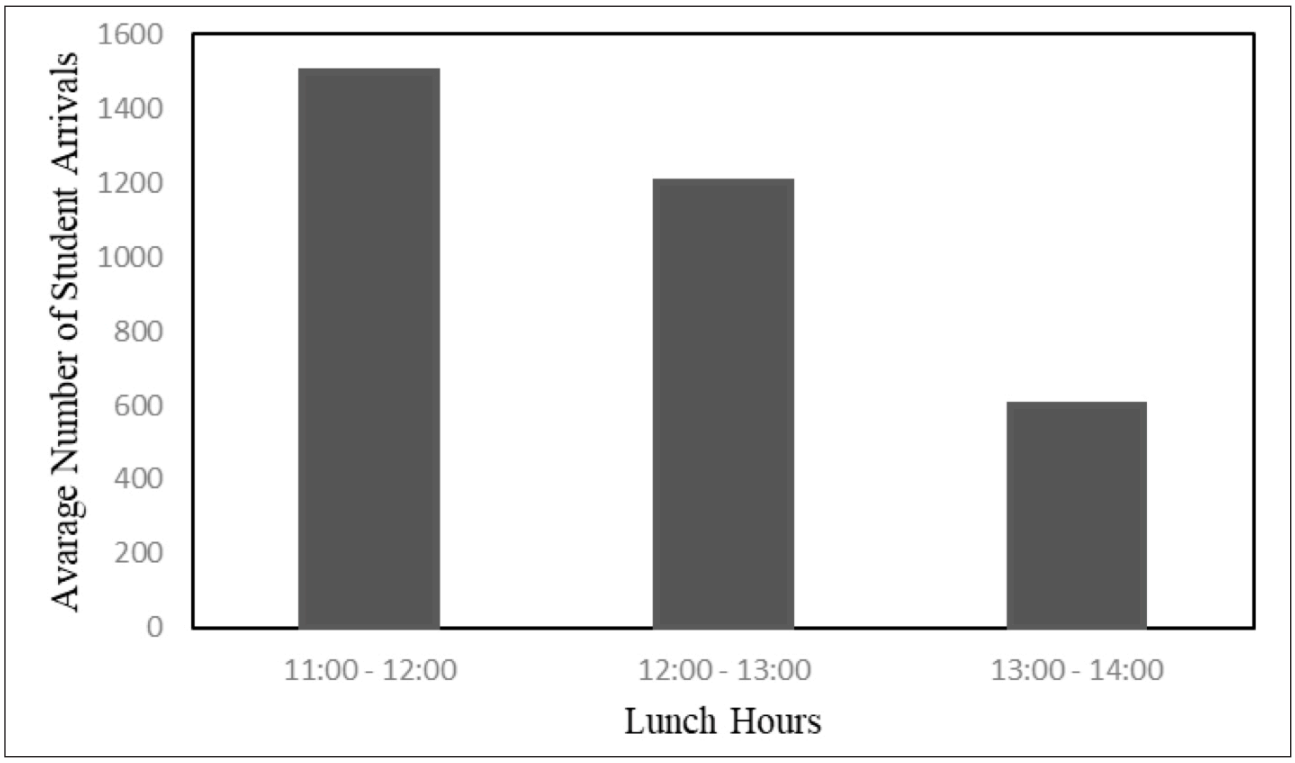

Figure 4: Baseline Model Average Number of Student Arrivals

Table 1. Total Average Waiting Times of Scenarios

	Average Waiting Time(min)	Difference with Baseline model(min)
Baseline model	14,429	N/A
Scenario 1	14,378	-0,051
Scenario 2	14,4	-0,029
Scenario 3	14,427	-0,002
Scenario 4	4,3502	-10,0788
Scenario 5	1,0487	-13,3803
Scenario 6	4,1922	-10,2368

is 14,378 minutes in Scenario 1. The reduction in waiting times at the card machine queues led to an increase in the number of students in the lunch queues. This represents a low-cost solution to reduce queues at the card machines.

Scenario 2 introduces an additional card machine in the facility. The results are similar to those in Scenario 1. As shown in Table 1, the total average waiting time is 14.40 minutes. This also serves as a low-cost capacity reallocation solution to address the card machine queue issues.

As shown in Table 1, the total waiting time in scenario 3 is 14,427 minutes. Change in floor decision possibilities doesn't change waiting times significantly.

Scenario 4 involves a capacity reallocation, where workers at the card reader machine areas assist cooks at lunch distribution. As shown in Table 1, the average waiting time in this scenario is 4.36 minutes. The queue at lunch distribution decreased by 80 percent. Waiting at the card reader machine may not be the most efficient option. If workers help cooks with lunch distribution, they

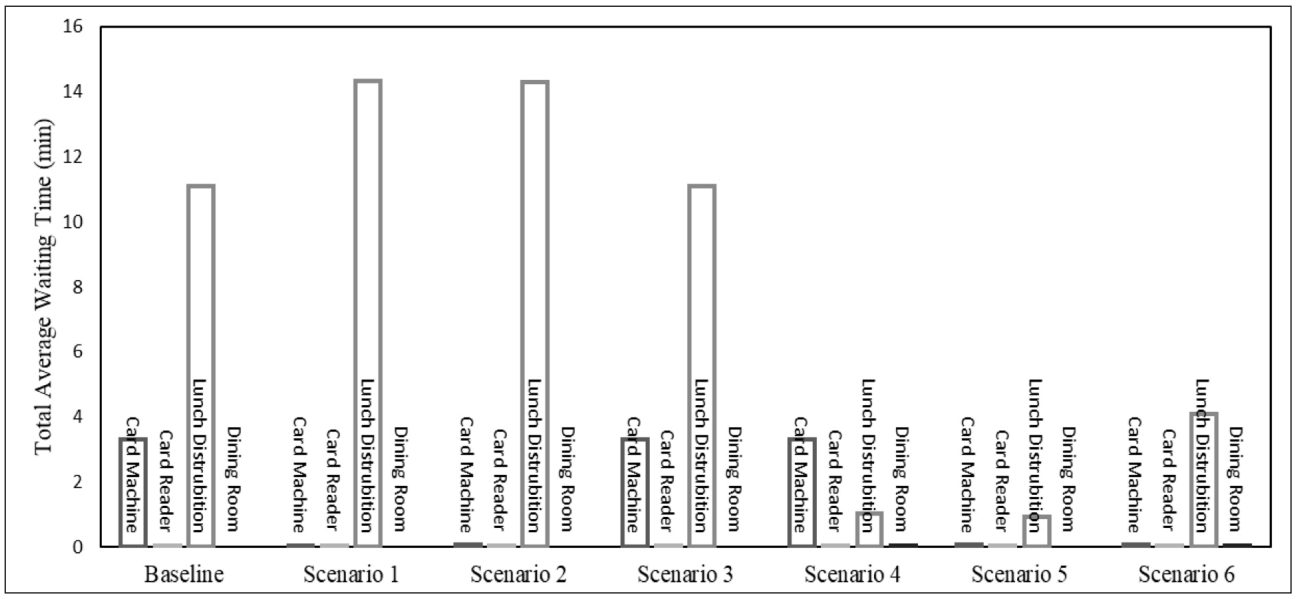

Figure 5: Total Average Waiting Times of Scenarios and Queue Locations

would provide greater benefits to the facility. If waiting at the card reader is not essential, this becomes a low-cost solution to address queue problems.

A hypothetical measure was examined in scenario 5, where it was assumed that all university classes were scheduled in such a way that student arrivals during lunch hours would be evenly distributed. Students typically enter the facility around 11:00. According to Table 1, the average waiting time in this scenario is 1.04 minutes. All resources are sufficient, and the few capacity issues that remain lead to fewer queues.

Scenarios that are easier to implement and have the potential to improve the system were combined in scenario 6. These include scenarios 2 and 4. According to Table 1, the average waiting time is 4.19 minutes.

DISCUSSION

All hypotheses were tested through scenario-based analysis and confirmed. H1: Resource-reallocation solutions were effective in solving queue problems. H2: The relationship between queues and student arrival rates was confirmed. Balancing the number of students arriving each lunch hour effectively solves queue problems. H3: In scenario 6, two resource-reallocation solutions were tested. A decrease in queues at the card machine area increased the number of students at the lunch distribution area, which reduced the effectiveness of the resource allocation solution in this area due to the system's flow.

Capacity reallocation scenarios impact average waiting times, and this effect is statistically significant. The results are consistent with findings from other simulation studies that focus on resource reallocation (Curin et al., 2005; Ghaleb et al., 2015; He & Hu, 2018; Kambli et al., 2020).

There is partial similarity with the literature regarding the results of changing students' arrival rates between lunch hours (Aslan & Özderir, 2021). Lillo et al. (2022) emphasized that altering the number of students arriving at a facility at different hours has minimal effect on capacity usage. In another study, where class scheduling was tested in a school cafeteria setting, scheduling was found to solve the queue problem (Nettles & Gregoire, 1997). The system being optimized in this case was an elementary school cafeteria, which may explain why class scheduling was so effective in addressing queue issues. However, in a study where class scheduling was applied to solve queue problems in a university cafeteria, the results were similar to those of Nettles & Gregoire (1997) (Ivan, 2021). Scenario 5 assumes that class scheduling and student arrival to the facility are related and seeks to investigate the outcomes if this relationship holds true. The optimal state for the facility can be achieved by balancing student arrivals, and numerous studies in the literature either support or challenge this hypothesis.

CONCLUSION

Many service facilities rely on managerial intuition rather than systematic analysis when addressing operational challenges. However, research in the field emphasizes the importance of data-driven, analytical approaches while often overlooking the role of intuitive decision-making. This study highlights the potential for integrating structured analytical methods with experiential judgment

to develop more effective solutions. By bridging this gap, the proposed approach provides a practical framework for service operations, ensuring that decision-making balances empirical analysis with managerial expertise. These findings contribute to the ongoing discussion on optimizing service systems by leveraging both quantitative techniques and professional insight.

Effective resource management contributes to productivity and plays a key role in addressing queue challenges. The 'chair' resource is sufficient for the facility, and there is no queue related to the 'chair' resource in any of the scenarios.

The card reading process is automated, eliminating the need for workers in these areas. Similar systems are common in cities, and people are familiar with their use, further reducing the need for manual assistance. Having workers solely to ensure proper card use is unproductive for the facility. These workers should be reassigned to lunch distribution for better efficiency. This solution would not require hiring additional personnel and would significantly reduce queues at lunch distribution. Compared to the other scenarios, Scenario 4 is simpler for the facility to implement and is recommended as an effective solution for addressing queue problems.

Encouraging students to use card machines outside of lunch hours may help alleviate queues in the card machine area. This solution is recommended if the facility can implement it. If such behavioral change advocacy is not feasible or is too costly, the solution in Scenario 2 should be considered. The results of Scenario 2 are similar to those of Scenario 1, with no statistically significant difference. This solution involves relocating the least used card machine on campus to the available space near the other card machines at the entry. With five card machines, queue problems in the card machine area can be effectively addressed.

Although based on an assumption and difficult to implement, the solution in Scenario 5 should still be considered. The primary cause of queues in the facility is the large number of students arriving in a short time frame. Queue problems could be alleviated if an approximately equal number of students arrive at the facility throughout the lunch hours. If students arrive at the facility immediately after their classes, class schedules can be adjusted to match the facility's capacity.

The most strongly recommended solution is Scenario 6, which combines the solutions from Scenarios 2 and 4. In this scenario, two workers from the card reading machine areas should be reassigned to assist with lunch distribution, and one of the least used card machines on campus should be relocated to the facility. This approach can reduce the average waiting time by 71 percent.

Productive resource usage is essential for improving service quality and achieving cost efficiency. By considering different viewpoints, the facility can uncover new ways to meet productivity goals.

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The Mediating Role of Occupational Self-Efficacy in the Relationship Between Leader-Member Exchange and Occupational Commitment: A Study on Accounting Interns

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ABSTRACT

It is observed that accounting interns lose interest in the profession without entering the profession professionally due to some events they encounter during their internship. Therefore, determining the driving forces of occupational commitment (OC) of accounting interns is important for the development of the accounting profession. This study aimed to discover how the leader-member exchange (LMX) of accounting interns with the members of the profession they work with affects their OC through their occupational self-efficacy (OSE) beliefs. To this end, data were collected through a survey method from 284 twelfth-grade students of the accounting and finance departments of Vocational and Technical Anatolian High Schools in Türkiye. The collected data were analyzed with the SmartPLS 4 analysis program. The analysis found that LMX positively affects both OC and OSE Furthermore, the analysis results showed that OSE positively impacts OC. Additionally, this study concluded that OSE is a partial complementary mediator variable in the relationship between LMX and OC. The available literature has overlooked the mediating role of OSE in the relationship between LMX and OC. This study offers new contributions in both theory and practice by highlighting the importance of LMX and OSE for the development of accounting interns' OC.

Keywords: Leader-Member Exchange, Occupational Self-Efficacy, Occupational Commitment.

JEL Classification Codes: M10, M12, M54

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INTRODUCTION

Organizational activities, which are becoming more complex with the rapid development of globalization and technology, lead to the expectation that accountants' occupational knowledge will become more qualified (Bozkurt, Öksüz, and Karakuş, 2013). Hence, vocational and technical education has an important place in development policies that focus on people in this new world order that is planned in line with global changes and becomes more complex (Ertaş and Şimşek, 2020). It has become a necessity for economic growth to train accounting and finance personnel, who take an essential place in vocational education and are needed, and bring them into the sectors. Therefore, one of the most significant functions of Vocational and Technical Anatolian High Schools is to provide employment for the workforce needed in the future.

Concerning the accounting education provided in Vocational and Technical Anatolian High Schools, the field of accounting and finance is divided into two branches, accounting and foreign trade, in the framework curriculum in order to train students with the qualifications required by the sector by following changes in laws and regulations. Moreover, students have the opportunity to implement what they have learned in the sector under the name of vocational skills training (internship) in the fourth year, the last year of the academic period (Şendurur, 2020). Therefore, for accounting interns, the period of internship is a process in which occupational knowledge, skills and occupational values are acquired (Uzay, 2005). Some events that interns will encounter at the beginning of their career cause changes in their attitudes and behaviors toward the profession. In this regard, whereas the relationships between interns and members of the profession in the institution where they do their internship and the positive interaction during the internship positively affect interns' perspective on their profession, the negative interaction and poor quality communication with members of the profession adversely affect their perspective on the profession. The intern, who is supported positively

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by the member of the profession, develops OC by regarding himself/herself as a part of the institution where he/she does his/her internship. Considering that employees with high OC are healthier, have higher performance, and are eager to go the extra mile (Bakker and Demerouti, 2008), it would be appropriate to research how accounting interns become committed to their profession and how this commitment can be increased. Hence, the current study focuses on the antecedents of accounting interns' OC. Accordingly, it may be interesting to investigate the impact of the interaction between the leader (member of the profession) and its members (interns) on OC.

According to LMX based on the social exchange theory (SET), leaders (members of the profession) and members (interns) with high-quality relationships share mutual trust, respect, and obligation and exhibit positive support, common bond, open communication, common loyalty, and affection. On the other hand, in line with the conservation of resources (COR) theory, quality LMX is an essential job resource. Individuals can develop OC to maintain and improve this job resource. Therefore, the question "Does a high level of LMX quality affect accounting interns' OC?" is the first research question of this study.

Since leaders (members of the profession) treat their subordinates (interns) more positively in high-quality LMX (Michael, 2014; Alshamasi and Aljojo, 2016), these employees have advantages that employees maintaining low-quality LMX do not have. As a result, considering the reciprocity principle of the SET, under these conditions, interns are expected to react by expressing more positive attitudes toward work, feel more optimistic, show more commitment (Santalla-Banderali and Alvarado, 2022) and have higher OSE. Likewise, in accordance with the COR theory, in strong LMX, a high level of organizational and personal resource exchange and mutual trust, sympathy, understanding, professional respect, cooperation, and loyalty occur between the parties (Martin et al., 2016; Kim and Koo, 2017). Since members (interns) are provided with more organizational support and autonomy, are given more desirable tasks, and are offered more training and development opportunities (Chaurasia and Shukla, 2013), members can improve their OSE to develop these job resources. Hence, the question "Does LMX affect OSE?" is the second research question of the present study.

On the other hand, interns with strong OSE are expected to exhibit more active approaches to challenging job demands. Based on the lens of the social cognitive theory (SCT), there is a high possibility that OSE will impact job behavior by reflecting an individual's perception of organizational resources (Breevaart et al., 2016). Therefore, the question "Does OSE affect OC?" is the third research question of the present study.

Finally, based on all these discussions, the current work aimed to reveal whether the OSE of accounting interns plays a mediating role in increasing their OC through the LMX they have established with their managers throughout the internship. To this end, the present study integrated the COR theory, the SET, and the SCT. The question "Does OSE mediate the relationship between LMX and OC?" is the last research question of this study.

In the present work, to test the four research questions stated above, data were collected by a survey method from individuals who were twelfth-grade students in the accounting and finance department of Vocational and Technical Anatolian High Schools and were accounting interns. The data collected were analyzed with the SmartPLS 4 analysis program. This study, which specifically addressed accounting interns' OC, aims to contribute to members of the accounting profession both in theory and practice by producing the information needed for the improvement of accounting interns' OC.

THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

The Relationship Between LMX and OC

The question of how to improve OC, which is described as an individual's adoption and acceptance of the values of the profession he/she has chosen, his/her efforts to realize these values, and his/her determination to improve himself/herself in the professional field (Benligiray and Sönmez, 2011), in accounting interns is the research subject of the current study. Interns' OC is their commitment to the profession they are preparing to do in the future. It is an essential requirement to maximize interns' OC during the internship (Uysal, 2013). Namely, the period of internship is important for these individuals to enter professional business life in the future. OC varies according to the degree of desire to remain in the profession. In this sense, OC is divided into three sub-dimensions: affective, continuance, and normative. Affective OC refers to an individual's strong desire to remain in his/her profession. An individual develops continuance OC by considering the cost of leaving his/her profession or the benefits he/she will

receive if he/she remains in the profession. Normative OC is a type of OC that is developed to remain in the profession with a sense of moral obligation (Bilgiç, 2009).

According to Steffensen et al. (2019), managers have a significant impact on employees, which means that employees are more enthusiastic about their jobs and have higher commitment when they receive trust and support from their managers (Slutter, 2019). Hence, it is interesting to research the impact of LMX on OC. In line with this, the question "Does LMX improve OC?" becomes important at this point.

LMX is defined as a high or low-quality social exchange between a manager and his/her employees (Yu and Liang (2004). This social exchange causes the formation of two groups (in-group and out-group). In-group members engage in high-quality exchange with the manager. However, out-group members engage in low-quality exchange with the manager (Yu and Liang, 2004; Slutter, 2019). When LMX is of high quality; It increases the employee's motivation (Chen and Kanfer, 2006), organizational commitment (Göksel and Aydıntan, 2012), job satisfaction (Laschinger, Purdy and Almost, 2007; Kırca and Basım, 2024; Yılmaz, 2024), organizational identification (Loi, Chan and Lam, 2014; Lu, Shen and Zhao, 2015; Ateş, 2024), organizational citizenship behavior (Wang et al., 2017), job dedication (Xanthopoulou et al., 2007; Slutter, 2019; Mustafa et al., 2022; Liu et al., 2023), well-being (Köseoğlu and Demir, 2024), job resourcefulness (Karaca, 2024), job crafting (Yalap et al., 2021), and self-efficacy (Soydan, Aksel and Dolma, 2021; Santalla-Banderali and Alvarado, 2022). Few studies in the literature have confirmed a positive correlation between LMX and job involvement (e.g., Ahmed, Ismail and Amin, 2014; Göksel and Ekmekçioğlu, 2016).

Due to the strong exchange of leaders with in-group members, it seems likely that they share their individual, physical, and emotional resources with in-group members. Based on the lens of the COR theory, a high-quality LMX can be considered a job resource (Gutermann et al., 2017). Job resources can be characterized as physical, social, or organizational aspects of the job that decrease job demands, enable employees to achieve job goals, and encourage personal development. Job demands are the opposite, in other words, aspects of the job related to physiological and psychological costs (Bakker and Demerouti, 2008). Owing to a strong LMX, individuals can improve their OC by balancing job demands and job resources. In this respect, it can be argued that LMX can positively impact OC.

On the other hand, based on the framework of the SET, exchanges characterized by low-quality leader-member interaction are based on formal requirements determined by contract (Breevaart et al., 2015; Martin et al., 2016). It can be stated that leaders use their authority and provide less support, trust, and attention to interns in this type of exchange (Mueller and Lee, 2002). On the contrary, high-quality LMX represents a closer relationship beyond the formal contract (Breevaart et al., 2015; Martin et al., 2016). In high-quality LMX, leaders provide their followers (interns) with more social support and autonomy, assign them more desirable tasks, and provide them with more training and development opportunities (Chaurasia and Shukla, 2013; Breevaart et al., 2015). Consequently, considering the reciprocity principle of the SET, under these conditions, employees are expected to react by expressing more positive attitudes toward work, feel more optimistic, and exhibit more OC (Santalla-Banderali and Alvarado, 2022). The hypothesis developed in line with both the SET and the COR theory is presented below:

H1: LMX has a positive impact on OC.

The Relationship Between LMX and OSE

OSE represents a person's belief in his/her ability to organize and carry out the actions necessary to perform job-related tasks or achieve a result (Bandura, 1977) and is a special type of self-efficacy. When a person with high self-efficacy faces a challenging problem, he/she attributes the reason for this to a lack of effort and continues to improve his/her abilities. OSE creates an attitude that one must overcome rather than give up even when a challenging situation emerges and encourages a challenging response to create high job performance. On the contrary, individuals with low self-efficacy perceive that their abilities are inadequate to achieve their goals. Therefore, they avoid or give up even in situations where the task is easy to accomplish (Schmidt and DeShon, 2010; Choi, Kang and Choi, 2021). While self-efficacy is so crucial, the question of how to improve the OSE of accounting interns becomes important at this point.

As specified above, in accordance with the SET, a high-quality LMX is a social exchange between the manager and the employee based on approval, trust, esteem, support, and evaluation (Tims, Bakker and Xanthopoulou, 2011). In other words, high-quality LMX ensures that employees receive active support,

encouragement, and constructive feedback from their managers while performing their duties (Martin et al., 2016). This will create and expand employees' belief that they can solve more challenging and complex problems. Based on the the lens of the SET, the quality of LMX can affect the level of OSE (Choi, Kang and Choi, 2021). The previous research on self-efficacy asserted that LMX is an essential antecedent variable for self-efficacy for creativity (Mathisen, 2011). For instance, a poor relationship with the manager can destroy the employee's self-belief, while the manager's support and trust can improve the employee's self-efficacy (Chaurasia and Shukla, 2014).

According to COR theory, it can be indicated that a work environment based on high-quality LMX makes employees feel more capable of achieving their job goals. The manager's support signals confidence in the employee's self-efficacy, making employees feel more competent (Dulebohn et al. 2012; Gashi Tresi and Mihelič, 2018). As a result, the following hypothesis was developed in the current research following the assumptions of the SET and the COR theory by assuming that interns with high-quality LMX will develop their OSE beliefs:

H2: LMX has a positive impact on OSE.

The Relationship Between OSE and OC

As stated before, OSE is regarded as an individual's belief whether he/she can successfully fulfill the task of his/her profession (Zimmerman, 2000). Employees with high self-efficacy exhibit more active approaches to challenging job demands. Hence, OSE is likely to impact job behavior by reflecting the individual's perception of social and organizational resources (Breevaart et al., 2016). In brief, self-efficacy is among the most significant personal resources that can be defined as positive aspects of the self that are usually linked to resilience and refer to individuals' sense of their ability to successfully control and influence their environment. Employees with high self-efficacy are known to have more confidence and pride in their jobs, find more meaning in their jobs, and, as a result, remain committed to their jobs. When an employee believes in his/her abilities, he/she will set goals and be more motivated to pursue the aforesaid goals, and as a result, will be committed to the job (Xanthopoulou et al., 2007).

In the literature review, some studies show that self-efficacy positively impacts OC in different occupational groups (Klassen and Chiu, 2011; Turhan et al., 2012; Ahmad et al., 2014; Park and Jung, 2015; Dalahmetoğlu, 2019; Doğanülkü and Kırdök, 2020). Nevertheless, there are few studies in the literature that specifically examine the relationship between OSE and OC. Accordingly, in line with the SCT, it can be said that OSE represents an essential antecedent of OC. Hence, the following hypothesis was put forward under the assumption that accounting interns who believe in themselves and their capacities will have higher OC:

H3: OSE has a positive impact on OC.

The Mediating Role of OSE

LMX through the exchange of knowledge, inspiration, and motivation can increase employees' OC (Schaufeli, Bakker and Salanova, 2006). In line with the COR theory, managers with high LMX devote more time to their employees by providing information and rewards, including empowerment and recognition, which can lead to positive job perceptions and higher levels of OC (Jacobs, Renard and Snelgar, 2014). As a job resource, a positive leader can improve followers' skills and expertise by encouraging them to participate and dedicate themselves to their jobs (Choi, Tran and Park, 2015; Jalil, 2017; Mustafa et al., 2022).

On the other hand, there is a higher possibility that employees will have higher levels of OSE with a high-quality LMX and the approval, trust, respect, support, and attention of their managers (Tims, Bakker and Xanthopoulou, 2011). A job resource such as LMX can stimulate employees' OSE, which can make them feel more competent and have more control over their work environments (Slutter, 2019). In line with the SCT, employees believing in their abilities will be more motivated to achieve job goals and, thus, will be more committed to the profession (Xanthopoulou et al., 2007). Based on all these discussions, it can be concluded that OSE has a mediating role in the correlation between LMX and OC. Hence, the following hypothesis was developed in the present work by combining the COR theory, the SET, and the SCT:

H4: OSE mediates the positive relationship between LMX and OC.

Figure 1 presents the research model.

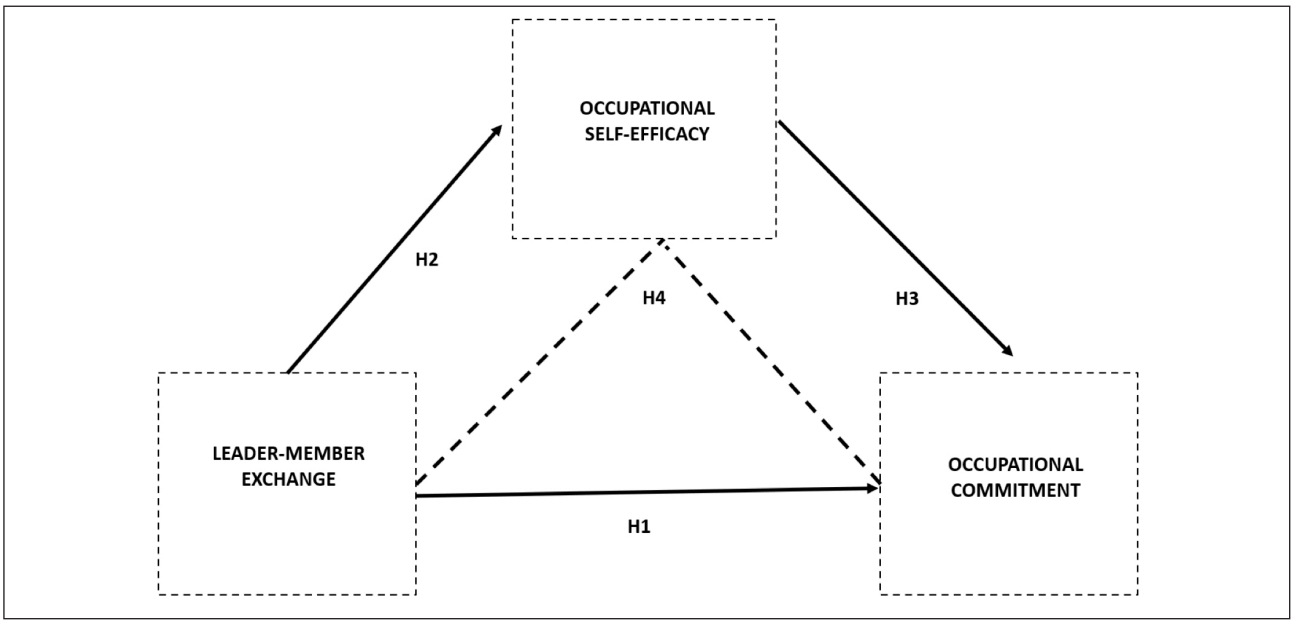

Figure 1: Conceptual Model

RESEARCH

Population and Sample of the Study

The present study is based on a quantitative research method. The study's sample consists of individuals who are twelfth-grade students in the accounting and finance department of Vocational and Technical Anatolian High Schools and who are accounting interns. The current study was conducted in accordance with the Ethics Committee Approval Certificate of Istanbul Topkapı University Academic Research and Publication Ethics Board dated 10.07.2023 and numbered E-49846378-050.01.04-2300007943 and the rules of scientific research and publication ethics. Data were collected through a survey method via Google Forms. Data collection lasted three months, between July and September 2023. Three hundred and three participants answered the survey, and 284 usable data were obtained. Upon examining the demographic characteristics of the survey respondents, it is seen from Table 1 that 55.99% are male, and 44.01% are female. Considering the participants' age range, it can be stated that the majority (59.51%) are between the ages of 18 and 20. This rate is followed by participants in the age range between 15 and 17 at a rate of 39.08%. Of the participants, 0.35% are between the ages of 25 and 35.

Statistical methods have been used in addition to procedural methods to eliminate concerns about common method bias (CMB) (Podsakoff et al., 2003). For the procedural method, participants were assured that the study would be confidential and anonymous. In the current study, Harman's single-factor test and Variance Inflation Factor (VIF), which are frequently used statistical techniques by researchers in PLS-SEM studies, were used (Cegarra-Navarro et al., 2021; Özgül and Çelenk, 2024).

Table 1: Demographic data

Demographic	Frequency	Percentage (%)
Gender		
Female	125	44.01
Male	159	55.99
Age		
15-17	111	39.08
18–20	169	59.51
21–25	3	1.06
25-35	1	0.35

Table 2: Measurement model results.

Constructs	Items	Factor Loadings	P Values	Cronbach's Alpha	rho A	Composite Reliability	AVE
Continuance Commitment	CC1	0,917	0,000				
	CC2	0,929	0,000				
	CC3	0,901	0,000	0,939	0,941	0,954	0,805
	CC4	0,900	0,000				
	CC5	0,836	0,000				
Affective Commitment	AC1	0,781	0,000				
	AC2	0,837	0,000				
	AC3	0,891	0,000	0,940	0,941	0,951	0,736
	AC4	0,870	0,000				
	AC5	0,854	0,000				
	AC6	0,899	0,000				
	AC7	0,868	0,000				
Normative Commitment	NC1	0,820	0,000				
	NC2	0,811	0,000				
	NC3	0,884	0,000	0,928	0,929	0,944	0,736
	NC4	0,914	0,000				
	NC5	0,868	0,000				
	NC6	0,847	0,000				
Contribution	CN1	0,844	0,000				
	CN2	0,936	0,000	0,882	0,892	0,927	0,810
	CN3	0,917	0,000				
Loyalty	LY1	0,872	0,000				
	LY2	0,945	0,000	0,907	0,909	0,942	0,844
	LY3	0,936	0,000				
Affect	AF1	0,952	0,000				
	AF2	0,911	0,000	0,927	0,930	0,953	0,872
	AF3	0,938	0,000				
Professional Respect	PRS1	0,844	0,000				
	PRS2	0,950	0,000	0,900	0,905	0,938	0,835
	PRS3	0,942	0,000				
Occupational Self-Efficacy	OSE1	0,915	0,000				
	OSE2	0,903	0,000				
	OSE3	0,945	0,000				
	OSE4	0,940	0,000	0,976	0,977	0,980	0,858

	OSE5	0,934	0,000				
	OSE6	0,925	0,000				
	OSE7	0,919	0,000				
	OSE8	0,929	0,000				
Occupational Commıtment	CC1	0,868	0,000				
	CC2	0,885	0,000				
	CC3	0,822	0,000				
	CC4	0,859	0,000				
	CC5	0,777	0,000				
	AC1	0,799	0,000				
	AC2	0,720	0,000				
	AC3	0,743	0,000	0,959	0,962	0,963	0,595
	AC4	0,705	0,000				
	AC5	0,732	0,000				
	AC6	0,756	0,000				
	AC7	0,704	0,000				
	NC1	0,796	0,000				
	NC2	0,704	0,000				
	NC3	0,763	0,000				
	NC4	0,782	0,000				
	NC5	0,723	0,000				
	NC6	0,707	0,000				
Leader-Member Exchange	CN1	0,881	0,000				
	CN2	0,755	0,000				
	CN3	0,902	0,000				
	LY1	0,924	0,000				
	LY2	0,840	0,000				
	LY3	0,890	0,000				
	AF1	0,930	0,000				
	AF2	0,841	0,000	0,973	0,974	0,976	0,775
	AF3	0,930	0,000				
	PRS1	0,833	0,000				
	PRS2	0,930	0,000				
	PRS3	0,924	0,000				

Harman's single-factor test result showed that a single factor explained 29.7% of the total variance. Later, when the VIF value was examined as a statistical technique, it was seen that the VIF values of all items were less than 3.1. Therefore, it can be said that there is no significant problem with CMB (Kock, 2015).

Development of the Data Collection Tool

The survey form prepared in line with the study's purpose consists of four sections. The first section includes questions about LMX perception, the second section includes questions about the level of OC, the third section includes questions about OSE belief, and the last section includes questions about demographic information (gender and age). The scale developed by Liden and Maslyn in 1998 and adapted to Turkish by Baş, Keskin, and Mert (2010) was employed to measure the level of LMX. The LMX scale comprises twelve questions and four sub-dimensions (contribution, loyalty, affect, and professional respect). In order to measure the level of OC, the OC scale, developed by Yetgin (2017) and consisting of three sub-dimensions, was used in the current study. A Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used to measure the level of OC and LMX. The second, third, fifth, sixth, and fourteenth questions on the OC scale were reverse-coded based on the literature. A 6-point Likert OSE scale, developed by Schyns and Von Collani (2002) and comprising 8 questions, was utilized to measure the level of OSE.

Analysis and Results

The data were entered into the SPSS program to prepare for statistical analysis, and data cleaning was performed. Partial Least Squares-Structural Equation Modeling (PLS-SEM) was employed to verify the hypotheses. The data were analyzed using the SmartPLS 4 analysis program with the assumption based on PLS-SEM. In this software, data are analyzed in two steps through measurement model and structural equation modeling techniques.

Measurement Model

In the present study, item reliability, internal consistency reliability, convergent validity and discriminant validity were used for the evaluation of the measurement model. The first step in evaluating the measurement model is to check the factor loadings. According to Table 2, all items are above the required threshold (i.e., 0.700).

Cronbach's alpha, composite reliability (CR), and rho_a values were examined to evaluate the internal consistency reliability of the survey. Cronbach's alpha is used as a measure of how reliable an item is. CR and rho_a values are also among the preferred methods when assessing internal consistency. For the data to be considered statistically reliable (Hair et al., 2010), all of Cronbach's alpha, CR, and rho_a values should be higher than 0.700. The study complies with the internal consistency reliability criteria.

Convergent validity refers to the rate at which all items in the model correlate with other elements of the same latent variable. Average Variance Extracted (AVE) measures convergent validity. Table 2 presents the results for convergent validity, and since all AVE values were higher than 0.500, convergent validity was achieved.

This study also considered discriminant validity, in addition to internal reliability and convergent validity. Discriminant validity assesses the level of correlation between model constructs and demonstrates how different the constructs are from other constructs (Hair et al., 2010). The current study employs three methods to examine discriminant validity. The Fornell-Larcker criterion was evaluated in the first method. In the method in question, the square root of the AVE value should be greater than the correlations between the constructs. The square roots of the AVE values of all constructs (values written in bold) are larger than the correlation values in the relevant rows and columns (see Table 3). Therefore, all constructs provide discriminant validity according to the Fornell-Larcker criterion.

Table 4: HTMT

Constructs	**1**	**2**	**3**
LMX			
OC	0,539		
OSE	0,736	0,630	

Table 5: Cross-loadings

Items	LMX	OC	OSE
CC1	0,465	**0,868**	0,566
CC2	0,406	**0,885**	0,539
CC3	0,396	**0,822**	0,504
CC4	0,443	**0,859**	0,550
CC5	0,434	**0,777**	0,530
AC1	0,614	**0,799**	0,603
AC2	0,340	**0,720**	0,404
AC3	0,350	**0,743**	0,424
AC4	0,361	**0,705**	0,417
AC5	0,287	**0,732**	0,406
AC6	0,359	**0,756**	0,388
AC7	0,338	**0,704**	0,425
NC1	0,473	**0,796**	0,565
NC2	0,419	**0,704**	0,395
NC3	0,424	**0,763**	0,457
NC4	0,372	**0,782**	0,458
NC5	0,328	**0,723**	0,355
NC6	0,387	**0,707**	0,469
CN1	**0,881**	0,445	0,618
CN2	**0,755**	0,439	0,583
CN3	**0,902**	0,468	0,658
LY1	**0,840**	0,490	0,612
LY2	**0,890**	0,501	0,623
LY3	**0,889**	0,484	0,621
AF1	**0,930**	0,447	0,669
AF2	**0,841**	0,406	0,591
AF3	**0,930**	0,452	0,651
PRS1	**0,833**	0,487	0,603
PRS2	**0,930**	0,442	0,671
PRS3	**0,924**	0,464	0,663
OSE1	0,656	0,539	**0,915**
OSE2	0,675	0,563	**0,903**
OSE3	0,660	0,561	**0,945**
OSE4	0,669	0,547	**0,940**
OSE5	0,649	0,552	**0,934**
OSE6	0,657	0,592	**0,925**
OSE7	0,655	0,608	**0,919**
OSE8	0,688	0,587	**0,929**

Table 6: Hypothesis Testing

Path Coefficients	Coef (β)	S.D.	T-Values	P-Values	Adj. R^2	f^2	VIF	Confidence Interval (BC)		Conclusion
								Lower Level	Upper Level	
LMX→ OSE	0.717	0.045	15.933	0.000	0.514	1.056	1.000	0.619	0.797	H2 Supported
OSE→ OC	0.493	0.072	6.902	0.000	0.391	0.194	2.056	0.343	0.625	H3 Supported
LMX→ OC	0.169	0.071	2.398	0.017		0.023	2.056	0.037	0.311	H1 Supported

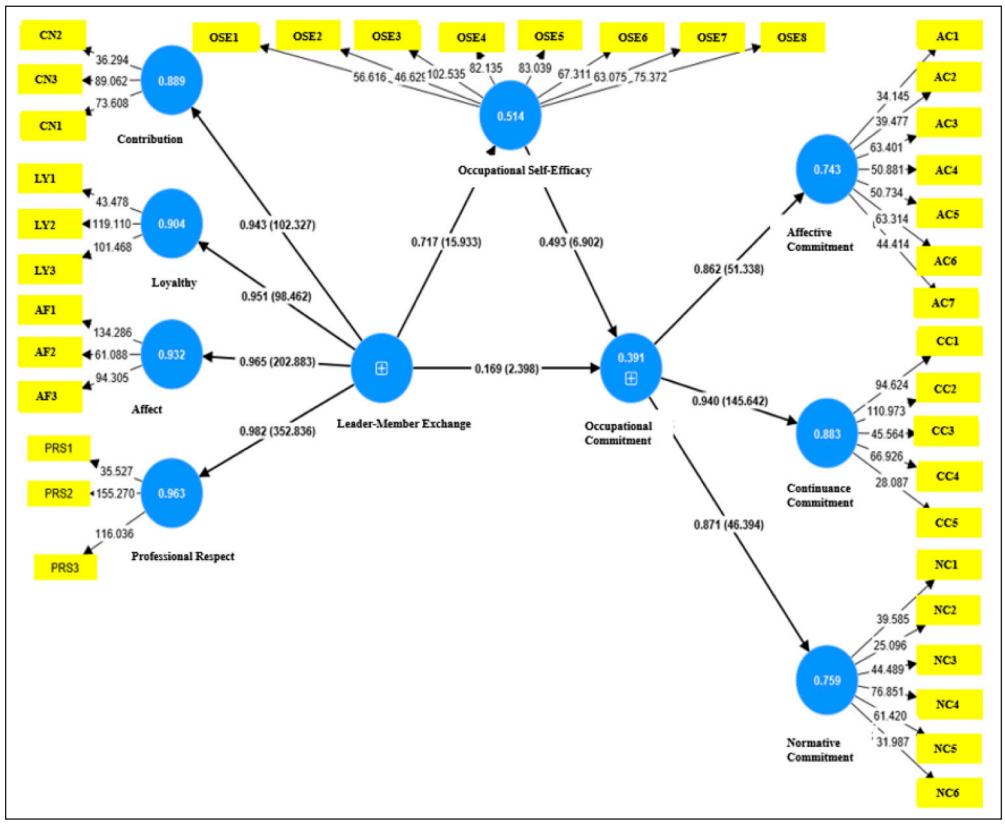

Figure 2: Structural Model Results

Table 7: Mediation Analysis

Path Coefficients	Coef (β)	S.D.	T-Values	P-Values	Confidence Interval (Bias Corrected)		Conclusion
					Lower Level	Upper Level	
LMX→ OSE→ OC	0.352	0.054	6.572	0.000	0.251	0.464	H4 Supported Complementary Partial Mediation
LMX→OC	0.169	0.071	2.398	0.017	0.037	0.311	

In the present study, the discriminant validity of the measurement model was checked using the Heterotrait-Monotrait ratio (HTMT) as a second method. To verify the discriminant validity between the constructs, the HTMT value should be below 0.85. As seen in Table 4, the HTMT values of all constructs are below 0.85. Hence, discriminant validity was also confirmed according to this criterion.

A third method to assess discriminant validity is to examine cross-loadings. The higher indicator loadings (bold values) of each construct in Table 5 indicate that these constructs meet the cross-loadings required for discriminant validity (Fornell and Larcker, 1981). The results show that each construct meets all three methods required for discriminant validity.

Finally, the statistical significance of the indicators of all constructs in the measurement model was analyzed using the 5000 resampling method. Each indicator is statistically significant with the construct it belongs to.

Structural Model

A structural model is employed for the purpose of testing the direct and indirect impact between dependent and independent variables. The structural evaluation criteria involve collinearity problem, path coefficient, R^2 showing what percentage of the endogenous variable is explained, Standardized Root Mean Square (SRMR), and Normed Fix Index (NFI). To ensure that collinearity does not skew regression results, this should be tested prior to evaluating structural relationships. The degree of multicollinearity is assessed by examining Variance Inflation Factor (VIF) values. The fact that the VIF values of all variables in this study (as shown in Table 6) are lower than 3 indicates the absence of a collinearity problem in the research.

After checking collinearity, the path coefficient between the latent variables of the model is evaluated in terms of significance. To examine both direct and indirect impacts, the bootstrapping method should be applied to acquire p-values and t-statistics. The analysis was conducted by performing 5000 resamples with a bootstrapping technique on SmartPLS 4. In line with the first finding of the study, the correlation between LMX and OC (β = 0.169; t = 2.398, p = 0.017) is positively significant. Likewise, the correlation between LMX and OSE (β = 0.717; t = 15.933, p = 0.000) is also positively significant. Moreover, considering the relationship between OSE and OC, the above-mentioned relationship is also (β = 0.493; t = 6.902, p = 0.000) positively significant. Hence, hypotheses H1, H2, and H3 were found to be significant and accepted (see Table 6).

Upon examining the R^2 values in Figure 2, it is seen that this value is 0.514 for OSE and 0.391 for OC, and these values are considered good (Hair et al., 2010). SRMR and NFI values should be examined to assess the model's goodness-of-fit. An SRMR value of 0.08 or less is accepted as optimal. The computed SRMR value is 0.056. It is optimal if the NFI value is above 0.80. The NFI value of the model in question is 0.87. These values indicate that the model is compatible. The effect size (f^2) value is checked to reveal whether an independent construct significantly impacts the dependent construct. According to the f^2 values in Table 6, while LMX has a large effect on OSE, it has a small effect on OC. It can be said that OSE has a medium effect on OC.

The mediation procedure adopted by Zhao, Lynch, and Chen (2010) was followed with the objective of testing the mediating effect of OSE on the relationship between LMX and OC. Table 7 contains the test results of the mediating effect of OSE. The results indicate that OSE is the mediator variable in the relationship between LMX and OC (β = 0.352; t = 6.572, p = 0.000). The impact of LMX on OC was evaluated to determine the level of the mediation effect, and since the above-mentioned effect was significant (β = 0.169; t = 2.398, p = 0.017), it was concluded that OSE has a complementary partial mediating role. Therefore, hypothesis H4 was supported.

CONCLUSIONS AND IMPLICATIONS

Discussion

The purpose of this study is to examine the effect of LMX on OC and the mediating role of OSE in the relationship between LMX and OC. To investigate this, data collected from 284 accounting interns were analyzed.

As predicted, the analysis results confirm the expected relationship between LMX and OC. In this case, hypothesis H1 was accepted. First, no study on the impact of LMX on OC was encountered in the literature. However, this result confirms studies that argue that there is a positive correlation between LMX and job involvement (Katrinli et al., 2008; Ouyang, Cheng and Hsieh, 2010; Lawrence and Kacmar, 2012; Ahmed, Ismail and Amin, 2014; Göksel and Ekmekçioğlu, 2016). Hence, a high-quality LMX consisting of empowerment, trust, esteem, support, and consideration can lead to increased OC. The aforesaid result is consistent with the assumptions of the COR theory and the SET.

Hypothesis H2 of the study was also confirmed, which means that LMX has a positive impact on OSE. This result supports researchers in the literature arguing that the quality of LMX will impact the level of OSE (e.g., Khorakian and Sharifirad, 2019; Slutter, 2019; Choi, Kang and Choi, 2021). On the other hand, the above-mentioned result is also compatible with the assumption that, in line with the SET, the OSE of employees who receive the trust and support of the manager through a high-quality LMX develops in the positive direction (Chaurasia and Shukla, 2014). This can also be explained by the COR theory, stating that LMX is a job resource and, therefore, positively affects employees' OSE, which is a personal resource (Xanthopoulou et al., 2009).

The findings of the present work also indicated a positive relationship between OSE and OC, which can be explained by the SCT. The result in question confirms studies revealing that self-efficacy positively impacts OC (Klassen and Chiu, 2011; Turhan et al., 2012; Ahmad et al., 2014; Park and Jung, 2015; Dalahmetoğlu, 2019; Doğanülkü and Kırdök, 2020). Employees with high OSE believe in their abilities, set goals, and are better motivated to achieve these goals, thus, they can enhance their OC. Hence, hypothesis H3 was also accepted.

Finally, hypothesis H4, indicating that OSE mediates the relationship between LMX and OC, was also supported. By employing the COR theory, the SET, and the SCT, this relationship can be explained in the following way: A job resource such as LMX stimulates employees' OSE, which in turn makes them feel more competent and have more control over their work environments, improving their OC.

Theoretical Contributions

The theoretical contributions of this study have four aspects. First, no study on the impact of LMX on OC was encountered in the literature. Therefore, this study contributed to the literature by addressing the correlation between LMX and OC based on the lens of the COR theory and the SET. Namely, the present study argued that an intern's social exchange relationships with his/her supervisor

have a critical role in OC and confirmed the aforesaid relationship. A form of social exchange is LMX, which is defined as a mutual exchange between managers and their subordinates on the basis of trust, respect, and obligation (Tims, Bakker, and Xanthopoulou, 2011). In accordance with the SET, LMX comprises a dyadic relationship between the manager and intern that develops through social exchanges between the two parties. According to LMX, managers have different relationships with each intern originating from role expectations and their fulfillment. A high-quality LMX means a high-quality relationship between the supervisor and interns, resulting in higher OC. Second, the present work contributes to the literature by developing the COR theory and the SET and indicating that the quality of LMX impacts the employee's level of OSE. The present study empirically confirmed that, according to the SET, the self-belief of an employee who has a poor relationship with his/her manager disappears, while the OSE of an employee who gains the support and trust of his/her manager develops in a positive direction. When viewed through the lens of the COR theory, the COR theory was developed by showing that when a resource-based environment is created, in other words, owing to LMX, which is considered an essential job resource, employees can enhance their OSE by feeling more competent and in control of their jobs. Third, this study made a significant contribution to the literature by specifically discussing the relationship between OSE and OC. The current research advances the SCT by showing that OSE is an essential antecedent of OC. Fourth, by integrating the COR theory, the SET, and the SCT, this study contributed to the literature by demonstrating that OSE mediates the relationship between LMX and OC.

Practical Contributions

The current study has practical contributions in addition to theoretical contributions. First, the present research will help managers find out how they can increase the OC of their interns through a strong LMX. Therefore, managers should focus on improving their relationships with interns. For instance, creating a work environment that fosters approval, trust, support, and respect will enable interns to actively participate in such an environment. Additionally, managers can be given training to enable them to coach and assist interns. Since managers cannot treat every employee equally, recognizing the two groups (in-group and out-group) can help the manager at least strive for equality (Breevaart et al., 2015). Thus, the manager can make every effort necessary to aim for the highest possible quality of LMX. In addition, accounting professional chambers can organize supportive and developing training programs for professionals to develop their leader-member relationships.

Second, a higher level of OSE resulted in a higher level of OC. Researchers have confirmed that OSE can be increased through education and internship (Thornberry et al., 2020; Oberman et al., 2021). Therefore, management can adjust job design and motivational techniques in terms of training and education. Interns with higher OSE are more motivated to self-actualize and learn voluntarily. For this reason, interns should be provided with education and training, and appropriate promotion and further training opportunities should be given to them. Furthermore, management can create appropriate learning environments and systems. On the one hand, the job design can stress job enrichment, and interns can be provided with more opportunities to be involved in the planning and control of the job. In addition, the Ministry of National Education can include OSE training in the high school curriculum to increase the self-motivation of accounting interns.

Third, the result of the study showed that OSE improved OC. Hence, enterprises should also focus on enhancing the OSE of their interns. Self-efficacy can be improved in several ways (Luthans et al., 2007). First, the opportunity to experience success can be presented. For instance, managers can deliberately place their interns in situations where they are more likely to achieve success and give them tasks they enjoy doing. Moreover, assisting an intern with breaking down a complex task into subtasks can also enhance the intern's OSE. Teaching them skills for one subtask at a time can enable interns to experience multiple accomplishments when successfully completing a subtask. Fourth, study results confirmed that the relationship between LMX and OC was mediated by OSE. Therefore, enterprises should focus on creating high-quality LMX within the organization and increasing the OSE of their interns. This will cause higher OC, which has benefits for both the enterprise and interns.

Although the present work provides meaningful implications for both academicians and implementers, future studies should consider a number of limitations. First, the current research is limited to accounting interns only. In future research, the scope of evaluations can be expanded to include other professions. Second, the present work stresses the mediating role of OSE. Other factors such as hope, optimism, and resilience, which are the other dimensions of positive psychological capital, can also be investigated. Furthermore, researchers can also investigate whether workplace qualities (such as collaborative culture) play a role in LMX and OC behavior. Third, the present study is limited to the quantitative research method. Further research opportunities may involve applying a qualitative research approach using focus groups, interviews, and observation methods for a more detailed understanding of this subject.

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Management Accounting Approach in International Strategic Moves: The Guantanamo Case

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ABSTRACT

An application carried out in the USA, which is closely related to international relations, is the subject of this study. The USA created a camp by renting a piece of land called Guantanamo in the south of the Cuban Island. In this camp, people alleged to be international criminals or members of a terrorist organization were kept, imprisoned and subjected to various treatments. With this action, the USA aimed for many goals, incurred costs and aimed to gain a benefit in return for these costs. The aim of the study is to examine the aims to be achieved by the Guantanamo camp and the costs incurred, to subject these to a deep analysis in terms of the USA, Guantanamo and the world public opinion and to present the results to the world public opinion by examining them in terms of management accounting. As a result of the analysis, it has been determined that Guantanamo Prison affects the net profitability positively for the USA, while negatively affecting the net profitability for the selected location, Guantanamo, and the world public opinion.

Keywords: Strategy, Strategic Management, Strategic Management Accounting, International Relations, Guantanamo Prison.

JEL Classification Codes: F50, L10, M40, M41

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INTRODUCTION

Almost every person, family, community of people, city, state, institutions, organizations and groups make strategic decisions on many issues that concern them. If the issue is considered individually, people make their most important strategic decisions when choosing a job and a spouse. Besides, they may have to make strategic decisions on many important issues that may radically affect their future. Similarly, institutions and states make strategic decisions on many issues, and these decisions significantly affect the future of institutions and states.

Since the subject of the study is determined on the level of international relations, the following explanations will be continued on strategic issues made at the institutional level, that is, made at the country or state level, rather than personal strategic decisions.

Important strategic decisions for a state can be listed as the decision to become or not to become a member of an international organization or community, the decision to enter or not to enter into war, the decision to initiate or terminate diplomatic relations with other states, etc. The aim of states can be summarized as "They should also make their citizens happy, in addition to maintaining their existence". In order to make their citizens happy and maintain their existence, states may have to perform actions that do not seem like a normal form of behavior in daily life, such as going to war, occupying another country's territory, abandoning a piece of land under their sovereignty, killing or kidnapping some people. In order to make their citizens happy, states regularly carry out routine tasks such as investing in cities, opening cultural centers, giving incentives, providing support, and reducing inflation. In addition to these, they can engage in many activities that can be considered routine, such as operating in international organizations or institutions, making international commercial agreements, and attracting international capital to invest in the country. These activities are activities that states have to carry out regularly under normal conditions in order to make their citizens happy or provide adequate living conditions. In addition, states can engage many activities under daily working conditions or in underground operations behind secret doors. These activities aim not only to make their citizens happy but also aim to gain superiority over other states. Superiority can be achieved in various ways, such as commercial, military, political, territorial

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gains, psychological, etc. States gaining superiority over each other can occur in the form of routine actions, either covertly or overtly, as well as through attacks at expected or unexpected dates and times. These attacks aimed at gaining superiority over other states can take various forms, such as starting a non-existent international relationship, ending an ongoing international relationship, declaring war on any state or occupying the territory of any state, arresting, detaining or killing any individual. Countries that carry out these attacks in the international arena may sometimes achieve their goals, but the opposite may also occur. The goal that seems to have been achieved after the attack may be lost depending on the reaction of the rival state. Moreover, a significant part of the opportunities available before the attack may be lost due to reasons such as the wrong attack, the wrong date, the wrong state.

While states carry out their visible activities in order to please their citizens in the international arena, they remain within international legal dimensions. However, sometimes their secret international activities or attacks may not be in compliance with international law. Although every state that engages in such activities declares to the international public that it carries out all its activities at the international legal level and does not do anything illegal, such activities can sometimes be a matter of debate.

It would be useful to leave the explanations about successful or unsuccessful attacks at the international level to other sections of this study and to explain the purpose of the article. A practice carried out by the USA, which is closely related to international relations, is the subject of this study. The USA rented a piece of land in the south of the Cuban Island, called Guantanamo, and created a camp. In this camp, people alleged to be international criminals or members of a terrorist organization were detained, imprisoned and subjected to various treatments. Although all of these actions took place in a remote location away from the eyes of the world, the events have leaked to the world public opinion. What happened in Guantanamo is not a situation that has been very common or frequently encountered throughout human history. With this action, the USA aimed for many goals, incurred costs and aimed to gain a benefit in return for these costs. This purpose of gaining benefit can be thought of as income obtained in return for costs.

The purpose of this study is to subject the aims to be achieved and the costs incurred by the Guantanamo camp to a deep analysis in terms of the USA, Guantanamo and the world public opinion, and to present the results to the world public opinion by examining the results in terms of management accounting. In line with this objective, the study consists of five parts. Following the introduction, the concept of strategic decision is explained in the second part. In the third part, management accounting is explained, and in the fourth part, the concept of international relations is explained. In the last part, which is the fifth part, after giving information about Guantanamo Prison, the creation of this prison was subjected to benefit cost analysis for various groups. The study was concluded with the sixth part, conclusion. It is thought that the study will contribute to the literature as it is the first study on the subject.

STRATEGIC DESICION

Before explaining the concept of "Strategic Decision", the terms of this concept are examined separately as follows:

Strategy and Strategic Management

The word "strategy" is based on the Greek "strategos" meaning "general". The Greek verb "stratego" means "to plan the destruction of one's enemies through the effective use of resources" (Bracker, 1980). Examples of military-based strategies are the use of the Trojan Horse, the development of the warship and the concept of fortified castles (Chinowsky, 2000).

Although the concept of strategy has maintained its importance throughout history in a military or political context, today it has a broader perspective and a meaning that does not differ from the general politics of any institution or country. Today, strategy has spread to a framework that focuses on the welfare, demands and tendencies of society rather than the military dimension. Therefore, strategy today covers a wide area including psychological, social, economic, ideological, military and administrative issues. In the field of management, the concept of strategy, which began to be used in the second half of the 20th century, functions as a tool that enables businesses to achieve their goals by using their resources effectively to regulate their relations with their environment and gain competitive advantage (Demir & Yılmaz, 2010).

Strategy in business management refers to the process of ensuring environmental compliance based on continuous internal and external environmental analysis in order to provide a certain direction to businesses and to maintain competitive advantage in the market. In this context, creating the necessary action plans and providing the necessary tools and resources to implement these

plans constitute the basis of the strategic management process. In other words, strategy involves creating a long-term general business plan by by effectively using existing resources to achieve predetermined goals (Ergin & Elmacı, 1999).

Strategy is the sum of the steps taken by managers to increase business performance compared to their competitors. If the business strategy leads to superior performance for the business, the business has a competitive advantage (Hill & Jones, 2022). In this context, strategy is the deliberate exploration of a plan of action that will develop and increase a business's competitive advantage. For any company, this search is an iterative process that begins with **recognizing the current position** and resources available. In this process, the most dangerous **competitors** are those who are most similar to you. A self-made business, no matter how small, already has some kind of competitive advantage. In this context, the objective is to enlarge the scope of your advantage, which can happen only at someone else's expense (Henderson, 1989). Thus, the essence of strategy is the creation of a unique and valuable position by choosing different sets of activities from competitors. If there was only one ideal position, there would be no need for strategy. If the best set of activities to produce all varieties, meet all needs, and reach all customers were the same, companies could easily switch between them and determine their operational efficiency performance (Porter, 1996).

The term "strategic" means "related to strategy". Since strategies can exist at various levels of a business; it is completely acceptable and appropriate to have a strategic plan at the business level, business unit level, and functional level. "Strategy" also means "important or valuable." Therefore, strategic plans aim to address the "important issues" at all levels of the business. In this respect, strategic issues, initiatives and plans are issues that affect the business in significant ways. Among these, those related to the direction and goal of the company (where is the business going?, what will happen?) are the most important. Not all strategic issues have to be long-term; a short-term crisis can also be of strategic importance and should be addressed accordingly. Briefly; the term "strategy" means "of great importance" (Nickols, 2016).

Strategic management involves analysis of a firm's internal and external environment and aims to ensure maximum use of resources according to objectives. Another important aspect of strategic management is supporting organizations to anticipate and cope with change. It also helps improve the ability to successfully cope with uncertainties and increases the ability to achieve goals by defining the process of achieving them (Bracker, 1980).

Strategic management is a set of decisions and actions that develop and implement strategies to provide a competitive advantage against the environment in order for the business to achieve its goals. Business managers utilize the strategic management process to answer strategic questions such as "Where is the business now and where would it like to be in the future?, What changes and trends are there in the competitive environment?, Which action plans will help achieve the goals?" (Daft, 1997). In this context, strategic management is a set of decisions and activities that focus on the development and implementation of effective strategies and the evaluation and control of their results. The strategic management process can be defined as a specific decision-making or problem-solving process. The beginning of the strategic management process, which generally includes the stages of planning, implementation and evaluation, is the determination of goals and the development of appropriate strategies. This is followed by the implementation of these strategies and the control and evaluation of the results obtained (Alpkan & Doğan, 2008).

Yüzbaşıoğlu (2004) defines strategic management as "the science of clearly and precisely explaining the functional decisions that will enable the organization to achieve its goals, completing and evaluating the integrity".

In this context, strategic management involves explaining the functional decisions of the organization in a distinct, clear and understandable way, requires the harmonious combination of these decisions with each other, and focuses on the systematic evaluation of the results obtained.

Decision and Strategic Decision

Managers face a number of challenges related to their decision-making processes, both due to the rapidly changing business world and the desire to achieve predetermined goals. Since the decisions taken by the manager play an important role in determining the success or failure of the business, the decision-making process in modern business is considered a critical function in business management (Kalmış & Dalgın, 2010).

The choice made by a manager or any individual on any issue is a decision. For this reason, the concepts of "preferring, adopting, choosing, taking a stand" and "decision making" are very related concepts. The solution or alternative path that a manager adopts after a process of deep thinking and evaluation on the issue represents the manager's decision (İzci, 2014: 190). Decision making means making an evaluation about what to do in a particular situation after considering some alternative action plans. The decision-making process is similar to the management process and includes three basic stages: finding a decision-making opportunity, finding possible action plans, and choosing among action plans (Harrison, 1996). These steps are followed to make a decision consciously and effectively.

In businesses, decisions are generally classified within a certain hierarchy. This classification is as follows (Arslan, 2008):

- Corporate Decisions
- Strategic Decisions
- Managerial Decisions
- Operational Decisions

This hierarchical classification provides a framework for understanding and managing decisions made at different levels of businesses.

Strategic decisions are decisions made in environments where change and competition are intense. These decisions are generally aimed at long-term goals and involve situations where the business faces risk, complexity and uncertainty. In addition, strategic decisions aim to gain advantage over competing activities and are result-oriented (Ülgen & Mirze, 2010; Arendt, Priem & Ndofor, 2005). In other words, strategic decisions can be defined as decisions taken in situations where future uncertainty and risk are high. In this context, the strategic decision-making process requires considering creativity, innovation, change and long-term impacts. Strategic decisions should be based on the principles of sustainability and effectiveness, which are important for the long-term success of the business (Papatya & Uygur, 2019).

Unlike many other decisions, strategic decisions deal with the long-term future of the organization and have three basic characteristics (Hunger & Wheelen, 2020):

- Rarity: Strategic decisions are unusual and usually do not have a predetermined situation to follow.
- Significance: Strategic decisions require significant resources and require great commitment from people at all levels.
- Directing: Strategic decisions are smaller decisions throughout the organization that provide guidance for future actions.

Since strategic decisions relate to the future goals and position of institutions, they involve great uncertainty and unpredictability. These decisions are made by coalitions that represent different units within the organization and therefore have various individual interests, as well as focus on different strategic agendas. This shows that strategic decision making is a highly political process (Shepherd & Rudd, 2014; Kurdoğlu & Ateş, 2021).

Today, the globalization of markets and the development of communication and transportation technologies have brought about an intense competitive environment in the business world. Being successful in this competitive environment is possible by making timely and correct decisions. In order to make the right decisions, timely, accurate and sufficient information is needed. Businesses must be able to produce a wide range of information, from their own internal activities to market competition, from the activities of rival companies to market structures, and deliver this information on time and to the necessary places. In this way, businesses can increase their competitiveness while continuing their operations profitably (Göl, 2015).

In other words, the ability to access information quickly and effectively plays a critical role in businesses gaining competitive advantage. Being successful in competitive environments is not only related to access to accurate information, but also to the ability to use this information effectively and make quick decisions.

MANAGEMENT ACCOUNTING

In today's competitive business environment, it is vital for business managers to make the right decisions to achieve their business goals. The decision-making process is a process that requires choosing the most appropriate one among various alternatives. Managers need information about decision options when choosing between these alternatives. Here, management accounting is a discipline that provides business managers with the information they need in their decision-making processes by providing numerical data (Yürekli, 2017). In this regard, management accounting is a type of accounting that provides business managers with the ability to organize and interpret the necessary information, create an annual budget and control it with standard applications, and also offers the

opportunity to make strategic analysis to evaluate the current situation (Yükçü, 1999).

The management accounting information system does not adhere to any formal rules that define the nature of processes, inputs or outputs. The criteria are flexible and based on management objectives. The management accounting system has three general purposes. These are (Hansen & Mowen, 2007):

- To provide information to determine the cost of relevant products, services and other objects,
- To provide information for planning, control, evaluation and continuous improvement,
- To provide information for decision making.

Management accounting collects information obtained not only from financial accounting sources, but also from economics, finance, operations research and other related disciplines, going beyond the boundaries of accounting, and transforms this information into usable data in line with the needs of management (Hacırüstemoğlu & Şakrak, 2002).

The information provided by accounting, especially financial accounting, helps managers in planning, control, organization and direction, and decision-making functions. At this point, the features that make management accounting different from financial accounting are as follows (Garrison, 1991):

- Management accounting focuses on providing data that the manager will use,
- Management accounting places more emphasis on the future,
- Management accounting attaches importance to data being relevant and flexible,
- Management accounting places less emphasis on precision and more emphasis on non-monetary data,
- Management accounting focuses on parts of the business rather than looking at the business as a whole,
- Management accounting draws heavily from other disciplines,
- Management accounting is not governed by generally accepted accounting principles,
- Management accounting is not mandatory.

Topics included in the field of management accounting that help corporate managers make plans by using accounting as an effective tool and make decisions by auditing activities are (Haftacı, 2013):

- Collecting cost and profit data,
- Standard costs and budgeting,
- Comparing activities with plans and budgets,
- Making recommendations about the potential consequences of decisions made by management.

The rapid increase in global competition and technological change have primarily led to the need for changes in business management approaches and practices. This need for change has led to the emergence of new searches in accounting systems, which are the basic basis of management decision processes. Businesses must necessarily adopt an adaptation process to meet these changes in cost and management accounting systems. This transformation and developing approaches necessitate an adaptation process to adapt the accounting systems of businesses to the emerging needs (Ergin & Elmacı, 1999).

In the 1980s, academics, consultants, and senior managers emphasized the importance of developing and implementing competitive strategies. Traditional management accounting is generally focused on the internal business and does not deal with external environmental and market conditions. This accounting approach focuses on short-term decisions, preparing plans and budgets, and measuring success. However, it often does not provide the financial information necessary to support monitoring existing strategies and developing new strategies. Strategic Management Accounting (SMA) can address this gap by providing businesses with financial analysis that supports the development of competitive strategies, and strengthens the strategic decision-making processes of businesses by providing such information (Yalçın, 2006). In this context, while traditional management accounting focuses on financial decision analysis and budget control, modern management accounting covers a more strategic approach that emphasizes determining, measuring and managing share value (Appelbaum et al., 2017).

Strategic Management Accounting (SMA) is the practice of preparing, storing and analyzing cost accounting information for management regarding business strategies. Business strategies are particularly concerned with real costs; it covers strategies related

to prices, quantities, market shares, cash flow and overuse of all resources in the business. In this context, it is observed that the term Strategic Cost Management (SCM) is generally used in the literature instead of the concept of SMA (Yüzbaşıoğlu, 2004).

Strategic cost management is not only cost management but also revenue management, in short, it is a philosophy of improving cost and revenue. Therefore, SMA aims to increase productivity, maximize profits and increase customer satisfaction. This philosophy plays a vital role in determining the future of the company because it promotes the idea of constantly finding ways to help organizations make the right decisions, thus moving towards the goal of creating more customer value at lower cost (Kumar & Nagpal, 2011).

In this context, factors such as low cost, high quality, product and service diversity, which arise due to the constant change of customer demands and increasing competition, have made accounting more than just a recording system for businesses, creating and guiding various forward-looking plans and strategies for the future and a tool sensitive to management needs.

After these evaluations regarding management accounting, in addition to being taught as a course, management accounting can be used as a tool in making decisions for businesses, families, all institutions, states and all human communities.

When deciding on any kind of formation, it is necessary to use, think and evaluate non-monetary data as well as monetary data. Regardless of how high monetary costs or revenues may be, the impact of some non-monetary benefits and costs may be much higher and more impressive than the impact of seemingly very high monetary values. Many social, political and economic events based on relationships of interest occur, especially in human relations, inter- corporate relations and intergovernmental relations. To make healthy decisions regarding these events, it is very beneficial to consider not only the benefits or revenues created by the relationship but also the costs or burdens.

In this study, management accounting was tried to be used with this approach. The subject examined is an extremely important, sensitive and impressive issue in terms of human relations. The fact that such a phenomenon took place deeply affected many people, families and the state, and the results were quite striking. What has happened from the beginning of the process until today may have resulted in an outcome or reached a conclusion for one of the parties. However, the impact this has on different groups of people may be very extreme. In this respect, concrete management accounting analyzes were tried to be made in the study.

INTERNATIONAL RELATIONS

In this section, after general information about international relations is given, the impact of the 9/11 attacks on International Relations is explained in accordance with the subject examined.

General Information about International Relations

International relations theories offer an approach to understanding the causes and formation processes of international events. After the long-term evolution process from the Treaty of Westphalia in 1648 to the end of the First World War, the discipline of international relations gained an autonomous perspective for the first time with the French Revolution in 1789. During this period, international relations were generally referred to as interdynastic relations, with a few exceptions in Europe where monarchies dominated. The Treaty of Westphalia of 1648 laid the foundation for the modern system of nation states in Europe. The French Revolution, on the other hand, revealed era-changing movements such as nationalism and led to the spread of nation-state structures worldwide. With this change, individuals have now shown more interest and participation in foreign policies for their own nations (Kutlu, 2023).

International Relations became a discipline in the 20th century, following World War I, and studies in international relations became widespread and matured after World War II. International Relations is a branch of social science that examines the political, legal and economic interactions between various actors as well as states (Bal, 2006).

Although the concepts of international relations and international politics are sometimes used interchangeably, international relations is a branch of social science with a broader perspective and includes many factors that go beyond political relations between states. This scope includes states, as well as governments, populations, international organizations, non-governmental organizations, multinational companies and other actors. It has a broad perspective covering many areas such as political, economic, commercial, financial, military, cultural and social. In this context, international relations have a broader framework and include not only political interactions between states, but also the participation of other actors and interactions in different fields (Arı, 2001).

The branches of science within the scope of International Relations are defined as follows (Bal, 2006):

- **International Politics:** International Politics is one of the sub-branches of international relations, that primarily examines the relationships between sovereign states, but also explores the complex relationships among various actors including individuals, international organizations, pressure groups, multinational corporations, and terrorist organizations.
- **International Economics:** It is a sub-branch of international relations that deals with foreign trade activities, the circulation of production factors, the decisions taken by countries in this field, international monetary movements, international economic integrations, theories and international relations and connections on the path of development.
- **Internation Law:** It is all the legal rules that members of the international community, especially independent states, must comply with in their relations with each other.
- **Foreign Policy (Politics):** These are the policies implemented by states outside their borders. There are many relations between states at the political, geographical, educational and military levels, and diplomatic contacts are needed to realize these relations. Diplomatic contacts can occur in a positive or negative way. Diplomacy has a very important place in these negative relations (Daban, 2017).

At the beginning, in international relations where initially only states were the actors/agents/determinants, new actors that emerged over time have gradually increased their effectiveness. In order for any unit to be considered an actor, it must be an organized, effective center of power that can carry out independent activities. Considering these features, when we look at the international environment, states, organizations, legal entities and private individuals that carry out international relations appear as the actors of international relations (Toklu, 2006).

The main actors within the scope of International Relations are defined separately below:

- **States:** The state, which is a geographical integrity governed by a central authority, is seen as the most important actor. The state is the main actor that initiates efforts to ensure the physical security of the population, ensures the economic well-being of citizens, creates a focal point for loyalty and belonging, and asserts sovereignty (Viotti & Kauppi, 2014).
- **International Organizations:** It is certain that states are not the only axis in international relations, especially in the age of globalization. International organizations, also known as intergovernmental organizations, are organizations established to find solutions to global problems and whose members are states. For example; entities such as the United Nations (UN), the European Union (EU) and the North Atlantic Treaty Organization (NATO) (Viotti & Kauppi, 2014).
- **Supra-national Organizations:** They are actors to which states delegate some of their sovereign rights and powers. The most developed of these actors is the European Union (EU) (Gül, 2014).
- **Non-governmental actors:** Non-governmental actors, which operate in almost every field from political issues to economic issues, from environmental problems to the protection of human rights, and play an important role in all issues, both on a national, regional and global scale, are also classified by definitions such as non-governmental organizations, non-profit organizations and voluntary organizations. Non-governmental organisations, pressure groups and organized interest groups, lobbies, political parties and groups, individuals, private actors, social sub-groups, leaderless communities and movements (workers, feminists, peace, nature), professional organisations, multi-national companies, are the most prominent examples of non-governmental actors (Gül, 2014).

American territory faced an attack for the first time with the 9/11 attacks, which occurred after the Japanese Navy attacked the Pearl Harbor naval base in Hawaii on December 7, 1941. More than two thousand American soldiers died in the attack on Pearl Harbor, and after the attack, the USA decided to enter World War II. While the attacks on September 11th mostly caused the death of civilians, they also started a new era in American foreign policy (Erdem, 2014). The main difference between the attacks and Pearl Harbor is that Osama Bin Laden, the former head of the terrorist organization Al Qaeda, was a non-state (non-government) actor. Osama bin Laden, who initiated the 9/11 attacks, managed to evade the

efforts to kill and capture him for more than twenty years. He was killed by American Special Forces in Pakistan in May 2011 (Viotti & Kauppi, 2014).

For this reason, the effectiveness of non-state actors in the discipline of International Relations has been opened to further discussion after the 9/11 attacks.

Transformation in International Relations Thought after the 9/11

On September 11, 2001, 19 terrorists hijacked four commercial airliners in the United States, crashing the first two into the Twin Towers of the World Trade Center and the third into the Pentagon in Washington, D.C. The last plane, along with its passengers and crew, crashed in a field in Pennsylvania. After all these attacks, in which thousands of people lost their lives, a state of emergency was declared in the USA and the President was given full authority (authority to use all necessary and appropriate force against nations, organizations, or persons who planned, authorized, carried out, or supported the terrorist attacks of September 11, 2001, in order to prevent future acts of international terrorism against the United States). Thus, the war on terror began, and the world united behind the United States by providing the necessary support and assistance to combat the threat. The coalition countries, acting together with the United States of America, demonstrated this widespread support by launching air strikes on the capital city of Afghanistan, Kabul, on October 7, 2001 (Jamison, 2005).

The September 11terrorist attack is one of the most important breaking points in recent international relations considerations and is considered to be the turning point of the 21st century international system, which created widespread effects even though it did not have the nature of war to a large extent. In the international environment after 9/11, the distinction between Islam and others has become clearer. The opinion has spread that the concept of radical Islam, symbolized by the identity of Al Qaeda, poses a great threat to the civilized world and that global terrorism is the world's most important security problem (Bahçeşehir Üniversitesi Yayınları, 2007).

After 9/11, a new perspective was adopted on concepts such as terrorism, Islam, security, extremism and fundamentalism. The balance of power around the world has been re-evaluated and international politics has become **inconceivable** without taking 9/11 as a basis. New fields of knowledge such as security studies and terrorism studies have rapidly developed and gained importance. The concepts of security and freedom of travel in daily life have undergone a radical change. New military units were established, strategies were reviewed, and great advances were made in weapons/intelligence technologies. The maps of the countries subjected to military interventions and occupations have changed and political governments have been shaken. Discussions on law and human rights have entered an important turning point with the emergence of practices such as Guantanamo Prison. This process has brought about deep thoughts and struggles about the legal norms and ethical values of the international community (Yılmaz, 2011).

Guantanamo Bay is a 45-square-mile area of Cuba occupied by the United States under a perpetual lease agreement established in 1903. Under this lease agreement, the USA gained the right to use the region for coal supply and naval operations. The text of the lease stipulates that "the United States will exercise full jurisdiction and control over these areas" while also reserving the right to "ultimate sovereignty" over Cuba. Therefore, since December 1903, Guantanamo Bay has operated as a USA naval base, and the area has been closed to private use, access and navigation without the USA permission. The base maintains its own schools, energy system, water supply, and internal transportation system. The base commander describes it as "small town of America." Previously entirely dedicated to military and related purposes, this 'small town' was converted into a detention camp for those seeking asylum in the USA in the early 1990s. Between 1991 and 1996, more than 36,000 Haitian and more than 20,000 Cuban asylum seekers were detained at Guantanamo Bay for varying periods of time under U.S. asylum policies, relying on interdiction, administrative detention, off-shore processing, and repatriation whenever possible. Thereafter, the immigrant processing operation at Guantanamo Bay was closed, except for short-term operations in 1996 and 1997. But in January 2002, shortly after launching a military campaign in Afghanistan, the United States began transferring hundreds of individuals captured in military operations in Afghanistan to Guantanamo Bay, where they have been detained since then without being charged as 'unlawful combatants' (Fleur, 2005).

After the September 11 attacks, the USA adopted unilateral and aggressive security strategies and declared a state of emergency on an almost global scale and implemented this understanding. It has adopted a series of policies and practices that set aside international war law regarding the detention and trial processes of captured terrorist criminals. The practices

in Guantanamo Prison, which are among the examples where the USA set aside or violated its obligations arising from international law, can be considered as important spatial representations of the state of exception, where law is instrumentalized according to the decisions of the sovereign. The extraordinary powers used to combat terrorism under the Bush administration continued during the Obama administration, and Guantanamo became the symbol of continuous detentions and laws that put them outside international law (Arıöz & Özekin, 2021). By deciding to keep the detention facilities at Guantanamo Bay open, Trump repeated his claim that terrorists are not ordinary criminals, but rather enemy combatants, showing that the state of exception has become normalized and continues under the pretext of a global war against terrorism (The Guardian, 2018).

The features that distinguish Guantanamo Camp, which has been operating since 2002, from other prisons are that general legal rules do not apply, what happens inside is kept secret from the outside world, and people are kept for years without being brought to trial. Guantanamo has become a torture center, especially after 9/11. This situation was criticized by many human rights organizations, and the United Nations reports emphasized that the prison should be closed (Baştuğ, 2011).

GUANTANAMO PRISON

Explanations regarding Guantanamo Prison are given under the following headings:

Purpose of the study

The aim of the study is to subject the aims to be achieved by Guantanamo prison, the costs incurred, to a deep analysis from the perspectives of the USA, the chosen location (Guantanamo) and the world public opinion, and to present the results to the world public opinion by examining them from the perspective of management accounting.

Guantanamo Prison

After 9/11 attacks, the terrorist organization Al Qaeda claimed responsibility, and the USA invaded Afghanistan on October 7, 2001, on the grounds that it was used as a base by this organization. Immediately after this occupation, some prisons abroad, which were described as the dark side of Bush's "global war on terror" policy, were established and detainees in these prisons were subjected to torture-containing interrogations. The USA military has transferred terrorist suspects in many countries, especially Afghanistan, to interrogation centers on American bases and secret prisons established by the Central Intelligence Agency (CIA) for interrogation. On January 11, 2002, the Bush administration announced that a prison was established at the USA Naval Base in Guantanamo Bay, Cuba, to hold terrorist suspects. However, although Guantanamo is known as the only prison where terrorist suspects are detained, the existence of torture prisons in many countries such as Thailand was kept secret until 2006. Among those detained in Afghanistan, Iraq and other countries in the region, 680 suspects were brought to Guantanamo in the first year after its establishment. According to the USA Department of Defense, a total of 797 suspects have been detained in Guantanamo so far. Guantanamo prison is described as "the worst prison in the world". The status of the suspects, dressed in orange clothes and black hoods, has been at the center of discussions about Guantanamo. The Bush administration established this base by opposing international public opinion and human rights organizations in order to easily carry out torture, which is considered a crime, on USA soil and to prevent prisoners held in Guantanamo from benefiting from the rights provided by USA law. In addition, this administration defined the detainees brought to Guantanamo as "enemy combatants" and paved the way for these people to be tried in military courts (Anadolu Ajansı, 2022).

When Barack Obama announced his candidacy for the presidency in 2007, he promised to close Guantanamo and frequently mentioned this commitment as an important promise during his election campaign. After taking over the presidency, he stated that he saw Guantanamo as "a dark stain on the image of the United States" and signed a decree ordering the closure of the prison within a year, but he could not fulfill this instruction. In February 2016, in his last year of office, he announced his plan to close Guantanamo and stated that they were considering sending some of the remaining detainees to their own countries or to other countries that would accept them. However, it planned to transfer some detainees who were still perceived as threats to prisons in the USA. Obama admitted that his efforts to close Guantanamo were blocked by the American Congress during his term of office and that he was subjected to pressure on this issue. When he took office, he completed the trials of 204 of the 245 detainees in Guantanamo, returned some of them to their own countries, and left some of them to the control of third countries. The most notable incident related to Guantanamo in recent years was the exchange of American Sergeant Bowe Bergdahl, who was held as

a Taliban prisoner in Afghanistan, for 5 Taliban members in 2014. These Taliban members, known as the "Taliban Five", were appointed to important positions in the Taliban interim government established in Kabul after August 31, 2021, when the United States completed the withdrawal process from Afghanistan (Anadolu Ajansı, 2022).

During the 2016 election process, Donald Trump promised that if he won the presidency, Guantanamo prison would not be closed and that he would continue to hold those accused of terrorism in this prison. One year after taking office, Trump announced in his "State of the Union" speech to Congress on February 18, 2018, that he had signed a new Executive Order to keep Guantanamo prison open. While no new detainees were added to the prison during Trump's administration, after Trump's announcement in Congress, the Pentagon announced that they returned a detainee named Ahmed Muhammad Ahmed Haza al Darbi, a Saudi Arabian citizen, to Riyadh on May 2, 2018. It has been stated that Darbi, the only detainee released from Guantanamo during the Trump era, will remain in prison in Saudi Arabia until 2027 (Anadolu Ajansı, 2022).

USA President Joe Biden stated that Guantanamo Prison should be closed both during Obama's vice presidency and during the 2020 presidential election campaign. However, only one Guantanamo detainee was released after Biden took office. The Pentagon announced on July 19, 2021 that they extradited 56-year-old Abdullatif Nasser, the last Moroccan citizen held in Guantanamo, to Morocco. This incident was recorded as the first release under Biden's presidency, and the number of detainees in Guantanamo fell to 39. However, Biden's success in closing this famous prison remains uncertain. According to the statements made by Pentagon Spokesperson John Kirby, the sentences of two of the 39 detainees in Guantanamo have been finalized, and the military court process of 10 detainees continues. While 13 other detainees were found suitable for extradition to another country, 4 detainees were subject to periodic review. The evaluation continues whether the detainees, who are subject to periodic review after the military court process is completed, will be extradited to another country later. After the relevant processes are completed, the necessary audit procedures will be discussed with the country to be returned. It was determined that 85 percent of the detainees released from Guantanamo or extradited to another country during the Obama administration had no connection with terrorism, but despite this situation, it took years for 197 detainees to be released. It is said that the release of the remaining 39 detainees may require a similar long process. The closure of Guantanamo prison is considered unlikely by the USA public, especially under pressure from Congress (Anadolu Ajansı, 2022).

Benefit Cost Analysis of Guantanamo Prison

The benefit cost analysis of Guantanamo Prison was made separately from the perspective of the USA, Guantanamo and the world public opinion as in the following:

Benefit Cost Analysis of Guantanamo from the Perspective of the USA

After the statements made about Guantanamo Prison, some analyzes were made regarding the expectations and costs incurred for the establishment of this prison.

In the first stage, the issue was evaluated from the perspective of the USA. The United States created Guantanamo prison with many expectations. It is very difficult to express these expectations, in other words, the returns, in monetary terms. Because the USA aims to fight its enemies in the creation of this prison. In order to effectively fight its enemies, the United States has made efforts to obtain information and has been able to obtain the necessary information. An operation was performed in line with this information, and as a result of this operation, the goal was achieved. Having achieved the goal is an invaluable benefit for the United States. This is because, in pursuit of this goal, the USA has been able to ensure the security of the country and its citizens.

In the analysis in Table 1, in addition to many monetary values, there are also non-monetary returns and costs. Although it is difficult to express these non-monetary returns and costs as amounts, they can be considered inestimably valuable. The amounts included in the analysis were created based on estimates from the data obtained as a result of literature reviews. It is not possible to state that these amounts are completely definite and accurate. While examining the analyzes in the study, the reader may imagine that there may be figures far different from those placed in the table. The purpose of making these analyzes is to encourage the reader and those who want to benefit from the analysis to think unlimitedly on this subject. Each reader may predict very different amounts in his or her own way. Some of the variables in the table are taken into account with their trace value.

In Table 1, where the situations of establishing Guantanamo Prison which is the current status and not having Guantanamo Prison are compared for *the USA*, there are many monetary

Table 1. Benefit cost analysis of Guantanamo from the perspective of the USA

	PRESENCE of GUANTANAMO (Current Status)	ABSENCE of GUANTANAMO
MONETARY INCOME		
• Friendly states saying yes to USA requests	$100,000,000,000	-
• Enemy states cowering to USA demands	$100,000,000,000	-
NON-MONERTARY INCOME		
• USA's survival problem	Present	Not Present
• Security of life of USA citizens	Present	Not Present
• Show of power to the world	Present	Not Present
• Feeling of superiority over all enemies	Present	Not Present
• Survival problem of USA enemies	Present	Not Present
• America's deterrence and psychological superiority over other countries	Present	Not Present
• Elimination of Osama bin Laden and his friends	Present	Not Present
TOTAL REVENUES	**$200,000,000,000**	**0**
COSTS		
MONETARY COSTS		
• Guantanamo rent expenses	$100,000,000	0
• Guantanamo personel expenses	$30,000,000	0
• Guantanamo operating expense	$20,000,000	0
• Transportation expense to Guantanamo	$80,000,000	0
• Medical expenses of the victims	$1,000,000	0
• Victims' compensation claim	$1	0
NON MONETARY COSTS		
• The world's perception of a lawless state	Present	Not Present
• Loss of image	Present	Not Present
• Damage to relations with Cuba	Present	Not Present
• USA's survival problem	Present	Present
• Life safety problem of USA citizens	Present	Present
TOTAL COSTS	**$281,000,001**	**0**
NET PROFIT ($200,000,000,000 - $281.000.001	**$199,718,999,999**	**0**

Source: Table 1 was created by us based on information compiled from the sources listed in the references.

Table 2. The costs that may arise if Guantanamo is located in Cuba and in the USA

	GUANTANAMO in CUBA (Current Status)	GUANTANAMO in the USA
Guantanamo rent expenses	$100,000,000	$10,000,000
Guantanamo personnel expenses	$30,000,000	$10,000,000
Guantanamo operating expense	$20,000,000	$10,000,000
Transportation expense to Guantanamo	$80,000,000	$10,000,000
Medical expenses of the victims	$1,000,000	$7,000,000 *
Victims' compensation claim	$1	$100,000,000 **

Source: Table 2 was created by us based on information compiled from the sources listed in the references.

*Due to the pressure created by the USA people, it is estimated that the "medical needs expense of the victims" will be higher in the USA ($7,000,000), as the health needs of the victims will be met in a more humane way.

**Due to the pressure created by the USA people, it is estimated that the "victims' compensation claim" will be higher in the USA ($100,000,000).

incomes as well as priceless non-monetary incomes in the current situation. In the other option, although there are no monetary or non-monetary returns, there are invaluable non-monetary costs. When the net profitability of the two scenarios is compared, it is seen that there is a significant difference arising from monetary income.

Difference Analysis on the Location Selection of Guantanamo

Citizens of the world reacted to the way Guantanamo prison was created and the inhumane treatment people suffered. However, these reactions were in the form of verbal protests, and no world citizen or state could actually intervene in the Guantanamo prison, which was established on Cuban soil. U.S. citizens living in the United States may also have reacted or wanted to react to the way Guantanamo was created. However, since Guantanamo Prison is not an accessible place for the USA citizens due to its location, the reaction of the USA citizens remained verbal and could not turn into any mass protest.

There are some advantages and disadvantages to the United States between establishing the Guantanamo prison in a rented area in Cuba which is the current status or in an area within the United States Territory in North America. These advantages and disadvantages are seen in Table 2.

Non-monetary revenues and costs are expressed in the relevant column. However, monetary revenues and costs were handled in the form of difference analysis in the analysis in Table 3. The purpose of difference analysis is to calculate the amounts that make a difference between the options and include them in the analysis. The difference between the options can be clearly seen in the result obtained after substituting the relevant amounts in the analysis. However, in this analysis, while the savings in one of the options are taken into account as income, in the other they appear as costs. Analysis is very important in this respect. The aim is to give an idea about how difference analysis should be thought of. Non-monetary values should also be taken into account.

The costs that may arise if Guantanamo is located in Cuba and the USA are estimated as in Table 2.

The values in Table 3 were created by taking the difference of the estimated amounts in Table 2 (only differences are taken into account in the Difference Analysis).

In Table 3, where the establishment of Guantanamo on the Cuban Island which is the current status and the establishment in the USA are compared in terms of location selection, the savings items that are currently included as monetary costs are included as monetary income elements in the other option. In the current situation, due to the fact that Guantanamo is located in Cuba, a place further away from the USA, there are higher levels of rent, personnel, management, transportation, etc. expenses arise. When both scenarios are compared in terms of their differing net profit, it is seen that a significant difference arises due to monetary costs.

Table 3. Difference analysis on the location selection of Guantanamo

	GUANTANAMO in CUBA (Current Status)	**GUANTANAMO in the USA**
MONETARY INCOME		
• Rent expense savings	0	$90,000,000
• Personnel expense savings	0	$20,000,000
• Operating expense savings	0	$10,000,000
• Transportation expense savings	0	$70,000,000
• Medical expenses of the victims	$6,000,000	0
• Victims' compensation claim	$99,999,999	0
NON-MONETARY INCOMES		
• Convenience in operation	Not Present	Present
• Ease of inquiry	Not Present	Present
• Convenience in logistics	Not Present	Present
TOTAL REVENUES	**$ 105,999,999**	**$190.000.000**
COSTS		
MONETARY COSTS		
• Rent expense savings	$90,000,000	0
• Personnel expense savings	$20,000,000	0
• Operating expense savings	$10,000,000	0
• Transportation expense savings	$70,000,000	0
• Savings for medical needs of victims	0	$6,000,000
• Victims' compensation claim savings	0	$99,999,999
NON MONETARY COSTS		
• Negative reaction from the USA public	Not Present	Present
• Reaction of human rights organization	Not Present	Present
• Possibility of physical intervention in the camp	Not Present	Present
• Tabooization of the camp	Not Present	Present
TOTAL COSTS	**$190,000,000**	**$105,999,999**
DIFFERENTIATED NET PROFIT ($105,999,999 - $190,000,000) and ($190,000,000 - $105,999,999)	**($84,000,001)**	**$84,000,001**

Source: Table 3 was created by us based on information compiled from the sources listed in the references.

Table 4: Benefit cost analysis of Guantanamo from the perspective of World public opinion

	PRESENCE of GUANTANAMO (Current Status)	**ABSENCE of GUANTANAMO**
MONETARY INCOME	Not Present	Not Present
NON-MONETARY INCOME		
• Accepting the dominance of the USA in all matters	Present	Not Present
• Knowledge of what will happen in the face of similar events*	Present	Not Present
• Information that similar terrorist activities will not be allowed	Present	Not Present
• Target detection and destruction	Present	Not Present
TOTAL REVENUES	**0**	**0**
COSTS		
MONETARY COSTS		
• The destruction caused by raids on some countries	$10,000,000	Not Present
NON MONETARY COSTS		
• Feeling of fear and dread	Present	Not Present
• Feeling of helplessness	Present	Not Present
• Sense of human rights violation	Present	Not Present
TOTAL COSTS	**$10,000,000**	**0**
NET PROFIT (0 - $10,000,000)	**($10,000,000)**	**0**

Source: Table 4 was created by us based on information from the sources listed in the references.

*The knowledge that in Guantanamo, practices that are extremely cruel, against human rights, and in which some people are disregarded are being practiced when necessary, and that in case of defiance of the USA, similar tyranny, cruelty and inhumane treatment may be exposed.

Considering only monetary values, there will be a difference of $168,000,002 ($84,000,001 + $84,000,001) between the two options. However, when considering non-monetary gains and costs, we leave it to the reader's judgment to evaluate the benefits of Guantanamo being established in Cuba, with the understanding that the most crucial factor for the USA is achieving its goal.

Benefit Cost Analysis of Guantanamo from the Perspective of World Public Opinion

Since the United States of America did not try to hide what was happening in Guantanamo prison from the world public opinion, the existence of Guantanamo prison was revealed by the whole world public opinion. If we look at the photos and videos in the world press, it is understood that the people in charge of Guantanamo Prison want the whole world to be informed about what is happening in this prison, and that they especially took detailed photos and videos and disseminated them to the world public. The purpose of leaking information from Guantanamo Prison to the world public is not just to provide information to the world public. At the same time, it is to make people feel that there are practices in Guantanamo that are extremely cruel, against human rights, and disregard some people when necessary, and to give the message that if the USA is opposed, such tyranny, cruelty and inhumane treatment may be subjected.

Table 4 attempts to present the impact on world public opinion if there is or is not a prison like Guantanamo. According to Table 4, many benefits and costs have arisen due to the existence of Guantanamo Prison.

In Table 4, which compares the presence and absence of a prison like Guantanamo from the perspective of global public opinion, while there are many income and costs in the current situation, in the case of the alternative option of not having the Guantanamo prison, there are no revenues and costs involved. Again, when the net profitability of the two scenarios is compared, it is seen that there is a significant difference, especially due to monetary costs. This monetary difference is significant and has emerged in favor of not creating Guantanamo Prison. However, considering the non-monetary income and costs, even though it contains some negative images against the USA, these moves made by the USA or the actions it can take when the survival problem is in question, can be used to intimidate the world public opinion, determine the level of international moves, and predict the cost of potential aggressive strategies against the USA.

CONCLUSION AND RECOMMENDATIONS

The subject of this study, written as a management accounting study, is based on the 9/11 attacks in the USA, the Guantanamo Prison established after these attacks, and the destruction of Osama Bin Laden, the perpetrator of these attacks.

The process appears to have been planned and carried out by the USA secret organization after the 9/11 attacks on the USA. During the Guantanamo phase of the process, some citizens of some countries were treated against human rights with approaches that could not be accepted by almost all citizens of the world. These behaviors were not accepted and protested by many people and states. However, these protests could never prevent what happened in Guantanamo. As a result of the investigations carried out in Guantanamo Prison, the USA was able to obtain the information it wanted and successfully reached the final conclusion. What happened in Guantanamo is against all written and unwritten national and international laws regarding human rights. Despite this contradiction, the USA continued the process without encountering any obstacles and achieved its goal by accessing the information it wanted. Even though the incident occurred in violation of international human rights, those who committed these acts were not accused or tried anywhere. In our opinion, there is no possibility of them being tried or accused in the future. Therefore, although legal limits were often exceeded in practice, the goal was achieved and results were obtained. Perhaps one of the most important details is that some people were subjected to acts that even people who violated human rights would initially object to and would not accept in Guantanamo prison. The location selection and implementation method of the process were very effective in achieving the goal.

Although the subject in this study is related with international relations and international politics, the effects of Guantanamo prison are examined in terms of management accounting. Benefit cost analysis regarding the selection of Guantanamo Prison has been examined separately, both from the perspective of the USA, Guantanamo (location selected) and world public opinion. In the first stage, the scenarios of the presence and absence of the Guantanamo prison from the perspective of the USA were compared, and as a result, it was determined that there is a significant difference in net profitability in favor of having Guantanamo Prison, which is the current situation for the USA. Afterwards, in terms of location selection, the situations of establishing Guantanamo on the island of Cuba and establishing it in the USA were compared in terms of their differing net profitability. In this analysis, the savings in one of the options are taken into account as income, while in the other they appear as costs. In terms of differing net profit in the current situation; it is observed that there is a significant disadvantage to Guantanamo being located in Cuba due to the higher level of rent, personnel, operation, transportation, etc. associated with being in a remote location outside the USA. In the last option, comparing the presence and absence of a prison like Guantanamo in terms of world public opinion; there is a significant monetary difference against the presence of the current Guantanamo Prison. However, in the same analysis, both monetary and non-monetary factors have played a significant role in equipping the world public opinion with a substantial level of information about the USA and convincing them. In our opinion, the same analyzes should be conducted on similar events and used in the education of people who are trained as international politicians.

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Capital Flows, Measures and Effectiveness of Monetary Sterilization Policies in the Selected Emerging Market Economies

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ABSTRACT

Sterilization policies aim to prevent the overvaluation of the national currency due to high capital inflows and the resulting inflationary effects from increased money supply. Emerging Market Economies (EMEs) faced instability from large capital inflows during the 1990s and 2000s, leading to the adoption of sterilization policies. With this motivation, this paper examines the extent and effectiveness of sterilization measures in 13 EMEs for the period 2005Q1-2021Q4. While the extent of sterilization measures is analyzed using the Instrumental Variables GMM technique, the effectiveness of these policies against different types of capital inflows is investigated using quantile regression analysis. The use of the Instrumental Variables GMM technique contributes methodologically to the literature as it produces more precise and robust results. In investigating the effectiveness of sterilization policies, in addition to the general types of capital inflows, gross portfolio equity and portfolio debt inflows and alternative definitions of capital inflows (gross debt and equity-based) make important contributions to the economic literature. The GMM results indicate the existence of partial sterilization and suggest that full sterilization was not implemented to reduce economic costs and promote domestic economic stability. Quantile regression analysis reveals that sterilization measures are particularly effective against short-term private capital inflows.

Keywords: International Private Capital Flows, Monetary Policy, Sterilization Coefficient, International Reserves.

JEL Classification Codes: C30, E50, E52, E58, F30

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INTRODUCTION

Signals of sudden stops in capital flows in EMEs were most evident in the Mexican (1994), East Asian (1997) and Russian (1998) crises (Calvo et al., 2004, p. 16). With the complete lifting of capital account controls in the 1990s, these economies witnessed large inflows of short-term capital (such as bank loans and portfolio investments). However, the initial benefits of the large amounts of foreign capital flowing into these economies in terms of financing deficits and boosting investment levels and growth rates eventually reversed and led to crises (e.g. the 1994/1995 Mexican (Tequila) Crisis, the 1997/1998 East Asian Crisis, the 1998 Russian Crisis and the 1999 Brazilian Crisis). The adverse consequences of the crises have revealed the harms of uncontrolled liberalization of foreign capital flows in these economies. Therefore, the crises brought about debates on whether high capital inflows are beneficial for the economies of the countries and the issue of imposing a restriction on capital flows rather than removing all barriers to capital flows came to the agenda. In fact, the debate has centered on whether restrictions on capital inflows and outflows can prevent possible crises or, if they cannot prevent these possible crises, whether they can eliminate the negative (adverse) effects of crises.

Emerging economies are believed to have learned an important lesson from the financial crises of the 1990s. It is argued that these economies have increased their international reserves as a way of hedging against sudden stops in capital inflows and significant shifts in their balance of payments. It is argued that the efforts of these countries to build better macroeconomic policies and strong reserve stocks were able to mitigate the effects of the 2008/2009 crisis and that this strategy also reduced the likelihood of a crisis (Mendoza, 2010, p. 2).

The 1997/1998 East Asian financial crisis caused a shift in countries' attitudes towards the accumulation of exchange reserves, resulting in increased demand for international reserves. There are a number of reasons for the change in the way international reserves are viewed.

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The fact that these countries used mainly speculative hot money inflows to finance their high current account deficits is seen among the important reasons that triggered the crisis. Moreover, the economies of the region continued to accumulate reserves as a precautionary measure to avoid a recurrence of the severe currency crises of 1997/1998, and hence a shortage of international liquidity resulting from sudden stops in capital inflows. This behavior was also a consequence of the distrust of the International Monetary Fund (IMF) (Park and Estrada, 2009). However, the crisis led to significant declines in production and investment volumes, collapses in credit supply and, for some regional economies, banking crises (Aizenman and Lee, 2007, p. 1; Cheung and Qian, 2009, p. 1; Filardo et al., 2010, p. 24)[1].

Given the underdeveloped financial systems of many EMEs, excessive reserve accumulation entails risks and costs for the domestic economy[2]. Excessive reserve accumulation may hinder the accumulation of assets other than foreign exchange that can contribute positively to the long-run growth of the economy (Cook and Yetman, 2012, p. 31). This implies that policy authorities would be willing to bear the opportunity cost of choosing to hold a certain level of foreign exchange reserves over assets with higher returns. Moreover, the accumulation of reserves may have crowding out effects on domestic investment (Mahraddika, 2019, p. 40).

Grilli and Milesi-Ferretti (1995) argue that there are some reasons to be concerned about the effects of large capital inflows on recipient economies, such as loss of competitiveness in exporting sectors, the deepening effects of real appreciation on current account deficits, or sudden reversals in capital inflows. Given these potential problems, Grilli and Milesi-Ferretti (1995) emphasize the need for recipient economies to take some precautions against the potential costs and argue that there are reasons why countries may find it useful to impose some restrictions on capital account transactions (capital controls). As a matter of fact, many Latin American and East Asian countries resorted to sterilization measures in order to reduce the pressures on real appreciation due to increased capital inflows in the 1990-1994 period (Frankel and Okongwu, 1996, p. 3).

Sterilization policy, which is an indirect monetary policy measure, refers to the interventions of monetary authorities in the foreign exchange market in order to prevent overvaluation of the national currency due to high capital inflows (Reinhart and Reinhart, 1998, p. 94). However, central banks resort to sterilization policy in order to prevent excessive monetary growth due to the fear that an increase in the money supply corresponding to the accumulation of reserves would lead to hyperinflation. In particular, central banks can neutralize the effects that may arise by ensuring that the market absorbs the liquidity glut caused by capital inflows through the issuance of commercial paper. Indeed, Calvo (1996) and Montiel (1999) argued that sterilization policy is a common macroeconomic stabilization policy to be implemented in the face of high capital inflows (Calvo, 1991 p. 921; Montiel, 1999, p. 14).

Sterilization policy has been a common policy response to excessive capital inflows for many emerging market economies. Chile, for example, tried to prevent the instability caused by large capital inflows in 1990-91 with a sterilization policy. Similarly, countries such as Colombia, Indonesia, Korea, Malaysia, Mexico, Thailand and the Philippines have also used sterilization policy extensively to prevent the adverse effects of significant increases in foreign reserves on the domestic economy. However, there is an important debate in the literature on the effectiveness and desirability of these monetary policy measures (Corbo and Hernandez, 1996, p. 74).

The experience of many countries in the 1990s showed that sterilization policies can be useful if they are a temporary monetary tightening measure. Hence, sterilization measures would lead to higher interest rates, which in turn would lead to more foreign capital entering the country due to perfect capital liberalization. These new capital flows would offset the effect of sterilization on domestic interest rates, rendering the policy ineffective. However, if there is a restriction on capital flows, the sterilization policy may be partially effective (Reinhart and Reinhart, 1998; Garcia, 2007). Therefore, although sterilization measures partially prevent the negative effects of large short-term capital inflows on macro aggregates, it is questioned whether they are effective enough to completely prevent crises caused by these negative effects.

The aim of this study is to understand how the sterilization coefficient works for 13 EMEs in the face of different types of foreign capital inflows for the period

[1] International reserve stocks have increased significantly, especially since 1998. The propensity to hold reserves has been much higher mainly in emerging markets. International Monetary Fund data show that reserves increased nearly 4-fold from 1998 to the 2008 crisis. The data show that this trend has continued in the aftermath of the global financial crisis (Mendoza, 2010, p. 2; IMF, 2014).

[2] These risks and costs generally include inflationary pressures, overinvestment, asset bubbles, difficulties in the conduct of monetary policy, large capital losses on central bank balance sheets, costs of sterilizing excessive monetary expansion, risks of credit misallocation by domestic banks, and segmentation of the public debt market (European Central Bank, 2006, p. 16-17)

2005Q1-2021Q4 and to investigate the effectiveness of sterilization policies for these countries. In this framework, our study seeks answers to the questions of whether the extent of sterilization measures (the degree of sterilization coefficients) in offsetting the macroeconomic effects of domestic monetary expansion resulting from foreign exchange intervention in emerging market economies varies across countries and periods. Additionally, our study aims to determine to what extent the sterilization policy is effective against foreign capital inflows and whether the degree of effectiveness differs according to the types of capital flows.

Our study makes various contributions to the related literature. In the study, instrumental variables GMM analysis technique is used to estimate sterilization coefficients for individual EMEs. The instrumental variables GMM method is more effective in dealing with endogeneity problems than the Two-Stage Least Squares (2SLS) method, which is mostly used in the related literature for estimating sterilization coefficients. However, the economic effects of sterilization measures may occur simultaneously or with a time lag. Thus, the effects of both immediate and past interventions on economic variables in future periods (in the long run) can be better assessed. In this framework, the instrumental variable GMM method provides significant advantages in terms of better capturing such dynamic effects. On the other hand, the sterilization coefficients for the periodically selected EMEs are investigated by using Recursive Estimation with current data sets. In this way, it is possible to examine how and in what direction the sterilization coefficients change across countries and to evaluate the effects of economic conditions by taking into account the financial stress periods that the EMEs have been exposed to since the mid-2000s. Finally, the effectiveness of sterilization measures for different types of foreign capital inflows for the panel group is investigated with fixed effect panel quantile regression analysis. Thus, quantile regression analysis makes it possible to reveal which type of sterilization measures are effective in restricting or encouraging capital inflows under different time periods and economic conditions.

The general organization of the study is as follows; After the introduction, Section 2 presents the results of empirical research on the effectiveness of sterilization policies in EMEs. Section 3 introduces the countries used in the analysis, their datasets, and the method of analysis. Section 4 presents the empirical results, and the paper concludes with a final section containing evaluations and policy recommendations.

EMPIRICAL LITERATURE

There are empirical studies in the literature investigating the effectiveness of sterilization policy. Cavoli (2007), one of these studies, investigated the relationship between international capital mobility and sterilization measures using monthly data for 5 selected East Asian countries for the period 1990-1997 within the framework of 2SLS procedure and VAR method. The study emphasizes that sterilization measures are more effective and applicable only in the case of limited capital mobility.

Cavoli (2017) investigated the possible determinants of sterilization policy for the period 1994-2012 using panel Ordinary Least Squares (OLS) analysis and concluded that reserve flows may be more effective for central banks to resort to sterilization measures. The findings suggest that private capital inflows of different maturities have indirect effects on sterilization decisions. On the other hand, the main motivation for these decisions is the changes in local interest rates.

Another study in the empirical literature on the effectiveness of sterilization measures is Arya et al. (2020). The authors investigated the relationship between monetary sterilization measures and foreign capital inflows using panel least squares and panel quantile regression analysis for 28 EMEs from Asia and Latin America for the period 1990-2013. As a result of the analyses, they found that sterilization measures cause the local interest rate to rise, thereby encouraging more FDI and portfolio inflows into the country.

Some empirical studies in the literature investigate the extent to which central banks in emerging market economies resort to sterilization measures. Cavoli and Rajan (2006), one of these studies, investigate the degree of monetary sterilization for five selected Asian countries using OLS estimation of a single equation model for the period 1990-1997 before the Asian crisis, and find that the coefficient of sterilization is -1.11 for Korea, -1.05 for Thailand, -0.77 for Indonesia, -0.94 for Malaysia and -0.98 for the Philippines. Similarly, Aizenman and Glick (2009) estimated the coefficient values for China, Brazil, Malaysia, Thailand, Argentina, Singapore, India, South Korea and Mexico as -0.78, -0.77, -0.93, -0.86, -0.96, -0.82, -0.96, -0.93 and -0.98, respectively, using quarterly data for 9 selected emerging market economies for the period 1985-2007. Kwack (2001), using the same methodology for 7 Asian countries for the period 1985-1996, finds the sterilization coefficient values as -0.99 for Indonesia, Malaysia and Singapore, -0.97 for Korea,

-0.94 for Philippines and Taiwan and -0.81 for Thailand. Kwack (2001) found the sterilization coefficient as -0.94 in his OLS estimation for the panel group[3].

Among the studies investigating the effectiveness of sterilization policy in China, Wang et al. (2021) used the ordinary OLS method to measure the degree of sterilization measures using monthly data for the period 2000-2017 and found the coefficient of sterilization to be -1.027 and -0.917. On the other hand, Takagi and Esaka (2001), using the classical OLS method with quarterly data for the 1987-1997 period for 5 emerging Asian countries, concluded that the sterilization policy yielded significant results only in the Philippines and the coefficient value was -0.11. Siklos (2000), in his study investigating the coefficient of sterilization for Hungary with monthly data for the period 1992-1997, found the coefficient value to be -1. These values indicated full sterilization practices for the periods in question.

Khemraj and Pasha (2011) investigated the size of the sterilization coefficient for 8 Caribbean countries using quarterly data for the period 1993-2008 with the OLS method and found the coefficient values as -0.62 for Bahamas, -0.83 for Barbados, -0.83 for Belize, 0.18 for Eastern Caribbean Currency Union Countries (ECCU), -1.03 for Guyana, -0.16, -0.50 and -0.70 for Trinidad and Tobago, Jamaica and Suriname respectively. On the other hand, Kim (1995) investigated the degree of sterilization for Korea through GLS and 2SLS methods with quarterly data for the period 1980-1994. Accordingly, while the coefficient of sterilization is found to be -0.64 in the estimation with the GLS method, this value is found to be -0.56 for the 2SLS method.

Celasun (2000) determined the sterilization coefficient as -0.37 with the 2SLS method using monthly data for Türkiye for the period 1990-1996. Similarly, Emir et al. (2000) estimated the sterilization coefficient in the case of Türkiye with 2SLS using data for the period 1990-1999. As a result of the estimation, it is concluded that a more effective sterilization policy was pursued in the 1995-1999 period (-0.88) compared to the 1990-1993 sub-period (-0.54). Altınkemer (1998), on the other hand, obtained the sterilization coefficient before and after the 1994 crisis as -1.04 and 0.93, respectively, as a result of his estimation with the classical OLS method.

Moreno (1996) investigated the degree of sterilization measures taken by monetary authorities in response to a shock in foreign assets by following a 4-variable VAR analysis procedure using monthly data for Korea and Taiwan for the period 1981-1994. The impulse-response analysis findings show that monetary authorities in Korea react more strongly to unexpected increases in foreign assets by reducing domestic assets, and hence the degree of sterilization is higher in Korea than in Taiwan[4]. Using VAR analysis for the Czech Republic, Christensen (2004) estimated the sterilization coefficient as -0.11.

Nakibullah (2011) used the 2SLS method using quarterly data for the period 1990-2009 for a sample of 6 oil exporter countries and found the sterilization coefficients as -1.03 for Bahrain, -1.01 for Kuwait, -0.97 for Oman, -0.38 for Qatar, -1.01 for Saudi Arabia and -0.39 for the United Arab Emirates (UAE). Similarly, Hassan et al. (2013), using the Seemingly Unrelated Regression method, found -0.84 for Bahrain, -0.52 for Kuwait, -0.81 for Oman, -0.75 for Qatar, -0.96 for Saudi Arabia and -0.17 for the UAE. Ljubaj et al. (2010), on the other hand, determined the sterilization coefficient as -0.81 for Croatia using the 2SLS method using monthly data for the period 2000-2009.

In the literature, there are also studies estimating the sterilization coefficient for country groups using panel data analysis techniques. Cavoli (2017), one of these studies, investigated the determinants of sterilization using panel OLS analysis method using 1994-2012 quarterly data. As a result of the estimation, the coefficient of sterilization was calculated as -0.91 for Korea, 0.89 for the Philippines, 0.89 for Thailand, 0.93 for Thailand, 0.99 for Singapore, 1.01 for Indonesia and 1.02 for Malaysia. Aizenman and Glick (2009) investigate whether the sterilization measures taken by monetary authorities against reserve inflows and different types of foreign capital flows are effective or not for the period 1980-2007 using OLS analysis method. According to the findings of the analysis, they revealed that during the sample period, selected Asian and Latin American countries increased sterilization measures due to rising inflationary concerns in the face of foreign reserve inflows. They also found that sterilization measures increased more in response to domestic monetary effects caused by short-term speculative capital inflows other than FDI inflows.

[3] A sterilization coefficient of "-1" implies that changes in foreign exchange reserves are fully sterilized and therefore changes in net foreign assets will not affect the monetary base. On the other hand, a coefficient value of "0" would reflect a situation where the effects of reserve changes on the monetary base are not sterilized at all. A coefficient value between -1 and 0 indicates partial sterilization (Aizenman ve Glick, 2009, p. 781-782).

[4] However, an important drawback of the VAR model is the assumption that the variables in the model are symmetrically endogenous. In the calculation of the degree of sterilization, the lagged values of the NDA and NFA variables are taken into account in standard VAR-based models due to the problem of defining the model form, and in the absence of any model restrictions, the estimated values of the effects of the variables in the current period cannot be obtained (Ouyang et al., 2010, p. 958).

Cardarelli et al. (2010) argue that high values of the sterilization index coinciding with the period when capital inflows increased indicate that policy makers aggressively increased sterilization measures. However, it was determined that the index values decreased in later periods. The authors suggest this is because policymakers have become more aware of the cost implications of implementing additional sterilization measures.

DATA SET AND METHODOLOGY

In this section of the study, the magnitude of sterilization coefficients and changes in these coefficients over time are investigated for 13 selected emerging market economies[5]. Variables, their descriptions, measurement methods, and data source information are presented in Table A1. The expected sign for the sterilization coefficient, which is our main focus of interest, should be negative. This coefficient indicates the response of net domestic assets (NDA) to changes in net foreign assets (NFA) or the degree of domestic monetary sterilization of central banks in response to increases in foreign currency assets (Meng et al., 2018, p. 26).

The monetary policy reaction function includes many variables that are likely to affect monetary policy. However, the impact mechanism of these variables on the central bank's domestic assets emerges in different ways. In this framework, taking into account the relevant empirical literature, the coefficients of the following variables are expected to be negative: money multiplier (see Zhang, 2010), real effective exchange rate (see Ouyang et al., 2008), foreign interest rate (see Zhang, 2010, Ouyang et al., 2008), inflation and cyclical income (see Wang et al., 2021).

Various methods are used in the literature to estimate the monetary policy response function. Among these econometric methods, OLS method may lead to biased and inconsistent estimation results. The reason for the possible bias problem in the estimation results is due to the fact that the NFA variable in the response function is endogenous. In this framework, an increase in domestic assets is expected to be offset by a decrease in foreign reserves. In this case, changes in NDA and NFA are expected to be in a simultaneous relationship. In this framework, the functioning mechanism of the sterilization policy can be represented by the simultaneous equations proposed by Kouri and Porter (1974) as follows;

$$\Delta NDA = \alpha + \beta\,\Delta\, NFA + \gamma X_2 + v \quad (1)$$

$$\Delta NFA = b + \beta\,\Delta\, NDA + cX_1 + u \quad (2)$$

When the central bank aims to sterilize the monetary effects of reserve inflows, domestic loans will be an endogenous variable in the model when domestic loans show simultaneous changes in response to changes in foreign assets. In this case, the error term in the domestic credit equation will be related to foreign assets, and the error term in the foreign assets equation will be related to domestic credits (Emir et al., 2000, pp. 14-15). However, the main question here is the direction in which the OLS estimators of the sterilization coefficient will deviate. Roubini (1988) shows in a simple mathematical form that the deviation will be towards -1. Therefore, a much smaller negative deviation of the sterilization coefficient in the OLS estimator would lead to misinterpretations as an indicator of significant sterilization measures. The same would be true for the values of the equalization coefficient (Roubini, 1988, pp. 7-9).

On the other hand, the Generalized Method of Moments (GMM) has some important advantages compared to traditional estimation methods. If the 2SLS method is used to estimate an over-specified model, the procedure of reducing the instrumental variables in the model should be followed. However, such a reduction is not necessary for the GMM approach with instrumental variables. With this method, all instrumental variables can be used.

On the other hand, instrumental variable GMM estimations for time series are performed with robust standard errors. Since instrumental variable GMM estimates will differ in over-specified equations, estimation with robust standard errors will be more efficient and consistent than 2SLS estimation. For this reason, in this study, instrumental variables GMM estimations are performed with the HAC standard errors used by Newey-West, thus increasing the reliability of the estimates by obtaining more accurate and robust standard errors in the presence of statistical problems such as heteroskedasticity and autocorrelation (Baum et al., 2003, pp. 14-15). Moreover, if statistical problems such as autocorrelation and heteroskedasticity prevail in the model, the 2SLS estimator will not be asymptotically efficient. In such a case, the GMM estimator will be more efficient (Söderbom, 2009, p. 24).

[5] These countries: Brazil, Chile, Colombia, Czech Republic, Hungary, Hungary, Indonesia, Mexico, Mexico, Poland, Poland, Russia, South Africa, South Africa, Thailand and Türkiye. The 13 EMEs analyzed in the analysis are included in the emerging markets category in the classification of the MSCI Emerging Markets Index. The lack of data for some of the countries in this scope for certain years necessitated the analysis to be conducted with 13 countries. In addition, these countries included in the analysis are countries with relatively higher foreign capital inflows compared to other emerging market economies.

Testing the validity of the instrumental variables, in other words, testing whether the instrumental variables are correlated with the error terms is of great importance for the consistency of the estimation results. Therefore, checking the overidentification restriction will reveal that the model specification is correct and the orthogonality conditions are met. Therefore, in the GMM framework, we check for over-identification restrictions using the J test statistic of Hansen (1982). This test statistic represents the value of the objective function of the efficient GMM estimator. If the null hypothesis is rejected, it means that the orthogonality conditions for the use of instruments in the model are not fulfilled. This implies that the GMM specification may not be appropriate because the instruments were incorrectly excluded from the regression. The opposite would be true for the alternative hypothesis (Baum et al., 2003, pp. 15-16).

EMPIRICAL RESULTS

Estimation of the degree of sterilization is attempted to be obtained by time series analysis for each EME, using data for the period 2005q1-2021q4. Although the coefficient values calculated for the entire analysis period are important in terms of revealing the extent to which these countries resorted to sterilization measures, they prevent a full assessment of policy responses. This limitation arises from the challenge of measuring the magnitude of sterilization over different periods. For this reason, recursive estimation method is applied to measure the degree of monetary responses of central banks of selected EMEs to foreign reserve increases.

In the econometrics literature, spurious regression in time series analysis arises especially when the series have a unit root process. In time series analysis, if the series contain unit roots, ignoring stationarity causes the analysis to produce unreliable results (Baltagi, 2001, p. 611). Unit root tests, specifically the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, were conducted to determine the stationarity of the time series. Based on the estimation results, it was found that all variables belonging to other countries were stationary at the level, except for the cyclical income of Russia, which showed non-stationarity in the ADF unit root test. However, the PP test shows that the cyclical income variable is stationary at level. Therefore, considering the advantages of the PP test (see Verbeek, 2008, p. 306; Leybourne and Newbold, 1999, p. 51), this variable is included in the analysis with its level values. These results are presented in Table A2 and Table A3 in Appendix A.

The Lagrange Multiplier (LM) test of Breusch and Pagan (1980), the Cross Section Dependent (CD) and Cross Section Dependent LM (CD_{LM}) tests introduced by Pesaran (2004) and the Bias-Adjustment LM (LM_{adj}) test of Pesaran et al. (2008) were used to check the cross-sectional dependence of the data sets of the panel units (countries). In this framework, the test results for horizontal cross-section dependence are presented in Table A4 in Appendix A. The results indicate the validity of horizontal cross-section dependence.

In this study, the CADF (Cross-sectionally ADF) test developed by Pesaran (2007), which considers horizontal cross-sectional dependence and serial correlation in the residuals, is used for panel unit root analysis. In this framework, the null hypothesis of the CADF test will imply the existence of a unit root. In this framework, CIPS test results reveal that the series are stationary at level (Table A5).

The lagged values of Costant, $\Delta \mathrm{NFA}$, $\Delta \mathrm{NDA}$, $\Delta \mathrm{mm}_t$, $\Delta \mathrm{r}_t$, Y_{t-1}, P_{t-1}, $\Delta \mathrm{G}_t$ and $\Delta \mathrm{REER}_t$ are used as instrumental variables in the analyses conducted using instrumental variables estimation methods[6]. Thus, the dynamic structure of the model and the exogeneity assumptions, which state that the instrumental variables should be uncorrelated with the error term, are taken into account. As a matter of fact, the results of Hansen's J test, which is used to test the exogeneity of the instrumental variables, support the exogeneity assumption by having high probability values. These results reveal the validity of the instrumental variables considered in the model and the reliability of the forecasts (see Table 1 and Table 2).

As a result of the estimation of the monetary policy reaction function for the entire sample period, changes in reserves are an important indicator in arriving at the sterilization coefficient values for countries. However, there are many factors that may affect the monetary policy decisions of central banks. As a matter of fact, these factors that may have an impact on the policy decision are included as control variables in the response function. In this framework, the analysis findings for individual countries are presented in Table 1. For the entire sample period, the degree of sterilization is found to be quite high for some of the selected EMEs and at or close to full and/or extreme sterilization for some other countries.

[6] Fair (1997) suggests that lagged values of both dependent and explanatory variables should be considered in the list of instrumental variables for better model estimation and to avoid endogeneity problems. Indeed, Hassan et al., (2013), Nakibullah (2011) and Nwogwugwu et al., (2020) followed a similar method in the selection of instrumental variables in the calculation of sterilization coefficients.

Table 1: GMM Estimation Results for Monetary Policy Response Function for Time Series (2005Q1-2021Q4)

	Türkiye (2005Q1-2021Q4)	Brazil (2005Q1-2021Q4)	Chile (2005Q1-2021Q4)	Colombia (2005Q1-2021Q4)	Czech Republic (2005Q1-2021Q4)	Hungary (2005Q1-2021Q4)
ΔNFA	-0.9220449	-0.8760012	-0.864181	-0.8338346	-0.8430646	-1.02484
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δmm_t	-0.9798526	-0.9207934	-1.28549	-0.8567811	-0.7890832	-0.7933574
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δr_f	-0.0104577	-0.0061174	0.025526	-0.0024644	0.0033484	-0.0042678
	(0.266)	(0.241)	(0.186)	(0.313)	(-0.0106877)	(0.637)
Y_{t-1}	-0.0868247	-0.1002652	0.699720	0.0740975	0.097941	-0.1407381
	(0.334)	(0.078)	(0.000)	(0.013)	(0.099)	(0.259)
P_{t-1}	0.3941059	0.4297184	-0.079861	0.1728303	0.0834862	0.031706
	(0.084)	(0.038)	(0.891)	(0.534)	(0.827)	(0.948)
ΔG_t	0.1302546	0.4871293	0.249853	-0.0827776	1.266039	0.5075101
	(0.497)	(0.283)	(0.362)	(0.274)	(0.395)	(0.032)
$\Delta REER_t$	-0.303967	-0.0050095	-0.513682	-0.1063564	-0.038662	-0.3364357
	(0.004)	(0.857)	(0.033)	(0.000)	(0.633)	(0.000)
Costant	0.0267965	0.0191306	0.007266	0.0210349	0.0125061	0.0158654
	(0.000)	(0.000)	(0.200)	(0.000)	(0.001)	(.0061765)
Wald chi2	483.21	3649.18	2710.77	2925.17	417.88	2589.08
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.93	0.97	0.96	0.94	0.92	0.98
Hansen-J Statistic	3.0359 (0.8043)	6.4572 (0.3740)	4.1591 (0.6552)	3.9312 (0.6860)	2.9821 (0.8111)	3.8908 (0.6914)
Endogeneity	0.5308	0.8837	0.8837	0.4977	0.0501	0.0974
	(0.4663)	(0.3472)	(0.6552)	(0.4805)	(0.8229)	(0.7550)

Continuation of Table 1.

	Indonesia (2005Q1-2021Q4)	Poland (2005Q1-2021Q4)	Russia (2005Q1-2021Q3)	South Africa (2005Q1-2021Q4)	South Korea (2005Q1-2021Q4)	Mexico (2005Q1-2021Q4)	Thailand (2005Q1-2021Q4)
ΔNFA	-0.985362	-0.9923113	-0.9250243	-.9148763	-1.005284	-0.9894354	-0.8393146
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δmm_t	-0.9807175	-0.9544943	-0.8224464	-.6426803	-.9661008	-0.6811224	-0.07562
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δr_f	0.001281	-0.015164	0.0073698	.0002804	-0.0095012	0.0025839	-0.0018224
	(0.826)	(0.000)	(0.265)	(0.926)	(0.000)	(0.315)	(0.689)
Y_{t-1}	0.2902556	0.0960143	-0.0091361	-.1368322	-0.1132483	-0.084677	0.0006384
	(0.005)	(0.026)	(0.953)	(0.011)	(0.076)	(0.004)	(0.345)
P_{t-1}	0.1877429	-0.0114789	0.3651185	0.8113304	-0.3091097	0.2000502	0.0826476
	(0.029)	(0.956)	(0.023)	(0.000)	(0.038)	(0.162)	(0.640)
ΔG_t	0.3342574	0.5892139	1.661465	0.0198796	0.3077826	0.3944413	0.1251289
	(0.002)	(0.009)	(0.003)	(0.902)	(0.024)	(0.013)	(0.324)
$\Delta REER_t$	-0.0075735	-0.1076642	-0.1751167	-0.0376642	0.019529	-.1274729	-0.1231863
	(0.876)	(0.132)	(0.000)	(0.271)	(0.630)	(0.000)	(0.244)
Costant	0.022475	0.0178504	0.0223157	0.0098284	0.0163605	0.0217999	0.0141944
	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.000)
Wald chi2	5129.79	5678.28	1641.85	3434.67	145289.22	6092.12	330.35
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.0000)	(0.000)
R^2	0.97	0.98	0.97	0.98	0.99	0.98	0.95
Hansen-J Statistic	5.9220 (0.4320)	4.9155 (0.5547)	9.49942 (0.1474)	5.24596 (0.5127)	2.7884 (0.8349)	5.3031 (0.5056)	2.0106 (0.9187)
Endogeneity	1.50252	0.1432	0.051426	0.3883	2.78842	0.00076	5.3405
	(0.2203)	(0.7051)	(0.8206)	(0.5332)	(0.8349)	(0.9780)	(0.0208)

Note: Values in parentheses denote probability values. Since real GDP data for Russia for 2021q4 is missing, the analysis period covers the period 2005q1-2021q3.

Table 2. Panel Two-Stage Least Square Results for the Monetary Policy Response Function (2005Q1-2021Q4)

EMERGING MARKET ECONOMIES (2005Q1-2021Q3)	
ΔNFA	-0.8702
	(0.000)***
Δmm_t	-0.4677
	(0.086)*
Δr_f	0.0012
	(0.820)
Y_{t-1}	-0.0046
	(0.212)
P_{t-1}	-0.1979
	(0.371)
ΔG_t	0.0314
	(0.842)
$\Delta REER_t$	-0.1436
	(0.144)
Fixed	**0.0223**
	(0.000)* **
Number of Observations	**845**
Wald X^2 Statistics	**3236.32**
	(0.000)
R^2	**0.82**
Hansen J Statistic	**5.385**
	[0.4954]

Note: Values in parentheses denote probability values. Since real GDP data for Russia for 2021q4 is missing, the analysis period covers the period 2005q1-2021q3.

Accordingly, the coefficient values of -0.92 and -0.96 for Türkiye and South Africa, respectively, are very close to full sterilization (-1). For Mexico (-0.98), Poland (-0.99) and Indonesia (-0.99), the coefficient values are almost close to full sterilization. Full sterilization for Korea (-1.00) and partial over-sterilization for Hungary (-1.02). On the other hand, partial sterilization is observed for the Czech Republic (-0.84), Brazil (-0.88), Thailand (-0.84), Russia (-0.86), Colombia (-0.83) and Chile (-0.86). Although these results are highly statistically significant, they suggest that the selected EMEs have adopted a significant sterilization policy in order to prevent the monetary effects of reserve accumulation (Table 1). The sterilization coefficient for the panel group was determined as -0.87 (Table 2).

Upon analyzing the control variables, it is evident that the money multiplier variable has a significantly greater impact than the other variables. This suggests that a rise in the money multiplier (mm) would be strongly offset by a fall in the NDA. As a result, an expansion in the money supply will prompt central banks to adopt contractionary monetary policy in response to its effects.

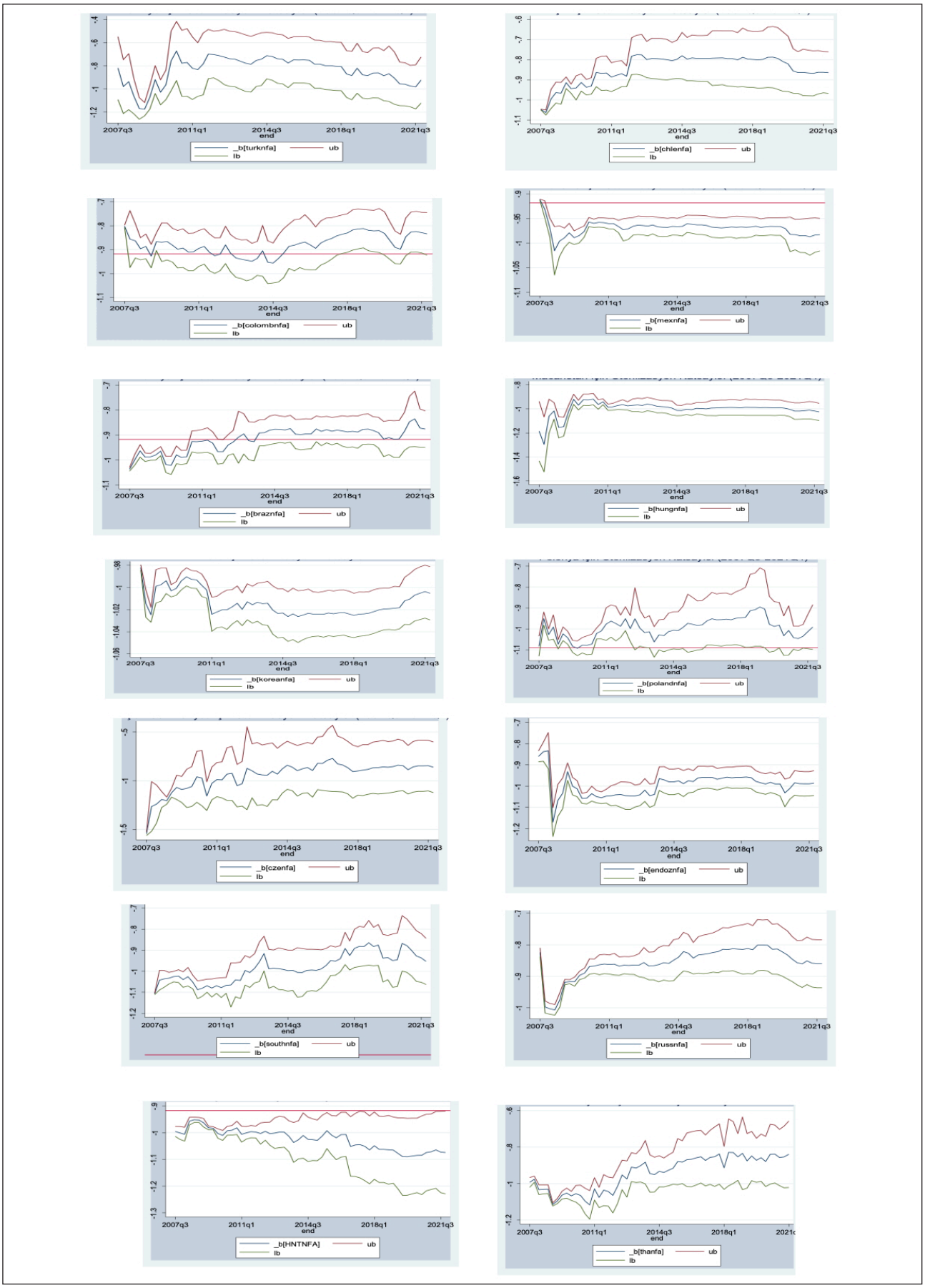
The only statistically significant contractionary effects on NDA from increases in the foreign interest rate were found in the Czech Republic, Poland, and South Korea. Moreover, the coefficient sign of this variable is negative in line with expectations. Accordingly, for many EMEs, increases in foreign interest rates lead to a deepening of macro instability as foreign capital flows to the source country with the expectation of lower risk but higher interest yields and worsens the balance of payments of the countries they leave. In this situation, emerging market central banks opt for a tight monetary policy such as a reduction in the NDA to mitigate indirect negative effects.

Increases in the value of the national currency (increases in the REER) make countries' export goods more expensive, leading to a loss of their relative competitive advantage in international trade. This price effect may cause deterioration in the current account balance and lead to a contraction in foreign reserves. These developments lead to the emergence of expectations of a decline in the value of the country's currency and a deterioration in the balance of payments, causing the central banks of the EMEs to resort to contractionary monetary policy measures (reductions in the NDA). In this framework, the coefficient sign of the variable for Türkiye, Chile, Colombia, Hungary, Russia and Mexico is negative as expected.

The coefficient signs and statistical significance of cyclical income[7], government expenditures and inflation variables differ for many EMEs. While the coefficient sign for all three variables is expected to be negative

[7] Although the data sets obtained by scaling the cyclical income variable with the trend values of real GDP and its deviations from the trend value following the studies of Wang et al. (2019) were used, the coefficient values did not change significantly in the analysis findings.

Chart 1: Sterilization Coefficients (2007Q3-2021Q4) for periodically selected EMEs, Recursive Estimation



Note: ub and lb denote 95% confidence intervals, respectively. The sterilization coefficient values obtained for each period are based on the instrumental variable GMM analysis technique for time series. Newey-West HAC correction is applied to resist autocorrelation and variance problems. Since the analysis period consists of quarterly data, a lag of 4 periods is considered for the correction.

economically, the opposite is true for some countries. Possible reasons for insignificant coefficients and incorrect signs of these two variables exist. First, the NDA, which is the dependent variable in the monetary policy response function, may be more volatile than inflation and cyclical income variables. In fact, the series of the other two variables are more stationary (Ouyang et al., 2008, p. 189). On the other hand, the positive relationship between the increase in net domestic assets and cyclical income may be the result of the central banks' increasing domestic liquidity during the expansionary phases of economic activity. However, all these may differ depending on the economic conjuncture. For example, central banks may adopt expansionary monetary and fiscal policies during periods of slowdown in economic activity. On the contrary, they may pursue tighter economic policies during periods of economic recovery (Ouyang and Rajan, 2011, p. 2022). In addition, depending on the economic situation, some countries may pursue pro-inflationary policies instead of implementing anti-inflationary monetary measures. Due to the economic crises in the world, countries may turn to expansionary monetary and fiscal practices to prevent contraction in economic activities (such as the 2008 global financial crisis, COVID 19 crisis) (Nakibullah, 2011, pp. 149-150).

On the other hand, an recursive estimation was performed to examine the change in sterilization over time and the results based on this estimation are presented in Chart 1[8]. Following the crises in the mid-1990s, the intensity of sterilization has increased in most EMEs, especially after 2002, in order to prevent the possible monetary effects of foreign reserve accumulation behaviors with periods of excessive international capital inflows. The degree of sterilization is found to have declined significantly for some of the EMEs during the 2008 crisis and 2009, when the effects of the crisis deepened, while it has increased for some EMEs and remained stable for others. During these periods, countries also suffered significant losses in their foreign exchange reserves. However, in some countries, sterilization measures have also increased during periods of financial stress in order to limit severe fluctuations in exchange rates, reduce inflationary pressures, balance capital inflows and outflows by preventing sudden capital flight, and ensure exchange rate stability.

Note: ub and lb denote 95% confidence intervals, respectively. The sterilization coefficient values obtained for each period are based on the instrumental variable GMM analysis technique for time series. Newey-West HAC correction is applied to resist autocorrelation and variance problems. Since the analysis period consists of quarterly data, a lag of 4 periods is considered for the correction.

Chart 2[9] shows the historical development of the exchange rate pressure index for selected EMEs. This index is generally regarded as an important indicator of exchange rate depreciation and international reserve depletion. This index is a crucial indicator of central banks' actions to sell foreign currency in order to safeguard the value of the national currency against depreciation due to currency crises in emerging economies. In this case, a positive index value would indicate a depreciation of the national currency and a decrease in reserve accumulation. A negative index value would indicate the opposite (Gupta and Sengupta, 2014, pp. 13-14).

The trend of the exchange rate pressure index during periods of financial stress, when capital inflows decline and even face the threat of a sudden stop, exhibits characteristics that can be considered common for the majority of the selected EMEs. In fact, the index shows a downward trend during the 2002-2007 period, when there was a surge in international capital inflows. However, upward trends are observed in the index during periods of financial stress, such as the 2008/2009 financial crisis, the Taper Tantrum phase in 2013, which indicated that tighter monetary policy would be implemented, the 2010 Euro debt crisis, the deterioration in China's economic outlook in 2015 due to disruptions in financial market functioning (Das et. al., 2022, p. 27) and declines in growth expectations (Ahmed and Zlate, 2017, p. 135), the 2017-2018 years and the COVID 19 crisis[10].

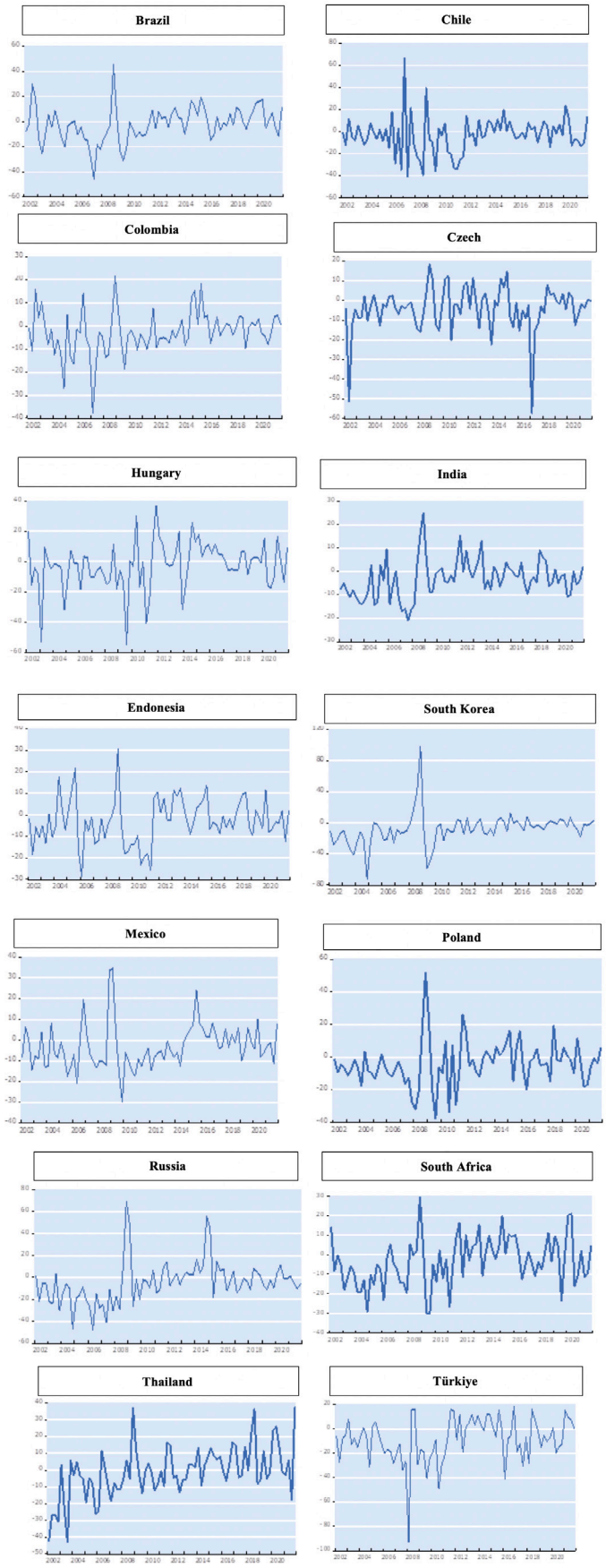
It is of great importance to determine how central banks respond to different types of capital inflows in terms of increasing or decreasing sterilization measures. In the related empirical literature, some studies have tried to investigate whether the willingness of central banks to engage in further sterilization efforts in the face of long- and/or short-term foreign capital inflows varies

[8] Countries are, from left to right, Türkiye, Chile, Colombia, Mexico, Brazil, Hungary, South Korea, Poland, Czech Republic, Indonesia, South Africa, Russia, India, Thailand.

[9] The exchange rate pressure index is calculated using the formula $\frac{\Delta e_{i,t}}{e_{i,t-1}} - \frac{\Delta IR_{i,t}}{M_{i,t-1}/e_{i,t-1}}$ following Aizenman et al. (2012). In this formula, $e_{i,t}$, denotes the nominal exchange rate of country i at time t, which is the value of foreign currency (dollar) in terms of national currency, $\Delta IR_{i,t}$ denotes countries' reserves in dollars excluding gold, and $M_{i,t}$ denotes the monetary base in dollars. International reserves are normalized by the monetary base in period t-1 (lagged by 1 quarter) (pp. 5-6).

[10] For detailed information see Martin et. al., 2020, p. 21; Hördahl and Shim, 2020, p. 1-2; Beirne et. al., 2021, p. 504-505.

Chart 2. Exchange Rate Pressure Index



Note: ub and lb denote 95% confidence intervals, respectively. The sterilization coefficient values obtained for each period are based on the instrumental variable GMM analysis technique for time series. Newey-West HAC correction is applied to resist autocorrelation and variance problems. Since the analysis period consists of quarterly data, a lag of 4 periods is considered for the correction.

across the components of capital flows (Aizenman and Glick, 2009; Arya et al., 2020; Yang, 2016). Some of these studies (e.g., Arya et al., 2020) investigate to what extent and in which direction the sterilization interventions of the central banks of the EMEs affect different types of capital inflows.

This study investigates the degree of sterilization measures at different quantile levels for all components of gross private capital inflows. With the findings obtained from different quantile levels through this method, it will be possible to determine more clearly which type of capital inflows policymakers aim to affect. Indeed, since the effects of international capital flows on financial stability differ at low, medium or high quantile levels, it is crucial for policymakers to develop appropriate strategies to determine the extent of sterilization to limit the effects of capital flows.

Linear statistical models such as the classical least squares regression method calculate the effects of explanatory variables on the average value of the dependent (explained) variable (Binder and Coad, 2011, p. 278). Therefore, linear modeling techniques of this type produce average estimates (Konstantopoulos et al., 2019, pp. 883-884). However, focusing on average effects causes the important features underlying the relationships between variables to be ignored. Moreover, in order for the OLS method to produce unbiased estimates, special assumptions such as normal distribution of errors, homoscedasticity and absence of autocorrelation problems should be met. If one or more of these assumptions are not valid, the estimation findings of this method will produce biased results that are not reliable.

Unlike traditional linear regression analysis, quantile regression analysis has predictive power for all conditional quantile functions instead of the conditional mean function. While the presence of variance in classical regression analysis exposes the estimation results to reliability problems, quantile regression analysis overcomes this problem. Quantile regression can provide complete information about the relationships between the dependent variable and independent (explanatory) variables across the entire conditional distribution and does not impose any distributional condition on the error term (John and Nduka, 2009, p. 61).

Quantile regression, first introduced to the literature with the contributions of Koenker and Baset (1978), enables the estimation of conditional quantile functions where the quantiles of the conditional distribution of the response variable (dependent variable) are functions of the observed explanatory variables (Koenker and Hallock, 2001, p. 143). Accordingly, the general form of the quantile regression model is as follows;

$$y_{it} = x'_{it}\beta_\theta + u_{\theta_{it}} \quad \text{and} \quad Quant_\theta(y_{it}|x_{it}) = x'_{it}\beta_\theta \quad j = 1,\ldots,p \qquad (3)$$

In Equation 3, y_{it} denotes the dependent variable, x_{it} , denotes the vector of explanatory variables, β denotes the parameters to be estimated and denotes the residuals vector. $\mathrm{Quant}_\theta(y_{it}|x_{it})$, represents the th conditional quantile of y_{it} for given x_{it}.

The quantile regression analysis method is robust to outliers and heavy distributions. However, this analysis method does not take unobserved heterogeneity into account. However, the panel fixed effects quantile regression method provides an important advantage in that it consideration unobserved individual heterogeneity. For this purpose, we consider the fixed-effects Method of Moments Quantile Regression introduced to the literature by Machado and Santos Silva (2019). This method makes it possible for individual effects to affect the entire conditional distribution. Although quantile regression methods have been developed in the literature to overcome the incidental parameter problem of individual effect quantile regressions, the calculation methods of these methods are difficult and complex and are based on overly restrictive assumptions about how fixed effects affect quantiles at different levels. However, the fixed-effects quantile regression method developed by Machado and Santos Silva (2019) provides significant advantages in terms of computational simplicity even when there are multiple endogenous explanatory variables and the model is nonlinear (Machado and Silva, 2019, pp. 145-146). In this framework, the quantile regression approach of Machado and Santos Silva (2019) is aimed at estimating the conditional quantiles $Q_\gamma(\tau|X)$ of the model whose conditional distribution is location scale. Accordingly;

$$Y_{it} = \alpha_i + X'_{it}\beta + \sigma(\delta_i + Z'_{it}\gamma)U_{it} \qquad (4)$$

In the equation, Y is the dependent variable, X is the explanatory variable, $\Pr\{\delta_i + Z'_{it}\gamma > 0\} = 1$ probability, $(\alpha, \beta', \delta, \gamma')'$ unknown parameters, Z is the vector k of differentiable transformations of known components of X through the element l given by $Z_l = z_l(X), l = 1,\ldots,k$, U_{it} denotes the unobserved random variable, $U(\alpha_i, \delta_i)$ parameters denote fixed effects for individual i with $i=1,\ldots n$. In this framework, based on Equation 3, the conditional quantile of the dependent variable will be shown in the following form;

$$Q_{\gamma}(\tau|X_{it}) = (\alpha_i + \delta_i q(\tau)) + X_{it}^{'}\beta + Z_{it}^{'}\gamma q(\tau) \quad (5)$$

In Equation 5, $X_{it}^{'}$ denotes the vector of explanatory variables and $\alpha_i(\tau) \equiv \alpha_i + \delta_i q(\tau)$ denotes the scalar coefficient of fixed effects in the quantile τ with respect to individual i. The fixed effects quantile regression method of Machado and Santos Silva (2019) differs from the usual fixed effects method in that the distributional effects are not location shifted. In other words, the distributional effect captures the effects of time-invariant individual characteristics that allow for different effects in different regions of Y. $\int_0^1 q(\tau)d\tau = 0$ can be interpreted as the average effect of α_i for individual i if it is valid. For the solution of the optimization problem;

$$\min_{q} \sum_i \sum_t p_{\tau}\left(\widehat{R}_{it} - \left(\hat{\delta}_i + Z_{it}^{'}\hat{\gamma}\right)q\right) \quad (6)$$

Based on Equation 6, $p_{\tau}(A) = (\tau - 1)AI(A \leq 0) + \tau AI\{A > 0\}$ denotes the control function (Machado and Santos Silva, 2019, pp. 147-148).

On the other hand, a linear quantile regression model that captures individual differences (heterogeneity) in order to examine varying effects at different quantile levels independent of average effects is shown in the following form;

$$Q_{Y_{it}}(\tau|\alpha_i, X_{it}) = \alpha_i + \beta_1 x_{it} + \mu_{it} \quad (7)$$

In the above equation, i represents country and t represents time, α is the fixed effect at the quantile level τ for unit i and μ is the error term. In addition, Y is the dependent variable and x is the main explanatory variables. Therefore, the dependent variable is the sterilization coefficients and the independent variables are the different components of gross capital inflows (as a share of GDP).

Quantile regression analysis findings are presented in Table 3, Table 4 and Table 5. In our quantile regression analysis, low percentiles indicate periods of economic and financial stress when capital inflows are relatively low, while high percentiles indicate periods when capital inflows increase and the economic and financial environment improves. The analysis also includes the exchange rate pressure index and investigates how central banks' sterilization measures change during periods of increased or decreased exchange rate interventions. In this framework, the findings of the analysis show that at low quantile levels, sterilization measures are reduced in the face of low-volume increases in aggregate portfolio inflows. Low capital inflows can significantly reduce the possibility of destabilization by causing severe fluctuations in exchange rates. Thus, policymakers may have less need for sterilization measures to maintain exchange rate stability and ensure stability in financial markets. On the other hand, low volumes of capital inflows can reduce the risk of excessive appreciation of the national currency and thus reduce the level of domestic money supply and inflationary pressures to a large extent. Moreover, in EMEs growing based on short-term capital inflows, policymakers may resort to less sterilization measures to stimulate the economy in the face of the growth-weakening effects of low-volume portfolio inflows. However, towards the median quantile level, the coefficient values for gross portfolio inflows become increasingly negative. These results suggest that sterilization measures are resorted to more as the volume of portfolio inflows increases. After the median quantile level, the findings for this capital type lose their statistical significance (Table 3).

On the other hand, sterilization measures against the possible macroeconomic effects of other investment inflows, a subcomponent of gross total capital inflows, are found to increase, including at low quantile levels. Gross other investment inflows are more volatile and can be withdrawn more rapidly than other subcomponents of gross capital inflows. With these characteristics, gross other investment inflows may disrupt economic balances and increase financial instability, which may lead policymakers to expand the scope of sterilization.

At the higher quantile levels of 55th and 60th quantiles, the coefficient magnitude for other investment inflows is 1.19 and 1.14, respectively. However, it is observed that the sterilization responses to increases in the volume of inflows of this type of capital decreases towards higher quantiles (e.g., at quantiles 65 and 70, the coefficient values are 1.08 and 1.02, respectively) (Table 3). This may be due to the level in the size of the volume of inflows of some types of capital. Indeed, after the 2008 crisis, the volume of capital inflows did not reach the level of pre-crisis periods. Post-crisis inflows periodically experienced significant contractions. The expansionary monetary policies implemented by the central banks of emerging economies in order to stimulate economic activity that contracted due to increased foreign exchange needs and falling demand during periods of stress may have weakened the response of emerging economies' central banks to inflationary tendencies to some extent. All these are indicators that sterilization policies depend on changing economic conditions and countries' political preferences.

At higher quantiles, no significant results were found for the coefficients of the different components of gross inflows and the EMP index. Table 4 presents the estimation results for the central bank's sterilization

responses to gross portfolio equity and debt inflows, which are the main components of gross portfolio investment. Initially, we find that increases in portfolio equity inflows at low quantile levels reduce sterilization measures. Again, the coefficient sign for gross other investment inflows is jointly positive. This result suggests that EMEs central banks try to sterilize the more volatile types of foreign capital inflows. At higher quantile levels (e.g., quantiles 55 and 60), the central bank's sterilization responses to gross other investment inflows are significant and consistent with economic expectations, but these effects gradually diminish. At later quantiles, all components of capital inflows are found to be statistically insignificant.

Table 3. Quantile Regression Analysis of Sterilization Responses to Different Types of Gross Capital Inflows

		Explanatory Variables			
Quantiles		**Gross FDI Inflows**	**Gross Total Portfolio Inflows**	**Gross Other Investment Inflows**	**Exchange Rate Pressure Index (EMP)**
Low Quantile Levels	**0.1**	0.2447 (1.9012)	-2.9683 (1.3492)**	1.7154 (0.7999)**	0.0090 (0.0399)
	0.15	0.0421 (1.6963)	-2.6636 (1.2045)**	1.6401 (0.7137)**	0.0071 (0.0357)
	0.2	-0.1251 (1.5388)	-2.4122 (1.0929)**	1.5781 (0.6474)**	0.0055 (0.0323)
	0.25	-0.2486 (1.4317)	-2.2265 (1.0174)**	1.5322 (0.6023)***	0.0044 (0.0300)
	0.3	-0.3893 (1.3217)	-2.0149 (0.9404)**	1.4799 (0.5560)***	0.0030 (0.0278)
	0.35	-0.5067 (1.2421)	-1.8383 (0.8848)**	1.4364 (0.5225)***	0.0019 (0.0261)
	0.4	-0.6587 (1.1599)	-1.6098 (0.8286)**	1.3799 (0.4879)***	0.0005 (0.0243)
	0.45	-0.8176 (1.1032)	-1.3708 (0.7894)*	1.3209 (0.4639)***	-0.0009 (0.0232)
Median Quantile	**0.5**	-1.0236 (1.0820)	-1.0609 (0.7747)	1.2444 (0.4550)***	-0.0029 (0.0227)
	0.55	-1.1728 (1.1057)	-0.8351 (0.7909)	1.1886 (0.4650)***	-0.0043 (0.0232)
	0.6	-1.3140 (1.1557)	-0.6242 (0.8249)	1.1366 (0.4861)***	-0.0057 (0.0243)
	0.65	-1.4581 (1.2324)	-0.4076 (0.8794)	1.0831 (0.5184)**	-0.0070 (0.0259)
	0.7	-1.6169 (1.3406)	-0.1687 (0.9553)	1.0241 (0.5639)*	-0.0085 (0.0182)
	0.75	-1.8072 (1.4961)	0.1175 (1.0651)	0.9534 (0.6293)	-0.0103 (0.0314)
	0.8	-2.0164 (1.6899)	0.4320 (1.2014)	0.8757 (0.7110)	-0.0123 (0.0355)
Higher Quantile Levels	**0.85**	-2.2052 (1.8795)	0.7159 (1.3339)	0.8057 (0.7908)	-0.0140 (0.0395)
	0.9	-2.3836 (2.0685)	0.9843 (1.4671)	0.7394 (0.8704)	-0.0157 (0.0435)
	0.95	-2.6547 (2.3694)	1.3919 (1.6832)	0.6387 (0.9969)	-0.0183 (0.0498)

Note: The dependent variable is the sterilization coefficient. Values in parentheses indicate t statistics. * indicates statistical significance at 10% level, ** at 5% level and *** at 1% level.

Table 4. Quantile Regression Analysis of Sterilization Responses to Different Types of Gross Capital Inflows

			Explanatory Variables				
	Quantiles		**Gross FDI Inflows**	**Gross Portfolio Equity Inflows**	**Gross Portfolio Debt Inflows**	**Gross Other Investment Inflows**	**Exchange Rate Pressure Index (EMP)**
Dependent Variable Sterilization (STER)	**Low Quantile Levels**	**0.1**	-0.0521 (1.9965)	-8.9198 (4.2772)**	-0.7538 (1.4652)	1.7963 (0.8974)**	0.0048 (0.0400)
		0.15	0.1972 (1.7865)	-8.0566 (3.8290)**	-0.7086 (1.3111)	1.7260 (0.9031)**	0.0035 (0.0358)
		0.2	-0.3216 (1.6245)	-7.3169 (3.4837)**	-0.6699 (1.1922)	1.6659 (0.7303)**	0.0024 (0.0326)
		0.25	-0.4148 (1.5174)	-6.7621 (3.2586)**	-0.6409 (1.1135)	1.6207 (0.6822)***	0.0016 (0.0304)
		0.3	-0.5400 (1.3980)	-6.0177 (3.0059)**	-0.6019 (1.0259)	1.5601 (0.6287)***	0.0005 (0.0280)
		0.35	-0.6366 (1.3297)	-5.4431 (2.8641)**	-0.5718 (0.9756)	1.5133 (0.5980)***	-0.0003 (0.0266)
		0.4	-0.7517 (1.2802)	-4.7586 (2.7650)*	-0.5359 (0.9391)	1.4577 (0.5758)***	-0.0013 (0.0257)
		0.45	-0.8745 (1.2698)	-4.0281 (2.7449)	-0.4977 (0.9313)	1.3982 (0.5712)***	-0.0024 (0.0254)
	Median Quantile	**0.5**	-1.0473 (1.3302)	-3.0008 (2.8739)	-0.4440 (0.9757)	1.3146 (0.5984)**	-0.0039 (0.0267)
		0.55	-1.1738 (1.4242)	-2.2486 (3.0700)	-0.4046 (1.0449)	1.2534 (0.6405)**	-0.0049 (0.0285)
		0.6	-1.2923 (1.5433)	-1.5432 (3.3182)	-0.3677 (1.1324)	1.1960 (0.6939)*	-0.0059 (0.0309)
		0.65	-1.3940 (1.6646)	-0.9385 (3.5773)	-0.3360 (1.2214)	1.1468 (0.7485)	-0.0069 (0.0334)
	Higher Quantile Levels	**0.7**	-1.5222 (1.8366)	-0.1762 (3.9419)	-0.2961 (1.3478)	1.0848 (0.8257)	-0.0079 (0.0368)
		0.75	-1.6774 (2.0666)	0.7471 (4.4316)	-0.2478 (1.5166)	1.0097 (0.9290)	-0.0093 (0.0414)
		0.8	-1.8466 (2.3364)	1.7536 (5.0056)	-0.1951 (1.7147)	0.9278 (1.0502)	-0.0108 (0.0468)
		0.85	-1.9749 (2.5503)	2.5167 (5.4563)	-0.1551 (1.8718)	0.8657 (1.1462)	-0.0119 (0.0511)
		0.9	-2.1478 (2.8480)	3.5444 (6.0897)	-0.1014 (2.0904)	0.7821 (1.2799)	-0.0134 (0.0571)
		0.95	-2.3603 (3.2256)	4.8088 (6.9069)	-0.0352 (2.3673)	0.6792 (1.4498)	-0.0153 (0.0647)

Note: The dependent variable is the sterilization coefficient. Values in parentheses indicate t statistics. * indicates statistical significance at 10% level, ** at 5% level and *** at 1% level.

Findings on sterilization responses to gross equity-based and debt-based capital inflows are presented in Table 5. When the estimation results are evaluated, it can be said that the findings are in line with economic expectations. However, these responses are found to be positive and significant only for gross debt-based capital inflows (at the 10% significance level for all statistically significant quantiles). According to the estimation results, it is observed that the coefficient values decrease gradually, albeit slightly, from the 45th quantile to the 50th and 55th quantiles. This situation points to the possibility that the volume of foreign capital inflows to EMEs has gradually weakened due to the impact of global-based shocks. In fact, these developments cause the global economic outlook to deteriorate and foreign investors to become more risk-sensitive, thereby reducing the likelihood of large-scale capital inflows. In the higher quantiles, the findings for both types of capital inflows are statistically insignificant.

Table 5. Quantile Regression Analysis of Sterilization Responses to Different Types of Gross Capital Inflows

			Explanatory Variables		
	Quantiles		**Gross Equity Based Capital Inflows**	**Gross Debt-Based Capital Inflows**	**Exchange Rate Pressure Index (EMP)**
Dependent Variable Sterilization (STER)	**Low Quantile Levels**	**0.1**	-2.7491 (1.8986)	0.8352 (0.8038)	0.0184 (0.0395)
		0.15	-2.5603 (1.7153)	0.8261 (0.7260)	0.0162 (0.0357)
		0.2	-2.3825 (1.5536)	0.8176 (0.6576)	0.0142 (0.0323)
		0.25	-2.2642 (1.4542)	0.8119 (0.6154)	0.0128 (0.0302)
		0.3	-2.0994 (1.3296)	0.8039 (0.5624)	0.0109 (0.0276)
		0.35	-1.9978 (1.2632)	0.7991 (0.5339)	0.0097 (0.0263)
		0.4	-1.8542 (1.1846)	0.7922 (0.5004)	0.0081 (0.0246)
		0.45	-1.6437 (1.1094)	0.7821 (0.4683)*	0.0056 (0.0230)
	Median Quantile	**0.5**	-1.4338 (1.0909)	0.7719 (0.4602)*	0.0032 (0.0226)
	Higher Quantile Levels	**0.55**	-1.2818 (1.1133)	0.7647 (0.4701)*	0.0014 (0.0231)
		0.6	-1.1232 (1.1685)	0.7571 (0.4937)	-0.0004 (0.0243)
		0.65	-0.9850 (1.2400)	0.7504 (0.5239)	-0.0019 (0.0258)
		0.7	-0.8234 (1.3455)	0.7427 (0.5687)	-0.0039 (0.0279)
		0.75	-0.5949 (1.5258)	0.7317 (0.6452)	-0.0065 (0.0317)
		0.8	-0.4213 (1.6805)	0.7233 (0.7109)	-0.0085 (0.0349)
		0.85	-0.2245 (1.8692)	0.7139 (0.7912)	-0.0108 (0.0389)
		0.9	-0.0422 (2.0534)	0.7051 (0.8695)	-0.0129 (0.0427)
		0.95	0.2411 (2.3555)	0.6915 (0.9966)	-0.0162 (0.0489)

Note: The dependent variable is the sterilization coefficient. Values in parentheses indicate t statistics. * indicates statistical significance at 10% level, ** at 5% level and *** at 1% level.

CONCLUSION AND RECOMMENDATIONS

Measuring policy responses to sterilization in the face of gross capital inflows and their different components is of great importance for balancing the effects of international capital flows and ensuring economic stability. However, these responses may differ depending on the composition and size of capital inflows. Therefore, this study investigates the effectiveness of sterilization measures against inflows of gross total capital and their components through quantile regression analysis using recent data sets. In this framework, the quantile regression analysis method is used to determine in which direction and at what levels sterilization measures will respond to low or large volumes of foreign capital inflows at different quantile levels. Thus, it is possible to determine the responses of sterilization measures depending on the type of capital inflows and to evaluate these responses at different levels. Moreover, non-linear relationships between capital inflows and sterilization measures are valid. In this respect, quantile regression

analysis provides great advantages in modeling non-linear relationships between variables and developing appropriate economic policies. Therefore, policymakers can make and implement better decisions by taking into account the types of capital inflows and their effects on the differentiated economy and the shocks they may cause.

The inclusion of instrumental variable GMM estimation in the calculation of the sterilization coefficient is another important contribution of this study to the literature. In addition, our study takes into account all financial stress periods since the 2008 crisis and takes into account the recent data sets and the sample period in a way to reveal the monetary policy actions of the central banks of the countries. In this framework, the GMM method with instrumental variables is a more efficient estimator of both over- and under-specified models than the 2SLS method, which is the method mostly used in the literature. It also provides a more flexible framework in terms of generating more efficient and successful solutions to more complex endogeneity problems such as missing instrumental variables. In this respect, we initially calculate the levels of monetary policy responses of the EMEs to changes in net foreign assets by obtaining sterilization coefficients for each EME. The findings of the analysis with the time series-based instrumental variable GMM estimator show that the coefficient values are high for most of the EMEs over the sample period. For the panel group, the sterilization coefficient was found to be -0.87. These results suggest that policymakers have generally pursued the objectives of reducing exchange rate volatility and inflationary pressures and stabilizing financial markets by reducing financial risks.

On the other hand, the overall quantile regression analysis findings suggest that among different types of foreign capital inflows, EMEs policymakers try to sterilize other types of capital inflows, especially those with shorter maturity and volatile characteristics, mainly banking flows. Moreover, we find that sterilization measures are reduced in the face of gross portfolio equity inflows at lower quantile levels. Indeed, given the relatively more stable nature of portfolio equity investments, such as long-term foreign capital inflows, and their long-term contribution to the economy, the negative relationship is in line with expectations. Considering that lower quantile levels represent periods when risk is lower and capital inflows are relatively more limited, it can be said that the findings are in line with expectations as sterilization measures are less. As a matter of fact, the pressure of lower volume capital inflows on the exchange rate is limited and excessive volatility is much less pronounced depending on the type of capital inflows. Therefore, it can be stated that sterilization policy would not be a primary requirement for exchange rate stability as well as economic stability. Moreover, the empirical findings show that gross portfolio equity-based capital flows are less volatile than gross portfolio debt flows and hence may have less destabilizing effects on the economy and hence may be less prone to sterilization measures.

As a result, policymakers may increase their sterilization efforts to ensure economic and financial stability by taking into account the periods when exchange rate fluctuations and financial volatility are more severe and pronounced. Moreover, the size of sterilization measures may differ due to different factors. Therefore, more balanced and flexible sterilization measures should be considered according to the type and amount of capital inflows as well as economic conditions.

Finally, the time period considered in the study to investigate the scope and effectiveness of sterilization measures is of great importance as it takes into account the effects of recent global financial crises and serious economic events such as pandemics. However, constraints on the availability of data for EMEs led to the limited number of countries analyzed and the number of countries analyzed. Therefore, in addition to extending the time period within the framework of this research, it would be of great importance to consider other emerging economies or regions in order to generalize the results.

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APPENDİX

Appendix A.

Table A1. Definition and Measurement Method of the Variables Used in the Empirical Analysis

Variables	Definition	Measurement	Source
$\Delta \mathrm{NDA}$	Change in Net Domestic Assets	The difference between the ratio of the change in the monetary base (Monetary Base-MB-) to the monetary base at time t and the change in NFA excluding the valuation effect: $\left(\frac{\Delta \mathrm{MB_t}}{\mathrm{MB_t}} - \mathbf{\Delta NFA}_{\mathbf{t}}\right)$	IMF
$\Delta \mathrm{NFA}$	Change in Net Foreign Assets	**Change in NFA excluding revaluation effect:** $\left[NFA_t - NFA_{t-1}\left(\frac{e_t}{e_{t-1}}\right)\right]/MonetaryBase$	IMF
NFA	Net Foreign Assets	The difference between dollar-denominated foreign reserves excluding gold multiplied by the nominal dollar exchange rate and foreign liabilities: $Reserves(R) \times NominalDollarExchangeRate(e) - \mathrm{ForeignExchangeLiabilities}(DY) = NFA$	IMF
$\Delta \mathrm{mm_t}$	Money Multiplier	Quarter-on-quarter logarithmic change in the ratio of broad money supply to monetary base	IMF
$\Delta \mathrm{r_t}$	Federal Effective Funds Rate	Change in the US federal funds rate compared to the previous quarter	Federal Reserve Economic Data (FRED)
$\mathrm{Y_{t-1}}$	Cyclical Income	Deviations from trend values calculated using current real GDP and its H-P filter	IMF
$\mathrm{P_{t-1}}$	Inflation Rate	Logarithmic difference in the Consumer Price Index (CPI) compared to the previous quarter	IMF
$\Delta \mathrm{G_t}$	Change in Public Expenditures	Ratio of quarter-on-quarter change in public expenditures to monetary base	IMF
$\Delta \mathrm{REER_t}$	Change in Real Effective Exchange Rate	Quarter-on-quarter logarithmic change in CPI-based REER	Bruegel Database (2022)

Table A2. Estimation Results of ADF and PP Unit Root Tests for Individual Countries

	Türkiye (2005q1-2021q4)		**Brazil (2005q1-2021q4)**		**Chile (2005q1-2021q4)**		**Colombia (2005q1-2021q4)**		**Czech Republic (2005q1-2021q4)**		**Indonesia (2005q1-2021q4)**	
	ADF	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**
$\Delta \mathrm{NDA}$	-7.675 (0.000)	-7.861 (0.000)	-6.187 (0.000)	-6.329 (0.000)	-9.694 (0.000)	-9.560 (0.000)	-7.621 (0.000)	-7.628 (0.000)	-10.64 (0.000)	-11.02 (0.000)	-7.407 (0.000)	-7.380 (0.000)
$\Delta \mathrm{NFA}$	-5.716 (0.000)	-5.824 (0.000)	-4.970 (0.000)	-5.070 (0.000)	-10.38 (0.000)	-10.14 (0.000)	-7.288 (0.000)	-7.342 (0.000)	-7.703 (0.000	-7.724 (0.000)	-5.762 (0.000)	-5.821 (0.000)
$\Delta \mathrm{mm_t}$	-8.684 (0.000)	-8.682 (0.000)	-6.397 (0.000)	-6.538 (0.000)	-7.017 (0.000)	-7.079 (0.000)	-13.42 (0.000)	-12.48 (0.000)	-7.094 (0.000)	-7.200 (0.000)	-8.721 (0.000)	-8.947 (0.000)
$\Delta \mathrm{r_t}$	-3.724 (0.003)	-4.157 (0.000)	-4.189 (0.000)	-4.157 (0.000)	-4.189 (0.000)	-4.157 (0.000)	-4.189 (0.000)	-4.157 (0.000)	-4.189 (0.000)	-4.157 (0.000)	-4.189 (0.000)	-4.157 (0.000)
$\mathrm{Y_{t-1}}$	-4.189 (0.000)	-3.813 (0.002)	-3.763 (0.003)	-3.833 (0.002)	-3.295 (0.015)	-3.572 (0.006)	-4.426 (0.000)	-4.386 (0.000)	-3.291 (0.015)	-3.408 (0.010)	-4.118 (0.000)	-4.124 (0.000)
$\mathrm{P_{t-1}}$	-5.309 (0.000)	-5.375 (0.000)	-4.324 (0.000)	-4.169 (0.000)	-5.094 (0.000)	-5.021 (0.000)	-3.724 (0.003)	-3.791 (0.000)	-4.270 (0.000)	-4.415 (0.000)	-6.076 (0.000)	-6.167 (0.000)
$\Delta \mathrm{G_t}$	-8.761 (0.000)	-9.514 (0.000)	-12.80 (0.000)	-11.91 (0.000)	-8.886 (0.000)	-8.856 (0.000)	-78.35 (0.000)	-116.1 (0.000)	-6.778 (0.000)	-6.945 (0.000)	-11.70 (0.000)	-12.33 (0.000)
$\Delta \mathrm{REER_t}$	-8.358 (0.000)	-8.357 (0.000)	-5.809 (0.000)	-5.723 (0.000)	-6.419 (0.000)	-6.288 (0.000)	-6.976 (0.000)	-6.914 (0.000)	-6.000 (0.000)	-5.918 (0.000)	-6.386 (0.000)	-6.269 (0.000)

Table A3. Estimation Results of ADF and PP Unit Root Tests for Individual Countries

	Poland (2005Q1-2021Q4)		Russia (2005Q1-2021Q3)		South Africa (2005Q1-2021Q4)		South Korea (2005Q1-2021Q4)		Mexico (2005Q1-2021Q4)		Thailand (2005Q1-2021Q4)	
	ADF	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**
ΔNDA	-10.733 (0.000)	-10.496 (0.000)	-5.460 (0.000)	-5.407 (0.000)	-7.580 (0.000)	-7.602 (0.000)	-7.454 (0.000)	-7.488 (0.000)	-4.482 (0.000)	-4.489 (0.000)	-8.164 (0.000)	-8.166 (0.000)
ΔNFA	-8.543 (0.000)	-8.542 (0.000)	-4.915 (0.000)	-4.873 (0.000)	-7.189 (0.000)	-7.225 (0.000)	-7.792 (0.000)	-7.859 (0.000)	-4.711 (0.000)	-4.677 (0.000)	-8.514 (0.000)	-8.507 (0.000)
Δmm_t	-13.409 (0.000)	-15.519 (0.000)	-7.549 (0.000)	-7.575 (0.000)	-10.063 (0.000)	-10.107 (0.000)	-10.768 (0.000)	-13.137 (0.000)	-7.782 (0.000)	-7.836 (0.000)	-12.125 (0.000)	-12.433 (0.000)
Δr_t	-4.189 (0.000)	-4.157 (0.000)	-4.156 (0.000)	-4.124 (0.000)	-4.189 (0.000)	-4.157 (0.000)	-4.189 (0.000)	-4.157 (0.000)	-4.189 (0.000)	-4.157 (0.000)	-4.156 (0.000)	-4.124 (0.00)
Y_{t-1}	-4.584 (0.000)	-4.659 (0.000)	-5.527 (0.000)	-5.691 (0.000)	-6.099 (0.000)	-6.095 (0.0009	-3.576 (0.006)	-3.846 (0.000)	-5.060 (0.000)	-5.050 (0.000)	-4.264 (0.000)	-4.349 (0.000)
P_{t-1}	-3.735 (0.003)	-3.725 (0.003)	-4.266 (0.000)	-4.269 (0.000)	-5.018 (0.000)	-5.070 (0.000)	-5.221 (0.000)	-5.366 (0.000)	-6.818 (0.000)	-6.976 (0.000)	-6.233 (0.000)	-6.222 (0.000)
ΔG_t	-8.457 (0.000)	-8.545 (0.000)	-6.859 (0.000)	-6.898 (0.000)	-3.940 (0.001)	-3.991 (0.001)	-6.191 (0.000)	-6.358 (0.000)	-6.470 (0.000)	-6.395 (0.000)	-9.071 (0.000)	-9.431 (0.000)
$\Delta REER_t$	-6.500 (0.000)	-6.377 (0.000)	-9.120 (0.000)	-9.137 (0.000)	-6.958 (0.000)	-6.892 (0.000)	-6.710 (0.000)	-6.745 (0.000)	-7.794 (0.000)	-7.804 (0.000)	-5.377 (0.000)	-5.312 (0.000)

Table A4. Horizontal Cross-Sectional Dependence Test for Panel Data.

Tests	Statistics	Probability Value
LM	**155.2**	**0.000**
LM adj*	**24.92**	**0.000**
LM CD*	**6.847**	**0.000**

Table A5. Panel Unit Root Analysis

ΔNDA	-5.5182
ΔNFA	-5.2840
Δmm_t	-6.1765
Y_{t-1}	-2.5067
P_{t-1}	-3.3694
ΔG_t	-4.2729
$\Delta REER_t$	-6.0338
CIPS Critical Values	-2.48 -2.28 -2.17

Note: "Federal Effective Funds Rate", one of the variables used in the analysis for the panel group countries, is the covariate. Since this variable is used by taking its change compared to the previous quarter, CIPS test results could not be obtained. Since the change values of the variable are close to zero, it is accepted that it meets the characteristics of stationarity and it is included in the analysis with its level values. However, it was found that there were no significant differences in the test results when the variable was included in the analysis in its first difference.

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The Many Faces of Poverty: A Comprehensive Analysis on Measurement of Poverty in Türkiye

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ABSTRACT

Although poverty statistics serve as crucial economic and social indicators, their measurement varies depending on the chosen definition of poverty. This study examines whether poverty estimations in Türkiye significantly differ based on the definition used and explores which concept of poverty is most appropriate. Utilizing the SILC micro datasets from 2014 to 2021, the study estimates two absolute poverty measures, a subjective poverty measure, and a multidimensional poverty measure. The findings reveal that poverty rates are highly sensitive to the definition applied. For instance, while the updated absolute poverty line from TurkStat identifies less than 20% of the population as poor, the subjective poverty line and the absolute poverty line defined by TÜRK-İŞ classify approximately 60% and 70% of the population as poor, respectively. Furthermore, while 43% of the population was considered multidimensionally poor in 2014, this figure declined to 31% in 2021. A significant concentration of poverty is observed in the Southeastern and Eastern regions across all measurement approaches. Finally, the study conducts a comparative analysis of various poverty definitions by examining trends in poverty rates, the overlap of poor households, regional rankings, pairwise correlations, and the demographic profile of individuals living in poverty.

Keywords: Poverty Measures, Absolute Poverty, Multidimensional Poverty, Subjective Poverty, Regional Poverty.

JEL Classification Codes: I32, O11, O12, O18, R11

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INTRODUCTION

Poverty measures are critical social and economic indicators. They allow us to compare poverty across groups and regions and monitor how economic well-being has evolved. These statistics can raise awareness and play an essential role in motivating political action (Atkinson, 2019). They are especially valuable in shaping social policies, targeting vulnerable populations, and allocating social budgets. Still, defining and measuring poverty remains a highly controversial issue. Various approaches can be used in this regard. The choice of welfare indicator, poverty line, or measurement technique can considerably influence the results (Atkinson, 1987). For instance, an improperly defined poverty line leading to either an underestimation or overestimation of poverty may undermine the effectiveness of poverty eradication policies. Robustness checks are, therefore, necessary for any measure of poverty (Deaton, 2018).

Given the diversity of conceptualizations and measurement methods, comparative analyses of poverty measures are crucial (Kwadzo, 2015). Even if policymakers tend to adopt a particular poverty definition and follow the poverty measure based on this definition, this choice may have critical consequences for the people in poverty. As Laderchi et al. (2003) argue, different conceptualizations and measures of poverty may not always identify the same people as poor. Conducting a comparative analysis helps determine which poverty measure is most appropriate under existing conditions.

Although poverty is fundamentally an issue of underdevelopment, it is also a significant concern in developed countries (Şenses, 2019). Still, the convenience of poverty concepts can be distinct for developed and developing countries. Deaton (2018) and Şenses (2019) argue that relative poverty measures are more relevant for developed countries where absolute poverty is negligible, whereas absolute poverty remains a critical concern in developing countries where significant segments of the population struggle to meet basic needs. Additionally, applying relative poverty measures in developing economies can yield counterintuitive results due to rapid economic shifts (Demir Şeker &

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Jenkins, 2013). For example, during periods of rapid economic growth, living standards improve; however, since median income levels also rise, relative poverty measures may fail to capture these gains. Conversely, in economic downturns, relative measures may not fully reflect declines in individual well-being. Therefore, the relative poverty approach is used primarily in developed countries where absolute poverty is no longer a major concern, rather than in developing economies that are undergoing rapid changes (Şenses, 2019).

Given the complexities surrounding poverty measurement, this study seeks to determine whether poverty estimates in Türkiye significantly vary based on the chosen definition and, if so, which conceptualization is most suitable for a developing country. For this purpose, using the Survey on Income and Living Conditions (SILC) micro datasets for the 2014-2021 period, this study estimates absolute poverty (via two distinct absolute poverty lines), subjective poverty, and multidimensional poverty rates. Considering the persistent regional disparities in the country (see for example, Doğruel & Doğruel, 2003), these estimates are also analyzed at the NUTS-2 regional level. The results reveal whether different approaches broadly classify the same households and regions as poor.

LITERATURE ON POVERTY MEASURES

The first studies on poverty measurement emerged in England at the end of the 19th century. Prior to the Industrial Revolution, poverty was the prevailing condition for the majority of the population, with only a privileged minority experiencing economic security (Rodrik, 2017). The rise of industrial capitalism in the late 19th century led to low-paid work with rough working conditions and visible socioeconomic inequalities (O'Connor, 2016). This is why initial studies on poverty correspond to this time. Indeed, Atwater's (1894) calory measurement as an indicator for basic subsistence level; Booth's (1895) poverty estimates in London with poverty lines; and Rowntree's (1901) examination of the social conditions of the workers in York coincided with this period.

A key debate in poverty measurement arises from the choice of an appropriate welfare indicator. Monetary indicators such as household income and consumption are commonly used, yet each has limitations. Consumption is not as volatile as income thanks to savings and borrowings (Ravallion, 1992). Since people in poverty tend to engage in activities with variable income (Banerjee & Duflo, 2012), consumption may be a better indicator. On the other hand, remembering what they spent is more difficult for households compared to what they earned. Another ongoing debate centers on whether poverty is better captured by material deprivation or low income. Some studies have highlighted the mismatch between income poverty and material deprivation, demonstrating that low income does not always align with broader measures of economic hardship (see for example Berthoud & Bryan, 2011; Hick, 2014).

The capability approach posits that a direct measure for evaluating well-being is neither commodities, nor utility, but individual's capability (Sen, 1983, 1985, 1993). This perspective has expanded the evaluation of living standards by emphasizing deprivations beyond economic hardship (Smeeding, 2016). Even if household income or consumption can indicate the accession to plenty of market goods, they exclude non-market goods such as access to health services or education (Ravallion, 2012). Hence, non-monetary indicators of welfare may play a significant role in comprehending the multifaceted nature of poverty.

Another key debate in poverty measurement concerns the selection of the poverty line. Townsend (1979) introduced the concept of relative poverty, defining poverty as a situation of people whose resources are so lower than an average person in the society that they are excluded from ordinary living standards. On the other hand, Sen (1983) argued that poverty should primarily be deemed as an absolute notion and addresses that *"... the fact that some people have a lower standard of living than others is certainly proof of inequality, but by itself, it cannot be a proof of poverty…"*. Kwadzo (2015) compared monetary poverty, capability poverty, and social exclusion in the U.S. and concluded that these three measures generate quite different poverty rates. The notable variation in the poverty rates indicates the sensitivity of the measures to the definitions.

Since the 1990s, The World Bank has estimated global extreme poverty through international poverty lines (e.g., 1.90$ (PPP) per day per person). Meanwhile, several countries estimate official poverty rates through different approaches. For instance, the absolute poverty notion is prevalent in the US following the Orshansky (1965) method, whereas poverty studies in Europe mostly focus on the concept of relative poverty and social exclusion (e.g., Walker & Walker, 1997; Gordon et al., 2000). More recently, the Supplemental Poverty Measure[1] in the US since 2011 and

[1] https://www.census.gov/topics/income-poverty/supplemental-poverty-measure.html

the Social Metrics Commission Reports[2] in the UK since 2018 have improved poverty measurements in these countries.

Another approach to poverty measurement involves subjective assessments of well-being. In this approach, survey respondents are directly asked to rate their well-being on an ordinal scale or are asked about the minimum income level required to make ends meet. However, self-assessed welfare may be biased and unreliable due to the possible high degree of variability in subjective data (Ravallion, 2012). Even under similar circumstances, respondents may provide widely different answers. The way survey questions are perceived can vary, even among communities with similar living standards (Şenses, 2019). Additionally, self-assessments may easily be influenced by personality traits, social norms, and reference groups.

Recently, the multidimensional poverty approach has gained prominence, emphasizing that poverty is intrinsically a multifaceted phenomenon ranging from undernourishment to poor health or housing conditions (Alkire & Foster, 2011; Alkire et al., 2015; Nolan & Whelan, 2014). In this regard, since 1990, the Human Development Index (HDI) has been estimated by the United Nations Development Programme (UNDP). This index is a summary measure of a decent living standard, education, and health. Furthermore, the Human Poverty Index (HPI) which consists of three dimensions (i.e., a decent standard of living, a long and healthy life, and finally knowledge) was introduced by the UNDP in 1997. This index is differently defined for high-income OECD countries and developing countries. In 2010, it was replaced by the Global Multidimensional Poverty Index (MPI). This multidimensional approach considers overlapping deprivations experienced by individuals and allows for a comprehensive analysis of poverty. The Global MPI comprises education (lack of six years of schooling and school attendance), health (*child mortality and undernourishment*), and living standards (*cooking fuel, sanitation, drinking water, electricity, housing, and assets*). It has been measured for more than 100 countries by the Oxford Poverty and Human Development Initiative and UNDP. The Global MPI was also measured for Türkiye in 2003, and 6.6 per cent of the population was identified as multidimensionally poor (Alkire, Roche, Santos, & Seth, 2011). However, as Acar (2014) states, rather than developing countries, the global MPI is more relevant for underdeveloped countries due to its low criteria. Lately, many developing countries (e.g., Mexico, Chile, Colombia, India, etc.) have constructed national MPIs considering country characteristics and have accepted these tailored MPIs as their official poverty measure.

In Türkiye, the official statistical institute, TurkStat, measured absolute poverty rates during the 2002-2009 period. However, in an effort to align with European Union statistical standards, TurkStat subsequently shifted to relative poverty measures. Even though there are a few studies on absolute poverty in Türkiye, these studies (e.g., Şengül, 2003; Demir Şeker & Jenkins, 2013; and Karadağ, 2015) examined a period more than a decade ago, leaving a gap in recent absolute poverty estimates for the country. Hence, there is a lack of absolute poverty measures in Türkiye in the present time.

This study aims to provide a comparative analysis of poverty measurement in Türkiye starting with absolute poverty estimates. First, it updates the old absolute poverty lines of TurkStat through the changes in the consumer price index (CPI). It also estimates absolute poverty by using the poverty lines of the Confederation of Turkish Trade Unions (TÜRK-İŞ), whose poverty lines have been the subject of significant public debate in recent years. To the best of my knowledge, this is the first study using TÜRK-İŞ' poverty lines to estimate poverty rates in Türkiye. Furthermore, this study estimates subjective poverty rates using a question in the SILC dataset. Finally, an MPI for Türkiye is developed and measured, and all these estimations are compared. Even though some studies have already measured the multidimensional poverty in the country, such as Acar (2014), Karadağ (2015), Limanlı (2016), Giovanis & Özdamar (2021), Karahasan & Bilgel (2021), the MPI in the current study brings out some new indicators and a new dimension. Also, it accounts for the whole population, while the previous studies mostly focused on the population above 15 years old.

DATASET AND METHODOLOGY

Poverty Concepts

This paper applies the four approaches in Table 1 to measure poverty in Türkiye. For this purpose, the SILC micro datasets for the years between 2014 and 2021 are utilized. These datasets cover household disposable income and non-monetary indicators for welfare. Household disposable income includes earnings, imputed rent, agricultural production for own consumption, and social allowances while excluding regular taxes. Income data in the SILC is one year lagged which means that income poverty in 2020 is estimated

[2] https://socialmetricscommission.org.uk/

Table 1. Poverty measurement approaches

Approach	Welfare indicator	Poverty line
Absolute poverty	*Household income*	*Updated absolute poverty line of TurkStat*
Absolute poverty	*Household income*	*TÜRK-İŞ' absolute poverty line*
Subjective poverty	*Household income*	*Subjective poverty line*
Multidimensional poverty	*Monetary and non-monetary indicators*	*Multidimensional poverty line*

using the SILC 2021, for example. Summary statistics for income data in the SILC are provided in Table A.1 in the appendix. The surveys contain annual income data, but in this study income data is converted into monthly income so that fluctuations throughout the year are eliminated.

Notable spatial price differences may exist within large countries, and in this case, national poverty measures need intra-national price indexes (Deaton & Dupriez, 2011). Given the regional heterogeneity in the country and the availability of the NUTS-2 level datasets since 2014, poverty estimates in this study start from 2014.

For absolute poverty measures, this study employs two different lines; the poverty lines of TurkStat and TÜRK-İŞ. Both poverty lines are based on the cost of basic needs during a month in Turkish Liras (TL). TurkStat previously calculated absolute poverty lines, which included food and non-food necessities, for the 2002-2009 period. These poverty lines were constructed using the cost of a minimum food bundle satisfying daily 2,100 kcal. The costs of non-food needs were estimated using the ratio of non-food expenditures to total household expenditures for households whose total consumption expenditures were slightly above the food poverty line.

To update TurkStat's most recent absolute poverty line (from 2009) for subsequent years, this study adjusts for inflation using changes in the CPI obtained from TurkStat. Additionally, to account for regional price disparities, the study constructs region-specific poverty lines by applying regional purchasing power parity (PPP) for the base year and regional CPIs for subsequent years. To ensure comparability across households of different sizes, the modified OECD equivalence scale is applied, assigning a weight of 1.0 to the first adult, 0.5 to other household members aged 14 or older, and 0.3 to children under 14. The same equivalence scale is also used for household income adjustments. The updated absolute poverty lines based on TurkStat's methodology are presented in Table A.2 in the appendix.

Despite these adjustments, the updated poverty lines of TurkStat have certain limitations. First, they do not consider the changes in the quality of existing goods, the arrival of new goods, or the substitution between goods over time (Meyer & Sullivan, 2012). Additionally, they cannot take the changes in needs into account. Furthermore, while this study utilizes the changes in CPI for inflation adjustment, food prices -comprising a significant portion of expenditures for low-income households- rose at a higher rate than overall CPI during the period. Lastly, concerns have been raised regarding the underestimation of official inflation rates in some years. For example, while TurkStat reported an annual CPI increase of 36.08% in 2021, ENAGrup estimated the rate at 82.81%[3]. Consequently, the updated poverty lines may underestimate actual poverty thresholds. Given the potential parsimony in these lines, poverty estimates using them can be considered as extreme poverty.

Another absolute poverty line used in this study is that of TÜRK-İŞ[4], which is a more generous line compared to that of TurkStat. TÜRK-İŞ first calculates a food poverty line for a household composed of four individuals, assuming that the daily calorie requirements for an adult male, adult female, a young (15-19 years old), and a child are 3,500 kcal, 2,300 kcal, 3,200 kcal, and 1,600 kcal, respectively. Then, it estimates the non-food part using the share of food expenditures in total consumption (i.e., 30.7%). TÜRK-İŞ' poverty lines are for a household comprised of four members living in the TR51 (Ankara) region. In this study, the poverty lines of TÜRK-İŞ are divided by the OECD equivalent scale[5], which is the most proper scale to convert these lines into adult equivalent terms. To consider the regional price level differences, the regional price level in TR51 (Ankara) is normalized to one. Afterwards, poverty lines for other regions are derived using regional price level indices for each year. These poverty lines can be found in Table A.3.

Third, subjective poverty is estimated using a survey question from the SILC dataset, in which respondents are asked to specify the minimum monthly income level required to make ends meet. Households whose income levels are lower than this self-reported threshold are counted as subjectively poor.

[3] https://enagrup.org

[4] https://www.turkis.org.tr/category/aclik-yoksulluk/

[5] The OECD equivalent scale (where the first adult takes 1, other members aged 14 or older take 0.7, and each child takes 0.5) is a more proper scale for the approach of TÜRK-İŞ compared to the modified scale. The same scale is also applied to household income.

Table 2. MPI for Türkiye

Dimension	Indicator
Education (1/5)	E1: If the average years of schooling among household members 15 years old or older are lower than eight years
	E2: If a household member who is at least 15 years old is illiterate
Health (1/5)	H1: If a member of the household suffers from a physical or mental health issue constraining daily activities
	H2: If a member of household suffers from accessing to health services
	H3: If household cannot afford a meal including chicken/meat/fish/vegetarian equivalent at least once every two days
Housing conditions (1/5)	HC1: If there are problems related to floor, walls, or roof
	HC2: If there is a lack of indoor toilet and bathroom
	HC3: If 2.5 or more members share a bedroom (overcrowding)
	HC4: If there is environmental pollution in the neighborhood
	HC5: If violence or crime issues occur in the neighborhood
	HC6: If there are heating problems resulting from a lack of isolation
Material deprivation (1/5)	M1: A lack of at least three of five assets (TV, cellphone, dishwasher, computer, and automobile) because of economic problems
	M2: If the household cannot pay housing rent, loan on interest, or mortgage credit at least twice during the last 12 months
	M3: If the household cannot pay bills (e.g., gas, electricity, water) at least twice during the last 12 months
	M4: If the household cannot repay a credit card debt or other debts at least twice during the last 12 months
	M5: If the household cannot afford an unexpected but mandatory expenditure[6]
Social exclusion (1/5)	S1: If there is a household member who is unemployed (looking for a job)
	S2: If a household member is not registered in social security in his/her job
	S3: If the household is not able to eat/drink with family or friends at home or outside at least twice a month because of financial limitations
	S4: If the household is not able to get involved in sports activities, cinema, or concerts at least twice a month because of economic hardships
	S5: If the household cannot access the internet because of economic limitations
	S6: If the equivalized income level of household is lower than sixty percent of the median adult equivalized income in the country

Source: Generated by the author.
Note: Weights are in parentheses.

Finally, following the Alkire-Foster (AF) methodology, official MPIs of other developing countries, and previous studies, an MPI for Türkiye is developed. Table 2 outlines the dimensions, indicators, and weights used in this index. All the indicators are binary variables and have a value of one (deprived) or zero (not deprived). The dual-cut-off approach of the AF method is implemented which has a set of deprivation cut-offs to identify whether a person or household is deprived in each indicator, and a poverty cut-off to determine whether a person or household is in multidimensional poverty. The equal weighting approach is adopted where both dimensions and indicators in each dimension are equally weighted. The poverty cut-off adopted here is 1/3 following the standard AF methodology and official MPIs of many other developing countries. Compared to the previous MPIs produced for Türkiye, the current MPI introduces a new dimension -social exclusion- along with additional indicators, such as internet accession and overcrowding. The summary of MPI indicators is provided in Table A.4.

In 1997, the compulsory education period by law became eight years in Türkiye. More recently, in 2012, this compulsory period was further increased to twelve years. Consequently, deprivation in E1 refers to households with lower education than the compulsory period (even based on the low criterion). The lack of micronutrients is included as an indicator of poor health (H3), reflecting nutritional deprivation. Overcrowding (HC3) is incorporated as an indicator for housing conditions following the official MPI frameworks used in Chile and

[6] This expenditure costs approximately 1,079 TL in 2021, for example.

Mexico. Similar to Gordon et al. (2000) and the HPI of UNDP, being out of employment and social security are adopted as indicators of social exclusion. Lack of participation in social activities, inability to access the internet -especially in this digital age-, and relative income poverty are also considered as indicators of social exclusion.

Poverty Measurement Methods

This study adopts the Headcount Ratio (HCR) from the Foster-Greer-Thorbecke (1984) (FGT) indexes to estimate poverty rates. This method has some practical and technical advantages in terms of intuitive interpretation and subgroup decomposability. FGT indices' general form is given below.

$$FGT_\alpha = \frac{1}{N}\sum_{i=1}^{M}\left(\frac{z_i - c_i}{c_i}\right)^\alpha In_i$$

where N refers to total population, M denotes the total number of households, c_i refers to the income level of the household, z_i presents the poverty line, and n indicates the number of individuals in each household.

$I=1 \quad \text{if} \quad c_i < z_i,$

$I=0 \quad \text{if} \quad c_i \geq z_i$

This definition of I signifies that only the households whose income levels are lower than the poverty line are counted. Population weights are also included if we have a sampling based on random stratification, ensuring representative estimates. Once α is zero (FGT_0), the index is called the headcount ratio (HCR), which measures the proportion of individuals classified as poor. FGT_1 refers to the poverty gap ratio (PGR), which captures the average shortfall of incomes from the poverty line. Finally, FGT_2 refers to the squared poverty gap (SPG), which gives greater weight to the poorest individuals.

For multidimensional poverty estimation, the Alkire-Foster (AF) methodology is followed in this study. Assuming that poverty is evaluated utilizing d number of dimensions where $d \in N$, and the total population consists of n individuals where $n \in N$, the formation of multidimensional poverty measure can be expressed through the n x d dimensional achievement matrix X below. The achievement of individual *i* in dimension *j* is shown by x_{ij} where $x_{ij} \in R_+$ for all i=1, …, n and j=1, …, d. It is assumed that higher achievements are preferable to lower ones.

$$X = \begin{matrix} \text{dimensions} \\ \end{matrix} \begin{bmatrix} x_{11} & \cdots & x_{1d} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{nd} \end{bmatrix} \text{people}$$

A weight is given to each dimension with respect to its relative importance. The vector of weights is $w = (w_1, \ldots, w_d)$. The normalized-weights approach is followed in this study where the sum of the weights is one, and each dimension is assumed with equal weights. It is the most widely used approach in literature unless there is evidence of disparities in the relative importance of dimensions.

Deprivation cut-off in dimension *j* is shown as z_j. The vector of deprivation cut-offs for all dimensions is $z = (z_1, \ldots, z_d)$, where $z \in R^d{+}{+}$. If $x_{ij} < z_j$, individual *i* is identified as deprived in dimension *j*, or non-deprived otherwise. Through the achievement matrix X and the vector of deprivation cut-offs, we obtain a deprivation matrix g^0 where $g^0_{ij}=1$ whenever $x_{ij}<z_j$ and $g^0_{ij}=0$ otherwise for all j=1, ..., d, and for all i=1, ..., n. Then, $g^0(X)$ matrix demonstrates the deprivation status of all individuals in all dimensions in the matrix X. A deprivation score c_i is produced by the matrix g^0 such that:

$$c_i = \sum_{j=1}^{d} w_j g_{ij}^0$$

where c_i refers to the sum of weighted deprivations of individual *i*, and w_j is the weight of the dimension *j*. The deprivation score increases as the number of deprivations of individual *i* rises and reaches its maximum if individual *i* is deprived in all dimensions. The vector of deprivation scores of all persons is $c = (c_1, \ldots, c_n)$. In this method, an individual who is deprived in a dimension is not necessarily identified as poor. An identification function p_k is employed such that:

$$p_k(x_i; z) = \begin{cases} 1, & \text{if} \quad c_i \geq k \\ 0, & \text{otherwise} \end{cases}$$

where k denotes the poverty cut-off. $p_k(x_i; z) = 1$ identifies individual *i* as poor. Standard poverty cut-off in the AF method is 1/3. In other words, households who are deprived in at least 33.3% of the weighted indicators are counted as in multidimensional poverty. Deprivations of the non-poor individuals are censored so that they are not embodied in the measure. After the identification approach is chosen, the aggregation step requires selecting a poverty index to summarize the information obtained. This step is based on the FGT indexes. The adjusted Headcount Ratio (M_0), commonly known as the Multidimensional Poverty Index (MPI), is the average of the censored deprivation score vector:

$$M_0 = \mu(c(k)) = \frac{1}{n} x \sum_{i=1}^{n} c_i(k)$$

It provides a comprehensive measure of both the incidence and intensity of multidimensional poverty. The adjusted Headcount Ratio can also be measured as M_0 =

HxA. Headcount ratio *(H) = H (X; z)* where *H=q/n,* and *q* denotes the number of poor persons based on the dual cut-off approach. "A" is the intensity of poverty which is the average deprivation score of people in poverty:

$$A = \sum_{i=1}^{q} c_i(k)/q$$

Since income data in the SILC dataset is recorded at the household level, the unit of identification in the monetary poverty estimates is households. Then, the results are reported as a percentage of people (rather than households) considering household sizes. In the multidimensional poverty approach, most previous studies focused on the population aged 15 or older due to data unavailability. This is because education and health data, as well as some social exclusion variables, are only available for this age group. A key distinction of the MPI in this study is that it measures poverty across the entire population by using households as the unit of identification and individuals as the unit of analysis. However, a limitation of this approach is that it cannot capture the intra-household inequalities. Differences in the bargaining power of household members depending on gender, age, or other factors can result in unequal distribution of resources within households (see for example, Jenkins, 1991). Nonetheless, adopting a household-based approach allows for the measurement of poverty among the whole population, and this is an acceptable compromise considering the widespread child poverty in the country which would be disregarded otherwise.

FINDINGS

Estimation results are given in this section. Survey weights are used in all estimates to measure poverty for the entire population.

Country-level Results

Table 3 indicates poverty rates (i.e., headcount ratios) estimated through four different approaches. Due to the one-year lag in income data within the SILC datasets, estimates of absolute and subjective poverty correspond to the previous year's conditions rather than the current period. The results reveal substantial variation in poverty rates, highlighting the sensitivity of poverty estimates to the chosen definition.

TurkStat's absolute line identifies less than 20% of the population in poverty which can be considered the extreme poverty rate as suggested in the previous section. In contrast, the subjective approach captures more than 60% of the population as poor. TÜRK-İŞ' line counts an even higher proportion of the population in poverty. Indeed, more than two-thirds of the population is identified poor with this approach throughout the period. These higher rates may result from that TÜRK-İŞ is a labor union, and during the negotiations on minimum wage, it defends the rights of employees each year, potentially influencing its poverty benchmarks. Meanwhile, multidimensional poverty rates are found more moderate compared to TÜRK-İŞ' and subjective approaches, yet they remain much higher than TurkStat's approach[7].

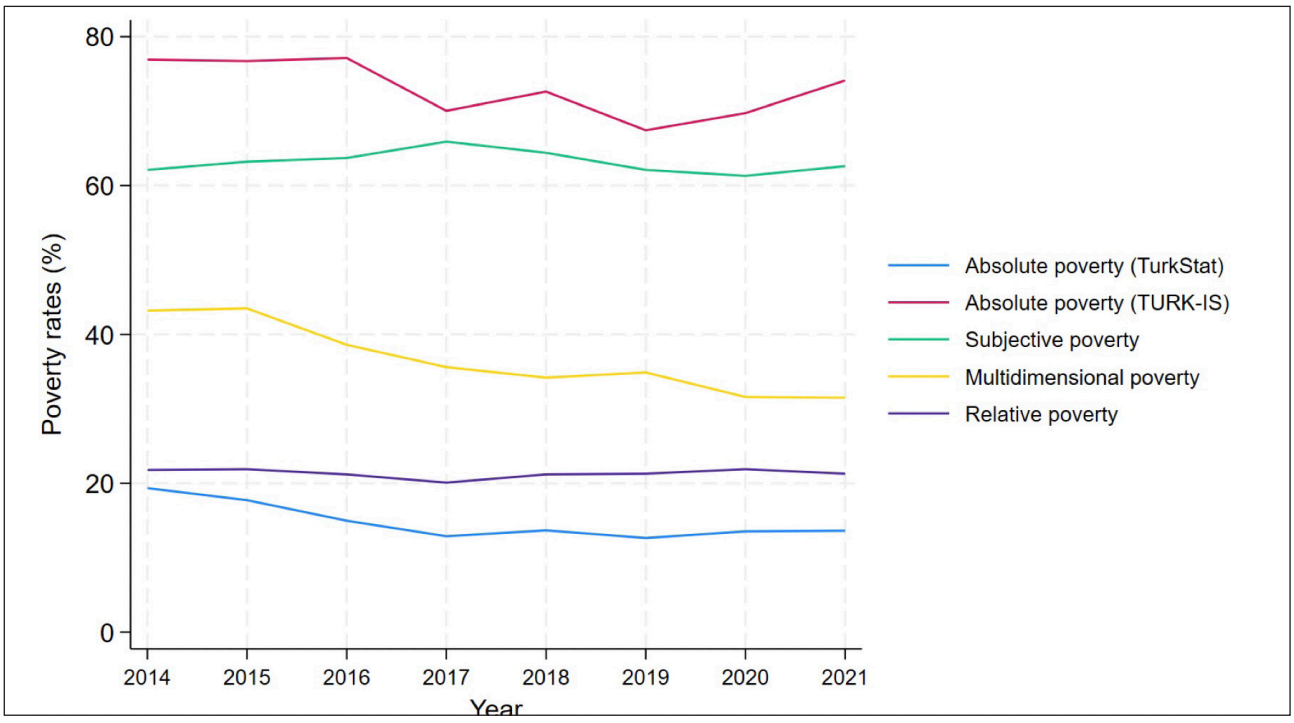
Table 3. Poverty rates by various methods (%)

Survey year	Absolute poverty (TurkStat's line)	Absolute poverty (TÜRK-İŞ line)	Subjective poverty	Multidimensional poverty
2014	19.35	76.92	62.1	43.2
2015	17.74	76.72	63.2	43.5
2016	14.97	77.14	63.7	38.6
2017	12.88	70.04	65.9	35.6
2018	13.72	72.62	64.4	33.9
2019	12.65	67.43	62.1	34.9
2020	13.54	69.73	61.3	31.6
2021	13.63	74.11	62.6	31.5

Source: Author's own estimates.

Şenses (2019) suggests that rather than expecting complete consistency across different poverty measures, it would be more useful to examine whether they reveal similar trends and rankings. In this sense, graph 1 presents poverty trends in Türkiye. As well as the poverty rates measured in this study, the graph also

[7] The multidimensional poverty rates are found higher than that in Karahasan and Bilgel (2021) and Giovanis and Özdamar (2021) mostly because those studies do not include child poverty.



Graph 1: Poverty trends in Türkiye
Source: Relative poverty ratios are taken from TurkStat, and the rest is the author's own estimations.

manifests the relative poverty estimates of TurkStat based on 60% of median equivalized income[8]. The trends indicate that absolute poverty rates (blue and red lines) and multidimensional poverty rates (yellow line) had a decreasing tendency until recently. However, estimations using the last surveys capture a rise in these ratios. Although multidimensional poverty rate declined in 2021, the number of people who are multidimensionally poor and average deprivation score increased that year. This recent rise in poverty coincides with the recent decline in GDP per capita ($) and increasing inflationary pressures in the country. As well as economic and political factors, the COVID-19 pandemic might play a role in the rise of poverty. These results are compatible with the findings of the World Bank (2022).

On the other hand, subjective (green line) and relative poverty rates (purple line) remained almost unchanged during the period. Nearly stable rates of subjective poverty imply that some parts of the population tend to perceive their income levels as insufficient. Moreover, the relative poverty approach did not capture the improvements until 2019 because the median income level also rose. It was not capable of reflecting the recent deterioration either, as the median income level fell. This finding is in line with the discussion on relative poverty measures in the introduction. It can be concluded that the relative poverty approach falls short of capturing the changes in the living standards in Türkiye.

Multidimensional estimates indicate that education is the most contributing dimension to the MPI in all years. It makes up around 30% of the index on its own (see Table A.5 in the annex). Health follows it with a 23% contribution rate. The MPI is also measured via different poverty cut-offs (see Table A.6). Compared to the original measure using the 1/3 cut-off, the ¼ cut-off estimates higher rates of multidimensional poverty, whereas the ½ cut-off captures a much lower share of population in multidimensional poverty. Still, a high correlation is found between these estimates. Also, the contribution rates of dimensions and regional variation in multidimensional poverty rates remain unchanged, providing a robustness check.

Table 4 shows the number of households in poverty or not (among participants of the SILC 2021) by poverty definition. The total number of households in the survey is 26,289. The table indicates that 15,350; 14,139; and 5,287 of these households are absolutely (by TÜRK-İŞ definition), subjectively, and multidimensionally poor, respectively, although they are not counted as poor through the updated absolute line of TurkStat. This finding reinforces the notion that the latter can be considered as extreme poverty line. The results indicate that all the households who are counted as poor through the TurkStat's poverty line are also identified as poor via the line of TÜRK-İŞ. This finding is just

[8] TurkStat uses separate relative poverty lines for each region.

Table 4. Number of households in poverty or not, by definition

Absolute poor (TurkStat)	Absolute poor (TÜRK-İŞ)		Subjective poor		Multidimensional poor	
	0	1	0	1	0	1
0	7,932	15,350	9,143	14,139	17,995	5,287
1	0	3,007	116	2,891	739	2,268
Total	7,932	18,357	9,259	17,030	18,734	7,555

Source: Author's own estimates.
Note: In the table, zero and one denote non-poor and poor households, successively.

like expected considering that TÜRK-İŞ' line is much higher than that of TurkStat. On the other hand, 116 households are detected as poor via TurkStat's line, although they are not subjectively poor. It means that even if these households' income levels are lower than the extreme poverty line, they consider that their income is sufficient to satisfy their needs. Furthermore, 739 households in the survey are in poverty according to the updated line of TurkStat, but they are not multidimensionally poor. Hence, there is an apparent lack of overlap in households falling into different types of poverty.

Region-level Results

Figure 1 exhibits average NUTS-2 level poverty rates over the period of 2014-2021. A remarkable regional clustering of poverty is observed in the country. Poverty concentrates mostly in the South-eastern and Eastern regions, while the Western regions have lower poverty rates in all estimations regardless of methodological choices.

Table 5 provides regional rankings by five dimensions of MPI, alongside absolute and subjective poverty estimates. The results indicate that regions with the highest average deprivation scores in each dimension of MPI have also the highest absolute poverty. However, rankings of subjective poverty considerably differ compared to the other types of poverty. For example, TR83 is ranked 25th (i.e., the second region with the lowest poverty) in subjective poverty, but it is ranked 9th by the absolute line of TÜRK-İŞ or by the education/health

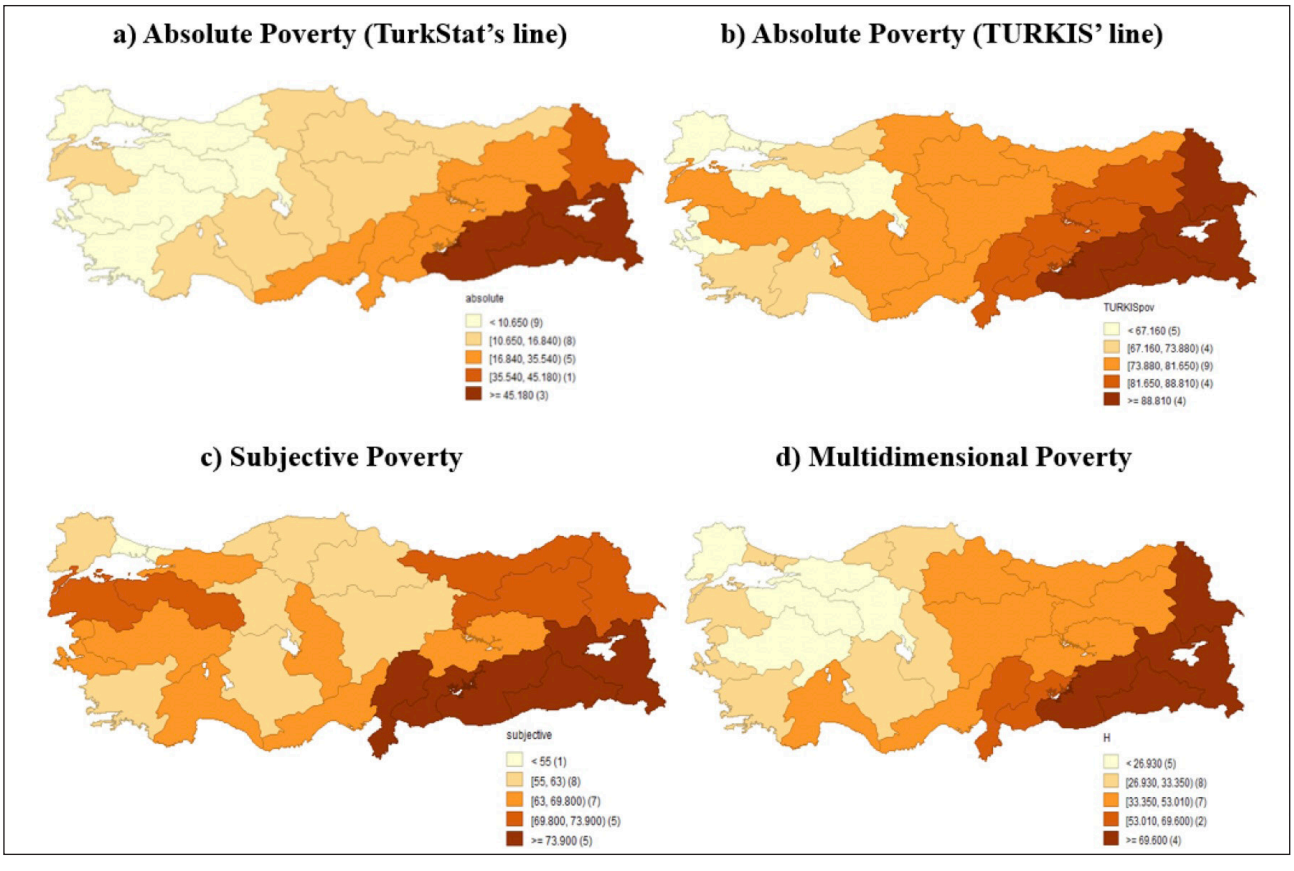


Figure 1. Regional poverty rates % (natural break maps)
Source: Author's own estimates.

Table 5. Rankings (2014-2021 Average)

region	education	health	housing	material deprivation	social exclusion	absolute (TurkStat)	absolute (TÜRKİŞ)	subjective
TRC2	1	2	1	1	1	1	2	3
TRB2	2	1	2	2	4	2	3	2
TRC3	3	6	4	5	2	3	1	5
TRA2	4	3	3	3	3	4	4	10
TRC1	5	5	5	4	5	6	5	1
TR63	6	4	6	6	6	5	6	4
TRA1	7	11	8	7	7	8	7	7
TR90	8	8	10	12	9	17	11	8
TR83	9	9	11	14	11	11	9	25
TRB1	10	13	13	19	10	9	8	14
TR62	11	12	7	8	8	7	13	12
TR72	12	7	9	11	12	12	10	23
TR81	13	16	16	21	20	24	19	18
TR82	14	18	20	17	18	13	15	20
TR71	15	19	17	23	17	14	12	16
TR61	16	10	15	10	13	16	21	17
TR31	17	14	12	9	14	19	25	13
TR33	18	25	25	25	22	18	14	11
TR22	19	21	21	15	16	10	16	6
TR32	20	15	18	18	23	20	20	19
TR10	21	20	14	13	15	21	22	26
TR52	22	17	24	20	19	15	17	21
TR42	23	23	22	24	24	23	18	15
TR21	24	22	19	16	21	22	24	22
TR41	25	24	23	22	25	25	23	9
TR51	26	26	26	26	26	26	26	24

Source: Author's own estimates.
Note: Regions with the highest poverty are ranked 1st and the least poor regions are ranked 26th.

criteria. Conversely, TR41 is one of the least poor regions in terms of absolute and multidimensional poverty, but it is the 9th poorest region according to the subjective poverty line. These findings confirm the potential bias in the subjective poverty estimates asserted by Ravallion (2012).

The table also shows that the most urgent needs of the regions can differ and therefore the priorities of the regions need to be diversified. In this context, region-specific poverty alleviation policies are thought to be helpful.

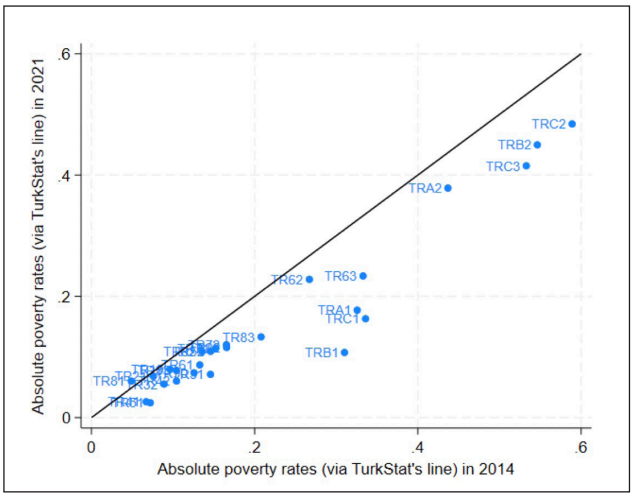
Table 6 demonstrates the pairwise correlations between various poverty rates at the NUTS-2 level. There are very strong correlations between absolute poverty rates (both with TurkStat's and TÜRK-İŞ' lines) and multidimensional poverty rates. This finding implies that despite the variation in poverty rates, absolutistic and multidimensional poverty concepts largely detect the same regions as poorer or less poor in the same years. On the other hand, subjective poverty has very weak correlations with the other poverty estimates.

Graphs 2-5 indicate the regional poverty rates at the beginning (2014) and the end (2021) of the period with a 45° line to trace the changes over time. The results show that regions with the highest initial poverty ratios in 2014 also exhibit the highest poverty rates 2021, suggesting the persistence of regional disparities in terms of poverty. From 2014 to 2021, while absolute poverty rates estimated through the TurkStat's line slightly increased in TR81, all the other regions managed to reduce their absolute poverty rates (see Graph 2). In some regions, such as TRB1, TRC1, and TRA1, striking

Table 6. Pairwise correlations

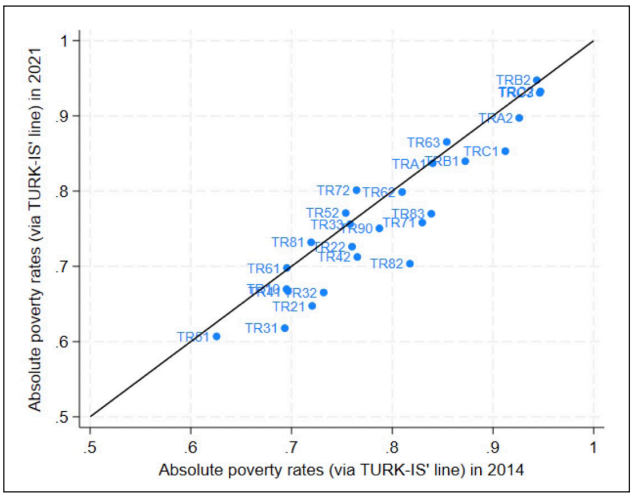
	Absolute (TurkStat)	Absolute (TÜRK-İŞ)	Subjective	Multidimensional
Absolute (TurkStat)	1			
Absolute (TÜRK-İŞ)	0.845*	1		
Subjective	0.495*	0.498*	1	
Multidimensional	0.923*	0.852*	0.474*	1

Source: Author's own estimates.



Graph 2. Absolute poverty rates (via TurkStat's line) in 2014 vs. 2021

Source: Author's own estimates.



Graph 3. Absolute poverty rates (via TÜRK-İŞ' line) in 2014 vs. 2021

Source: Author's own estimates.

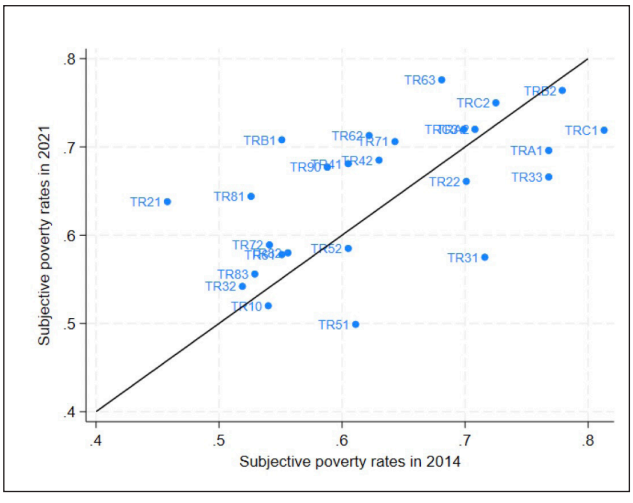
poverty reductions are observed. Conversely, absolute poverty rates estimated through the poverty line of TÜRK-İŞ are mostly located near the 45° line which means that there were no significant changes in the poverty rates (see Graph 3).

Although subjective poverty rates in most regions increased, a fall in subjective poverty was observed in some regions (see Graph 4). Especially, the poverty alleviation in the metropolitan areas (e.g., TR51, TR31, and TR10) probably tolerate the rises in the other regions, and therefore, country-level subjective poverty rates remain almost stable.

Multidimensional poverty rates in all regions decreased in this period (see Graph 5). In particular, enormous poverty reductions were noticed in TRB1 (by 34.8 percentage points), TRA1 (by 26.5 points), TR42 (by 24.4 points), TRC1 (by 23.7 points), and TR72 (by 23.2 points).

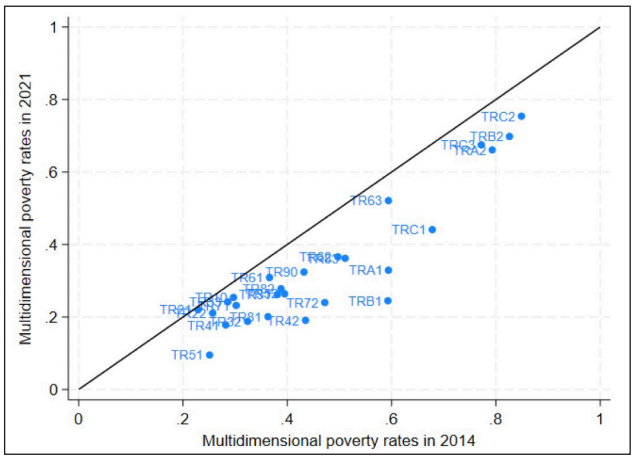
Profile of People in Poverty

The study also examines the characteristics of individuals living in poverty in terms of gender, age, education level, household size, homeownership, employment, and social assistance status. For this purpose, the survey participants of SILC 2021 are analyzed. The variables are chosen depending on the existing literature on poverty-related factors and the availability of relevant data.



Graph 4. Subjective poverty rates in 2014 vs. 2021

Source: Author's own estimates.



Graph 5. Multidimensional poverty ratios in 2014 vs. 2021
Source: Author's own estimates.

According to Table 7, poverty rates among men and women are more or less the same in all types of poverty. However, this finding may result from that intra-household inequalities are not incorporated into the analysis here. Some previous studies argue that as their bargaining power in households tends to be lower than men, women are more vulnerable to poverty (e.g., Özar, Kutlu, & Mülayim, 2022). For instance, female members of a non-poor household may still suffer from poverty, highlighting the limitations of household-level poverty assessments.

The relationship between age and poverty varies across different poverty measures. As age increases, absolute and subjective poverty rates fall. This finding aligns with the OECD (2008) report stating that older groups' poverty risks declined thanks to the upward trend in old-age income security, while younger individuals became more vulnerable due to the decline in the benefits towards the non-elderly population. On the other hand, the lowest rates of multidimensional poverty are found among the middle age groups. This result can be explained by the fact that younger populations tend to experience higher monetary poverty, while older individuals are more likely to be disadvantaged in education and health dimensions.

Moreover, education emerges as a key factor in reducing the risks for all types of poverty. As education level increases, the poverty rates enormously fall. Poverty rates also vary across different-sized households. Households composed of five or more members exhibit much higher poverty rates than less populated households. This finding supports the previous studies associating a higher household size or household dependency with a greater poverty risk (e.g., Crettaz, 2011; Acar, 2014).

The tenure status of the dwelling also matters. Individuals residing in employer-provided lodging experience lower poverty risks, suggesting that stable employment with housing benefits serves as an effective poverty alleviation mechanism. In contrast, households that do not own property but live in rent-free accommodations exhibit the highest poverty rates. This pattern suggests that many of these households receive housing assistance from relatives or the government, indicating pre-existing financial hardship. Homeownership is associated with lower absolute and subjective poverty rates compared to tenancy; however, homeowners exhibit slightly higher multidimensional poverty rates than tenants. This discrepancy may be explained by rural-urban differences in homeownership patterns. Approximately 60% of households in Türkiye are homeowners[9], with homeownership being significantly more prevalent in rural areas. Given that rural areas tend to have lower access to education, healthcare, and infrastructure, homeowners may experience higher multidimensional poverty despite their relative economic stability in monetary terms.

As for employment status, individuals looking for a job have the highest rates of poverty in all estimates, reinforcing the argument that employment is a crucial pathway out of poverty as suggested by Minsky (2013). However, poverty is not exclusively limited to the unemployed; at least 10% of the working population experiences monetary poverty, while 27% of employed individuals are classified as multidimensionally poor. This finding suggests that while having a job is necessary, it is not always sufficient to escape poverty, highlighting the importance of in-work poverty[10].

Once the beneficiaries of social allowances are examined, it is observed that people getting in-kind social allowances are more likely to be poor than those getting cash. Only 40% and 49% of the beneficiaries of cash and in-kind social allowances, respectively, are identified poor by TurkStat's line. On the other hand, nearly all recipients fall below the TÜRK-İŞ' poverty line, indicating that thousands of households with incomes above the updated TurkStat poverty line but below the TÜRK-İŞ poverty line rely on social assistance. In addition, 80 percent of the beneficiaries are subjectively considered poor, reporting a subsistence level exceeding their income. In other words, 20 percent of the beneficiaries receive social assistance despite considering their

[9] https://nip.tuik.gov.tr/?value=KonutIstatistikleri

[10] Indeed, ILOSTAT (2019) states that one-fifth of the working population of the world was living in households with a daily per capita income under 3.1$ (PPP) in 2018.

[11] This table presents the profile of the people in poverty among the survey participants of the SILC 2021. Since population weights are not employed, poverty rates are slightly different than those across the whole country.

Table 7. Profile of the people in poverty[11]

Category	Absolute poverty rate (Turkstat) %	Absolute poverty rate (TÜRK-İŞ) %	Subjective poverty rate %	Multidimensional poverty rate %
Gender				
Male	16.14	76.59	65.63	33.45
Female	16.78	77.13	65.61	34.60
Age				
<15	25.21	85.15	73.72	37.85
15-30	19.42	81.00	66.27	36.45
31-45	15.15	74.22	67.93	27.45
46-60	11.10	70.11	59.99	31.68
>60	6.43	69.36	55.30	36.85
Average years of schooling among household members over 14-year-old				
0-4 years	27.75	88.80	70.80	64.10
5-8 years	20.55	87.94	68.22	41.44
9-12 years	6.54	73.14	62.92	8.65
13-16 years	1.82	36.27	55.09	1.78
>16 years	0.48	11.70	45.28	0.40
Household size				
1	6.57	49.88	68.55	24.67
2	4.52	60.30	61.67	24.93
3	5.98	63.39	61.06	22.05
4	10.19	76.95	65.51	21.52
5	18.85	87.95	67.64	34.97
≥6	41.68	96.41	70.47	67.29
Tenure status of dwelling				
Owner	14.70	74.42	59.78	34.38
Tenant	18.85	78.89	76.55	32.25
Lodging	2.16	55.85	61.33	8.81
Not owner but free accommodation	20.77	85.08	71.20	37.80
Employment status				
Working	10.18	66.13	59.23	27.12
Looking for a job	28.09	88.02	73.06	52.40
Retired/cannot work	9.19	68.62	57.73	36.58
Other inactive	20.61	83.90	70.33	35.99
Social assistance beneficiary				
Social allowances in cash	40.11	97.13	80.13	63.01
Social allowances in kind	49.39	98.62	81.02	77.44

Source: Author's own estimates.

income sufficient, indicating a 20 percent leakage rate in the distribution of social benefits. Similarly, 37 percent of cash beneficiaries are not in multidimensional poverty, further raising concerns about the efficiency of social aid allocation.

These high leakage rates suggest inefficiencies in the allocation of social assistance funds. However, it is also possible that some households have successfully escaped poverty due to social assistance. The issue of leakage, wherein social aid is distributed to individuals who may not be truly in need, has been identified in previous studies as a challenge to poverty alleviation efforts in Türkiye. For a critical evaluation of the Social Aid and Solidarity Promotion Fund in Türkiye, Şenses (1999) and Ilıman & Tekeli (2016) can be examined[12]. Additionally,

[12] Şenses (1999) assessed the Social Aid and Solidarity Promotion Fund (SYDTF) established in 1986 in Türkiye. He criticized the fund because it was applied without identifying the people in poverty by using a poverty line. Instead of an objective criteria, the fund was allocated to the people depending on the subjective identification by local authorities. He argued that even though the leakage ratio of the fund could not be estimated due to lack of data, the leakages were

as Şenses (2008) argues, a further concern regarding cash and in-kind assistance programs is their potential to create long-term dependency. Instead of facilitating the integration of individuals living in poverty into the labor market, excessive reliance on social benefits may contribute to the development of a dependency culture, ultimately hindering economic and social inclusion.

CONCLUSION

This study conducts a comparative analysis of poverty measurement to examine if theoretical and empirical definitions of poverty yield significantly different outcomes by taking Türkiye as a case study. The findings reveal that absolute and multidimensional poverty rates considerably decreased over time, but the estimations based on the latest surveys capture a rise which can be explained by the pandemic, the recent decrease in GDP per capita ($), and rising inflation rates. In contrast, subjective and relative poverty remained almost stable during the period. Although relative poverty is the officially recognized measure in Türkiye, findings provide strong evidence that relative poverty measures fail to accurately track the changes in poverty during the times of rapid movements in the living standards. This limitation may extend to other developing countries as well.

Absolute poverty measures in the study have some limitations. The updated absolute poverty lines of TurkStat are parsimonious lines and estimations using them most probably suffer from underestimation as expected in the first place. Therefore, they can be interpreted as extreme poverty rates. Moreover, the very high and unchanged rates of subjective poverty reinforce the concerns about the unreliability of self-assessed poverty measures. Absolute poverty estimates using the lines of TÜRK-İŞ are found even higher than the subjective lines, implying to a potential overestimation. Multidimensional poverty rates are found somewhere between these possibly underestimated and overestimated rates. Besides, given that the multidimensional approach takes into account not only monetary but also non-monetary aspects of poverty, it can be the most appropriate estimate in the current study. Additionally, despite the variations in poverty rates, regional rankings and pairwise correlations show that absolutistic and multidimensional poverty concepts largely detect the same regions as poorer or less poor. This finding suggests that, while poverty rates vary depending on the measurement approach, the spatial distribution of poverty remains largely consistent across methodologies.

The sub-national analysis reveals a notable clustering of poverty, with South-eastern Anatolia and Eastern Anatolia consistently exhibiting the highest poverty ratios no matter which methodology is executed. These findings are in line with the previous studies, such as Karadağ and Saraçoğlu (2015), Limanlı (2016), and Karahasan and Bilgel (2021). Given the severity of poverty in these areas, these regions need more attention for targeted poverty alleviation strategies. The regional concentration of poverty underscores the necessity of developing region-specific policies to address localized socioeconomic challenges (Şenses, 2008). On the other hand, notable reductions in poverty rates are observed in a few regions, such as TRB1, TRA1, TR42, TRC1, and TR72. Future studies can examine how these regions managed to reduce their poverty rates, providing lessons for other regions.

Finally, the profile of the people in poverty reveals that all types of poverty rates considerably fall as the education levels of individuals increase. While the elderly population exhibits the lowest rates of monetary poverty, middle age groups are found as the most robust group against multidimensional poverty. Furthermore, households with five or more members, unemployed individuals, and recipients of social benefits experience remarkably high rates of poverty across all definitions.

In conclusion, this study suggests that policymakers need to evaluate various types of poverty in policy making processes given the sensitivity of measures to their respective definitions. An elaborative national poverty measurement strategy would serve as a vital guide to eradicate poverty. To this end, the absolute poverty line of TurkStat can be updated considering the basic needs at present. Also, an official MPI tailored to the socioeconomic conditions of the country can be generated similar to the one in this study. As Şenses (2002) argues, the problems of identifying and profiling the poor are just the tip of the iceberg. Further research is essential to broaden our understanding of regional imbalances and the underlying reasons of poverty, enabling the development of effective poverty alleviation policies.

predicted to be very large in size, resulting from misuse, partisanship, and favouritism. Likewise, Ilıman and Tekeli (2016) empirically examined the fund and concluded that the allocation of these social expenditures were partly shaped by political interests.

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APPENDIX

Table A.1 Summary statistics of monthly equivalized income (SILC)

Survey	Number of households	Mean	Std. Dev.	Min.	Max.
2014	22,740	1,257	1,129	7	25,856
2015	22,763	1,426	1,261	27	18,116
2016	22,441	1,658	1,643	4	38,923
2017	22,869	1,848	1,989	18	51,414
2018	24,068	2,058	2,301	10	75,240
2019	24,924	2,420	2,482	17	73,273
2020	25,706	2,779	2,901	14	76,203
2021	26,289	3,141	3,339	5	202,854

Table A.2 Updated poverty lines of TurkStat (per adult equivalent) in TL

Region	2013	2014	2015	2016	2017	2018	2019	2020
TR10	585	639	690	740	820	947	1,086	1,245
TR21	532	581	621	668	741	860	994	1,126
TR22	531	581	629	681	761	878	1,017	1,179
TR31	542	594	643	698	781	912	1,058	1,219
TR32	516	561	607	656	734	866	1,011	1,150
TR33	512	556	602	651	722	846	983	1,125
TR41	528	573	616	667	739	857	989	1,144
TR42	535	580	625	673	747	871	1,000	1,152
TR51	547	598	644	698	772	887	997	1,131
TR52	497	538	577	622	698	817	945	1,075
TR61	528	575	617	666	740	869	1,006	1,154
TR62	515	556	598	654	731	858	1,001	1,144
TR63	494	536	575	619	693	819	945	1,071
TR71	502	546	583	627	702	812	943	1,082
TR72	503	548	593	638	714	832	963	1,106
TR81	511	556	598	648	729	855	984	1,121
TR82	504	548	589	635	708	825	958	1,066
TR83	503	548	590	636	710	833	965	1,115
TR90	537	583	622	673	752	886	1,030	1,176
TRA1	514	560	592	636	709	829	964	1,121
TRA2	503	547	584	631	706	824	966	1,075
TRB1	505	551	586	633	705	829	954	1,071
TRB2	511	554	592	635	712	833	980	1,116
TRC1	507	553	599	645	728	852	986	1,135
TRC2	501	545	589	637	711	831	978	1,133
TRC3	477	513	552	596	665	780	908	1,039

Table A.3 Poverty lines of TÜRK-İŞ (per adult equivalent) in TL

Region	2013	2014	2015	2016	2017	2018	2019	2020
TR10	1,327	1,514	1,728	1,784	1,976	2,318	2,773	3,268
TR21	1,212	1,366	1,556	1,606	1,769	2,078	2,494	2,903
TR22	1,198	1,358	1,559	1,615	1,744	2,037	2,447	2,890
TR31	1,238	1,407	1,612	1,671	1,878	2,214	2,670	3,129
TR32	1,181	1,329	1,537	1,592	1,756	2,071	2,518	2,928
TR33	1,145	1,287	1,483	1,534	1,688	1,985	2,408	2,797
TR41	1,184	1,333	1,522	1,578	1,756	2,063	2,483	2,932
TR42	1,217	1,371	1,568	1,619	1,793	2,099	2,515	2,925
TR51	1,240	1,414	1,616	1,683	1,836	2,136	2,501	2,905
TR52	1,133	1,269	1,449	1,496	1,705	1,985	2,388	2,769
TR61	1,195	1,348	1,535	1,588	1,744	2,057	2,493	2,897
TR62	1,182	1,325	1,519	1,585	1,746	2,044	2,480	2,888
TR63	1,124	1,258	1,437	1,486	1,622	1,911	2,298	2,650
TR71	1,132	1,270	1,447	1,492	1,646	1,921	2,321	2,684
TR72	1,141	1,285	1,473	1,522	1,673	1,957	2,350	2,733
TR81	1,163	1,320	1,510	1,564	1,719	2,022	2,426	2,819
TR82	1,141	1,290	1,478	1,533	1,688	1,978	2,390	2,760
TR83	1,145	1,297	1,483	1,537	1,708	2,004	2,414	2,810
TR90	1,207	1,360	1,548	1,606	1,762	2,072	2,514	2,929
TRA1	1,162	1,305	1,471	1,523	1,691	1,988	2,393	2,797
TRA2	1,126	1,264	1,435	1,483	1,610	1,887	2,283	2,646
TRB1	1,157	1,305	1,478	1,528	1,679	1,968	2,348	2,696
TRB2	1,147	1,291	1,470	1,517	1,639	1,935	2,335	2,722
TRC1	1,143	1,287	1,479	1,532	1,681	1,965	2,361	2,750
TRC2	1,130	1,274	1,453	1,503	1,651	1,946	2,363	2,751
TRC3	1,100	1,225	1,401	1,451	1,612	1,920	2,309	2,714

Table A.4 Summary of MPI indicators

Indicator	Weight	Percentage of people deprived								
Education		**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
E1	0.1	62.02	61.69	58.93	57.97	56.56	54.71	53.11	50.33	47.75
E2	0.1	27.77	28.29	27.41	26.35	24.95	23.79	22.84	21.46	20.00
Health										
H1	0.07	44.85	45.46	50.12	39.35	45.38	47.77	47.47	42.35	43.07
H2	0.07	29.78	27.56	23.77	15.77	14.10	15.01	14.97	8.48	19.30
H3	0.07	46.09	33.64	35.81	37.74	33.97	31.95	33.56	37.29	38.32

Housing conditions										
HC1	0.03	39.73	37.18	39.01	38.09	36.62	35.91	36.88	34.72	33.89
HC2	0.03	9.24	7.97	6.82	5.49	4.80	4.28	3.99	3.79	3.41
HC3	0.03	27.67	28.81	27.40	25.99	24.84	23.15	22.36	21.67	14.42
HC4	0.03	24.28	24.38	24.19	24.51	22.94	24.83	26.10	22.60	23.40
HC5	0.03	9.71	10.57	11.26	10.66	11.33	11.18	10.87	9.79	9.98
HC6	0.03	42.21	38.66	43.04	42.20	40.77	39.39	39.31	36.73	34.28
Material deprivation										
M1	0.04	17.20	14.22	13.15	10.42	7.58	6.12	6.11	6.17	6.50
M2	0.04	8.56	9.03	9.06	8.60	7.84	7.05	9.18	7.79	8.89
M3	0.04	33.64	31.02	28.52	24.31	21.48	18.16	22.47	18.40	19.52
M4	0.04	22.46	21.70	21.76	18.90	17.80	15.31	19.42	13.89	16.98
M5	0.04	48.99	29.05	32.64	34.43	31.74	30.17	29.69	32.23	33.43
Social Exclusion										
S1	0.03	12.11	12.69	13.76	13.62	14.98	14.64	17.66	20.70	17.92
S2	0.03	41.43	38.61	36.40	34.14	33.11	32.86	32.46	28.06	28.94
S3	0.03	35.98	24.40	22.47	14.04	12.11	12.82	13.19	13.66	15.28
S4	0.03	38.08	27.21	29.61	20.29	16.98	17.54	19.58	18.14	19.82
S5	0.03	32.40	28.25	25.39	18.06	10.08	7.20	6.53	6.35	4.80
S6	0.03	24.59	24.01	24.39	23.78	23.13	22.89	23.45	23.59	23.31

Note: Deprived refers to the individuals whose indicator values are below the threshold.

Table A.5 Contribution of each dimension (%)

Dimension	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Education	.29	.29	.31	.32	.31	.30	.31	.29
Health	.23	.23	.22	.23	.24	.24	.23	.25
Housing conditions	.15	.16	.16	.17	.17	.16	.16	.15
Material deprivation	.15	.15	.15	.14	.14	.15	.14	.15
Social exclusion	.18	.17	.16	.15	.15	.15	.16	.16

Table A.6 Multidimensional poverty with various poverty cut-offs

Year	H (%)			M (%)		
	1/4	**1/3**	**1/2**	**1/4**	**1/3**	**1/2**
2014	54.7	43.2	19.8	25.1	21.8	12.3
	(.004)	(.005)	(.004)	(.002)	(.003)	(.003)
2015	55.1	43.5	19.4	25	21.6	11.9
	(.004)	(.005)	(.004)	(.002)	(.003)	(.003)
2016	50.3	38.6	15.7	22	18.6	9.4
	(.005)	(.005)	(.004)	(.002)	(.002)	(.002)
2017	47.6	35.6	13	20.3	16.9	7.8
	(.005)	(.005)	(.004)	(.002)	(.002)	(.002)
2018	45.9	33.9	12.2	19.4	16	7.2
	(.005)	(.005)	(.003)	(.002)	(.002)	(.002)
2019	47	34.9	12.3	19.9	16.4	7.4
	(.004)	(.004)	(.003)	(.002)	(.002)	(.002)
2020	43	31.6	10.5	17.9	14.6	6.1
	(.004)	(.004)	(.003)	(.002)	(.002)	(.002)
2021	43.8	31.5	11	18.2	14.6	6.5
	(.004)	(.004)	(.003)	(.002)	(.002)	(.002)

Note: *H* denotes the headcount ratio, and *M* presents the adjusted headcount ratio (i.e., MPI). Standard errors are given in parentheses.

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Empowering Visually Impaired Consumers in Retail: A Systematic Review of Accessible Payment Solutions for All

Asiye Ayben ÇELİK[1]

ABSTRACT

A decrease or loss of sensory ability may occur due to aging, accidents, illnesses, or congenital conditions. This underscores the critical importance of adopting an "inclusive approach to differences", as a principle that businesses must prioritize. This study aims to identify the dynamics of an accessible payment experience for visually impaired consumers (VICs) while shopping that can support consumer normalcy. By employing Synder's systematic literature review framework, the study examines the existing literature to assess the current state of payment systems used by VICs in retail with a dataset covering the period 2007-2024 drawn from Scopus, Web of Science, and Google Scholar, and synthesizes the stakeholder actions influencing market regulations and best practices. Key findings of the study highlight the payment tools employed by VICs in shopping, the challenges they face, and their coping mechanisms, and initiatives about accessible payment terminals, aimed at fostering a more inclusive payment experience to support consumer normalcy. With the study, by gathering the outputs of the literature, and practical insights from business operations and NGOs' efforts to reorganize regulations, it is intended to provide both theoretical contributions and actionable insights for practitioners and policy makers.

Keywords: Accessibility, Accessible Payment, Consumer Normalcy, Visually Impaired Consumer, Financial Inclusion.

JEL Classification Codes: M31, M14

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INTRODUCTION

A decrease in vision throughout the life cycle can occur because of some congenital disorders, various diseases, accidents, or age. In this context, aging, lifestyle factors or hereditary factors can often affect visual impairment (Swenor et al., 2019). The World Health Organization (WHO) reported that 2.2 billion people suffer from near or distance vision impairments, representing over 25% of the world's population struggling to navigate daily life with this challenge (WHO, 2023).

In Türkiye, the latest Health Survey findings demonstrate that 5.1% of the total population reports experiencing vision problems (TurkStat, 2023). The number of visually impaired individuals registered in the National Disability Data System of the Ministry of Health is 215,076 people (T.R. Ministry of Family and Social Services, 2023). Additionally, findings from the 2023 Turkey Elderly Profile Survey revealed that 10.1% of individuals aged 65 and above in the representative sample stated that they experienced great difficulty seeing or were unable to see at all. Women were found to experience these difficulties at higher rates than men did (TurkStat, 2024). Aging leads to a decline in vision. In this context, addressing the needs and expectations of a population with visual impairments or limitations in the marketplace while organizing business processes in alignment with inclusive production, marketing practices, and universal design principles can create reciprocal benefits for both consumers and businesses.

Inclusive design, defined as designing products to be "usable and accessible for everyone" from the outset without requiring significant adaptations, encourages businesses to embrace diversity and foster inclusivity and provides the opportunity to cater to the needs of a much wider spectrum of consumers (Cambridge University, 2017). However, when examining the overall market for goods and services, it is observed that, apart from niche products specifically developed to generate value for consumers with disabilities, the general target audience is predominantly assumed to be able-bodied consumers. This approach results in the launch of non-inclusive products to the market, which fail to address the needs of individuals with varying levels of ability in their design. This, in turn, can have a restrictive impact on the benefits derived from the goods/services or may even lead to their outright rejection. By adopting

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the "inclusive design - design for all" approach across processes ranging from product development to post-consumer use, it becomes possible to offer consumers more equitable, participatory, accessible, and inclusive goods and services that consider individual differences.

Inclusive design takes a broad approach to user needs, ensuring that products and services are accessible not only to able-bodied individuals but also to those with temporary or permanent impairments. This approach aligns with the Social Model of Disability, which argues that disability is a result of societal structures that exclude individuals based on their physical impairments (Oliver, 1996). In the Social Model of Disability, disability is defined as "the disadvantage or restriction of activity caused by a contemporary social organization that takes little or no account of people with physical impairments, thus excluding them from participation in the mainstream of social activities" (Oliver, 1996, p.22). By adopting inclusive design in retail, external barriers for participation in society can be removed and every individual can be treated equitably, regardless of any limitations they may face (Baker, 2006; Kaufman-Scarborough and Childers, 2009). Shoppers with disabilities, especially those with visual impairments, need more than just physical adjustments; they want to actively participate, be acknowledged, and feel a sense of belonging (Baker, 2006). Thus, this approach supports the concept of consumer normalcy, which reflects how individuals form and maintain their identities through shopping, striving to be accepted and recognized as equals in consumption contexts (Baker, 2006, Kaufman-Scarborough and Childers; 2009).

From this perspective, this research aims to analyze the literature by performing a systematic literature review and examining practices regarding payment systems that can enable consumers with visual impairments to experience consumer normalcy and support their autonomy while shopping in the retail environment. In addition, the focus is on actions taken by businesses in the market, the perspectives of macrolevel actors, and the evaluation of these dynamics. Specifically, this study seeks to answer the research question "How can an accessible payment experience be achieved for visually impaired consumers in retail to support consumer normalcy" by incorporating a systematic literature review, examples of good practices, and insights into the development of legal frameworks at the macro level worldwide. With the study, it is expected to shed light on practitioners and make theoretical contributions in this field.

CONCEPTUAL FRAMEWORK

Shopping, as an integral part of urban life, is defined as "a social movement, interaction, and experience that structures individuals' daily life practices" (Falk and Campbell, 1997). As one of the essential activities of daily living, it is imperative that the shopping experience for visually impaired individuals occurs within an environment that facilitates their ability to navigate autonomously and with greater independence. Equally important is their ability to experience the concept of "consumer normalcy," which can be succinctly defined as the desire "to be treated like everyone else" during shopping activities (Baker, 2006).

Baker's concept of consumer normalcy comprises four distinct dimensions: (1) "I belong"—the consumer's desire to cocreate a shopping experience with sellers and other customers, along with the aspiration to enjoy the value and pleasure offered by the market; (2) "This is me"—the wish to be recognized for their individuality, where differences are attributed not to visual impairments but to personal tastes and preferences; (3) "I'm in control"—the preference to retain ultimate decision-making authority during the shopping process; and (4) "I belong here"—the expectation of equal treatment as other consumers receive (Baker, 2006).

The aspiration of VICs to experience some or all these dimensions within retail environments, as well as the challenges they encounter in this regard, has been highlighted in numerous studies (Baker, Holland, and Kaufman-Scarborough, 2007; Kaufman-Scarborough and Childers, 2009; Ramatla and Mastamet-Mason, 2013; Yu, Tullio-Pow, and Akhtar, 2015; Çelik et al., 2019; Kara et al., 2020; Umut, Velioğlu and Eru, 2021; Çelik and Yakut, 2021). Additionally, the contribution of technology to enabling VICs to achieve consumer normalcy has also been identified as a significant finding in the literature (Kaufman-Scarborough and Childers, 2009).

The prerequisite for experiencing consumer normalcy in online shopping is compliance with accessibility standards. However, accessibility for VICs remains a significant challenge and inadequacy, both on websites and social media platforms, which are expected to ensure inclusivity and equal access for all (Raymond, Smith and Carlson 2024). For example, social media content, which plays a pivotal role in informing, comparing, and decision-making processes for consumers, is designed with accessibility considerations in mind in only a small fraction (approximately 5%) of cases (Raymond, Smith and Carlson, 2024). Similarly, while retailers' websites

adopt an inclusive approach that aims to embrace diverse consumer groups, they still fall short of achieving full accessibility. In the study by Çelik (2021), the compliance of Turkish retail chains' websites with accessibility standards was examined. Excluding CarrefourSA, which operates globally and achieves 90% compliance, other retailers, such as Migros, Şok Market, and A101, demonstrated an average ability of only 74% to create shopping platforms where VICs could shop independently without a need for assistance, using screen reader technologies. The accessibility of electronic marketplaces can be improved by ensuring that VICs have access to an accessible and secure payment mechanism, that can support the concept of consumer normalcy.

Crosier and Handford's (2012) study, titled "Customer Journey Mapping as an Advocacy Tool for Disabled People," visualizes the customer experience through a customer journey map focused on the end-to-end shopping process of VICs. This work clearly illustrates the challenges faced by VICs throughout their shopping journey. In this map, the final stage of shopping highlights a critical point: enabling VICs to complete their shopping independently by making a payment without assistance (Crosier and Handford, 2012). Assistive technologies such as Shop Talk, OrCam My Eye 2.0, Brailleback, Blindsquare, and VoiceOver, which are utilized by visually impaired individuals, significantly contribute to their shopping journeys and support visually impaired individuals' mobility, communication, and daily activities. These technologies converge on common functionalities such as identifying objects held by the visually impaired, providing verbal descriptions, and reading texts aloud. Their primary goal is to facilitate the lives of consumers and enable autonomy (Zor and Vuruşkan, 2019; Bolaños-Fernández and Bacca-Cortes, 2024). Although these technologies assist them during the shopping process, there remains a need for adjustments to payment terminals to enhance consumers' sense of trust and security, particularly during payment. In online shopping, fully accessible websites that comply with accessibility standards and are compatible with screen readers are important to address these concerns.

While assistive technologies have made shopping more accessible for visually impaired consumers, the digitalization of payment tools has introduced new challenges. As payment systems evolve, vulnerable groups, including those with visual impairments, may struggle to adapt due to impairments and a lack of digital literacy (ECB, 2022). The European Central Bank and national central banks point out the risk of excluding vulnerable groups, such as visually impaired consumers, from convenient and secure retail payments. Difficulty in access, lack of digital and financial literacy, and low trust in electronic payment solutions are seen as the main causes of that (ECB, 2022). To provide accessible retail payments for VICs, all those facts should be taken into consideration.

METHODOLOGY

The purpose of this study is to identify the dynamics of an accessible payment experience for visually impaired consumers while shopping. To achieve this goal, the research answers the research question by using sectoral practices and regulations and the existing body of knowledge in the literature. Within the scope of the study, a systematic literature review was conducted to analyze and interpret the findings obtained from articles, conference papers, and other documents related to the topic (Creswell, 2008) and synthesized with the outcomes of sectoral practices and relevant regulations. First, a manual Google Scholar search was used to gather data on sectoral practices and stakeholder actions pertaining to legislation that influence accessible payments. Then, with the dataset obtained from Scopus, Web of Science and Google Scholar, a systematic literature review was then conducted. The results and field practices were then combined through content analysis to enable a thorough discussion.

The systematic literature review was conducted based on the review framework formulated by Synder (2019). According to this framework, four key phases were fulfilled. First, in the *design phase*, the research question was determined, and the search strategy developed including search terms, databases, and inclusion/ exclusion criteria. Secondly, in the *conduct phase* the selection of relevant studies were done following the search strategy, and in the third phase, the *analysis* was performed by extracting and coding data from selected studies, analyses aligned with the research objectives, and ensuring quality control and consistency. Finally, the fourth phase *structuring and writing the review*, was carried out with a transparent and structured approach to presenting the results and contributions. These phases collectively ensure the rigor, reliability, and meaningfulness of the literature review (Synder, 2019).

The research begins by defining the research question based on the research objective.

RQ: How can an accessible payment experience be achieved for visually impaired consumers in retail to support consumer normalcy?

Specifying search terms and database repositories

To gather the literature about the subject, Scopus, Web of Science and Google Scholar were utilized as academic search engines with extensive database coverage.

The relevant literature was sought by employing the keywords "blind", "visually impaired", "payment", "accessibility","inclusion" in titles, abstracts, and keywords. With a focus on accessible payment systems for VICs in retail, those keywords were chosen to fully capture the pertinent literature for the systematic review. The terms "blind" and "visually impaired" specifically target the population for this study. The keyword "payment" has a clear connection to the review's focus, which identifies the payment solutions accessible to people with visual impairments. "Accessibility" emphasizes the significance of designing payment systems and technologies enabling all individuals to use, including the visually impaired. Finally, "inclusion" underlines a broader goal of guaranteeing that all customers, irrespective of disability, can fully participate in financial transactions. To refine the data from the database, the following search string was constructed: (TITLE-ABS-KEY (blind) OR TITLE-ABS-KEY (visually AND impair*)) AND TITLE-ABS-KEY (payment) AND TITLE-ABS-KEY (accessibl*) OR TITLE-ABS-KEY (inclusi*)).

As of November 2024, based on the query results from Scopus, research on accessible payments for visually impaired individuals remained limited. From the first study conducted from 2007-2024, a total of 24 publications were identified. Among these publications, 19.5% were in the field of medicine, 19.5% were in computer sciences, 12% were in social sciences, 9.8% engineering, 7.3% were in economics, and only 4.9% examined the subject from a business perspective. Rest of the studies were produced in diverse disciplines including decision sciences, art and humanities, etc. In addition to Scopus and Web of Science with similar query results, to reach a wider literature, a search was conducted in Google Scholar in November 2024, using the keywords "accessible payment" and "visually impaired", or "blind". These queries resulted in 29 publications for "accessible payment" and "visually impaired" and 56 publications for the keywords "accessible payment" and "blind". Finally, "financial inclusion" keywords were also applied together with "accessible payment", "blind" and "visually impaired". The total number of publications obtained from those database repositories was 109.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion	Rationale
Population	Publications focusing on directly VICs	Publications focusing on consumers with other sensory impairments	The study's focus is only visually impaired consumers.
Context	The publications addressing the "payment experience" of VICs	The publications with outcomes unrelated to VICs' payment experience	The study aims to understand visually impaired consumers challenges with payment tools in retail environment.
Time period	Publications in all time periods were included, from the first publication in 2007 till 2024.	No exclusion	A key goal of a scoping review is to assess the breadth of existing research; therefore, publications from every period were considered.
Methodology	All publications were included without making a discrimination based on the methodology adopted.	No exclusion	The study covers publications from different disciplines assessing the visually impaired payment tools and solutions to help analyze the literature's approach to VICs' inclusion in the retail environment.
Publication type	Journal article Conference paper Working paper	Thesis, books and publications without accessible full text, Duplicate publications	Including journal articles, conference papers and working papers aids in having an inclusive review covering the studies both by the academics and practitioners.
Language	Publications written in English and Turkish	Publications were written in non-English	Publications in other languages requires translation, which is excluded due to time and cost constraints.

Source: Compiled by the author (Thadikaran and Singh, 2025)

Determining Inclusion/Exclusion Criteria

Following the identification of the results using the selected keywords, the inclusion and exclusion criteria displayed in Table 1 were applied through a three-stage filtering process (Karsen, Chandra, Juwitasary, 2019). In the first stage, the publications identified through the keywords were categorized. The second stage involved reviewing the titles and abstracts of these publications to assess their relevance to the research question, with the shortlisted works classified as "candidate studies." Finally, in the third stage, the full content of the candidate studies was thoroughly analyzed, and those meeting the criterion were categorized as "selected studies." This systematic approach ensures a rigorous and focused selection of relevant literature (Karsen, Chandra, Juwitasary, 2019).

Relevance Appraisal

Relevant articles were manually chosen from the initial list, whereas irrelevant ones were excluded by analyzing their titles, keywords, abstracts, and full texts. Articles eliminated from consideration matched at least one of the exclusion criteria shown above.

Since the topic remains relatively underexplored within the academic literature due to its niche nature, the number of studies included in this review was limited to 16 publications, displayed in Table 2. That included two sources—a working paper and an article- which were incorporated through citation tracking of the included publications (Dai, et al., 2023). Following a thorough review of the complete publications, after extracting and coding data, emerging themes were: (1) payment tools used by VICs, their challenges, and their coping mechanism and (2) accessible payment terminals for inclusive payment experience.

FINDINGS and DISCUSSION

As demonstrated in Table 2, even if the oldest article was published in 2007, "accessible payments for visually impaired" subjects have been studied for the last ten years, most of them published in scientific journals, or conference proceedings. Researchers have focused mostly on Europe, but there are other studies from America (USA, Colombia), Asia (India, Indonesia Malaysia) and Africa (Nigeria).

EMERGING THEMES

The study aims to answer the research question of how to provide an accessible payment experience for VICs while shopping to support consumer normalcy. By demonstrating examples of best practices in the market, analyzing insights into the development of legal frameworks, and conducting a systematic literature review and content analysis, the findings obtained were synthesized under two overarching themes.

Payment Tools Used By Visually Impaired Consumers, Their Challenges, and Their Coping Mechanism

Under that theme, the payment tools available to VICs during transactions were categorized, and under each category the challenges they face, and their coping mechanism were articulated.

Cash Payments, Challenges and Coping Mechanism

Cash payments maintain its popularity, particularly due to the positive effects on VICs' increasing self-confidence and supporting autonomy while shopping, as well as the ease of tracking personal budgets and managing expenses. On the other side, reluctance to adopt digital payment methods because of low financial literacy can be compensated cash payments (Hernandez, Jonker, Kosse, 2017, Broekhoff et al., 2023; Van Der Cruijsen and Reijerink, 2024). Since VICs often encounter difficulties in adapting to digital payment systems, and the limited accessibility of these methods has led them to perceive cash as a more reliable and convenient alternative (Van Der Cruijsen and Reijerink, 2024).

To overcome potential difficulties in cash handling, VICs frequently adopt strategies like sorting and grouping their money in their wallets before shopping (Çelik et al., 2019). Additionally, they may be assisted by family members, ask for help from strangers, use money recognition tools, distinguish the currency by color, or recognize it through tactile features or written inscriptions (Kara et al., 2020). In Türkiye, the Central Bank introduced an inclusive approach to meet to the needs of VICs by adding features like "size differentiation, embossed printing dots, widespread embossed printing, and holographic stripe foil." This help VICs to detect banknotes value through braille alphabet applications, facilitate to make discrimination by altering the banknotes dimensions, and attempts to assist visually impaired users with developed security features offered by holographic stripe foils (TCMB, 2009). Additionally, in the same year, a program was launched to distribute money-measuring tools (Para-Ölçer) to VICs through relevant NGOs (TCMB, 2009).

Table 2: Findings of the Literature by Publication Year

Author/s & Publication year	Publication's title	Purpose & Findings	Country	Publication type
Broekhoff, M.C., van der Cruijsen, C., Jonker, N., de Haan, J. (2024)	"Toward financial inclusion: Trust in banks' payment services among groups at risk"	This research examines the trust of vulnerable consumers in the payment system. Findings indicate that consumers with low digital literacy, financial challenges, or visual impairments report below-average trust, attributing their concerns to dissatisfaction with bank policies, frequent service interruptions, and the ongoing digitalization of payment services.	Netherlands & Germany	Journal Article in *Economic Analysis and Policy*
Singh, S., Jatana, N., Sehgal, S., ... Arunkumar, B., Ramesh, J.V.N (2024)	"Making Digital Payments Accessible Beyond Sight: A Usability Study of UPI-Based Smartphone Applications"	The study evaluates accessibility issues in UPI (Unified Payment Interface) apps like Google Pay, Paytm, and PhonePe for visually impaired (VI) users. Testing revealed design flaws such as poor screen reader support and complex navigation, inadequate feedback mechanisms. It emphasizes redesigning these apps with user-centered improvements by developing the management of navigation, error feedback, and interface clarity.	India	Journal Article in *IEEE Access*
Bolaños-Fernández, C., Bacca-Cortes, E.B. (2024)	"Mobile Application for Recognizing Colombian Currency with Audio Feedback for VI People"	The study's focus is the problems of the VIs in identifying Colombian currency and introduces "CopReader," a smartphone app for VI users to recognize their currency offline using neural networks like MobileNetV2. Achieving 99% accuracy, it provides real-time audio feedback, enhancing financial independence and accessibility.	Colombia	Journal Article in *Ingeniería*
van der Cruijsen, C. and Reijerink, J. (2024)	"Uncovering the digital payment divide: Understanding the importance of cash for groups at risk"	The research aims to explore the role of cash in payment behavior. The findings support that cash is important for people with low digital literacy, suffering from disabilities like visual impairment, intellectual capacity, and low-income level.	Netherlands	Working Paper
Kurnia Ningrum, N.A., Fauzi, R., Suakanto, S. (2023)	"Designing an e-Wallet Solution for Users with Visual Impairment: A Design Thinking Perspective"	The study examines the VI's challenges in using e-wallet applications. It adopts a Design Thinking approach comprising "empathize, define, ideate, prototype, and test" phases to develop "Visipay," an accessible e-wallet solution tailored for VI users. The findings of usability tests point out the significance of 'user-centered design' in improving financial inclusivity and accessibility for underserved populations, emphasizing iterative prototyping and feedback-driven refinement.	Indonesia	Conference Paper
Singh, K., Gupta, S., Chawla, M., Rashid, G., Anand, U. Jain, R., Agarwal, A. (2023)	"Currency Recognition System for Visually impaired using a Novel CNN-LSTM based Hybrid Approach"	The study proposes a smartphone-based system to help the VIs recognize currency notes. Combining CNNs for feature extraction and LSTMs for sequence prediction, the model achieves a high level. It provides real-time audio feedback and is optimized for low-light conditions and cloud deployment, offering a robust, scalable solution for enhancing financial independence.	India	Journal Article in *Journal of Artificial Intelligence and Internet of Things*
Borowski-Beszta, M., Borowska-Beszta, B., & Polasik, M. (2023)	"Digital payment services in Poland as assistive technology and empowering tool for consumers with disabilities"	This study examines the adoption and perception of digital payment methods among consumers with and without disabilities in Poland. Findings show that individuals with disabilities actively use diverse payment services, including contactless payment cards. Digital payments are viewed as empowering tools that enhance financial control, and it's recommended to design inclusive digital financial services aligning with the needs of disabled people.	Poland	Journal Article in *Disability & Society*
Parvathy, V. and Durairaj, D. (2022)	"Adoption of Mobile Payment among Visually Impaired Users in Tamil Nadu based on TAM"	The study aims to explore the VICs' mobile payment adoption by employing Technology Acceptance Model. The findings reveal that the ease-of-use factor plays key role in adopting mobile payment since the users don't need to be assisted while performing the transaction via mobile application.	India	Journal Article in *International Journal of Health Sciences*, 5346–5361

Samuel, I., Ogunkeye, F.A., Olajube, A., Awelewa, A. (2020)	"Development of a Voice Chatbot for Payment Using Amazon Lex Service with Eyowo as the Payment Platform"	The study develops a voice chatbot using Amazon Lex and the Eyowo payment platform to facilitate financial transactions for the VI. It explores how a voice-based system can enable independent financial management through secure balance inquiries and money transfers. The findings show that the chatbot effectively uses speech recognition and natural language understanding to improve accessibility and financial inclusion.	Nigeria	Conference Paper
Kara, S., İnal, Ö., Torpil, B., Cemali, M., Tatlı, İ., Akı, E. (2020)	"Money Recognition and Using Methods in Visually Impaired Individuals"	The study examines the strategies that the VI employ for money recognition and usage, and the challenges they face. The findings highlight difficulties in money recognition, counting, and receiving change. Participants use various methods for money identification - tactile recognition, size comparison, and assistance from family or strangers.	Türkiye	Journal Article in *H.Ü. Sağlık Bilimleri Fakültesi Dergisi*
Kameswaran, V., Muralidhar, S.H. (2019)	"Cash, digital payments and accessibility – A case study from India"	This study examines VI individuals' challenges in using cash and digital payments. Findings reveal significant accessibility barriers in both payment modes, requiring additional effort necessary to navigate inaccessible systems.	India	Conference Paper
Guo, A., Kong, J., Rivera, M., Xu, F.F., Bigham, J.P. (2019)	"StateLens: A reverse engineering solution for making existing dynamic touchscreens accessible"	The StateLens project addresses the accessibility challenges faced by blind individuals when interacting with dynamic touchscreen interfaces. Utlizing 'a hybrid crowd-computer vision pipeline', it creates state diagrams, enabling interactive conversational agents and tactile exploration through 3D-printed accessories. User studies show the system effectively enhances independent access to touchscreens, offering a practical solution to significant accessibility barriers and fostering inclusivity.	USA	Conference Paper
Braeken, A. (2017)	"An Improved E-Payment System and Its Extension to a Payment System for Visually Impaired and Blind People with User Anonymity"	The study proposed an improved e-payment system using the ASEC protocol for enhanced security and privacy by integrating user anonymity, securing transactions, and accessibility, for the VI. The proposed system enables VI users to perform their transactions autonomously by using their smartphones while dealing with nonrepudiation, forward secrecy, and mutual authentication issues. This innovative solution improves accessibility without requiring significant hardware modifications, making it a practical option for inclusive payment systems.	Belgium	Journal Article in *Wireless Pers Commun.*
Wong, E.J., Yap, K.M., Alexander, J., Karnik, A. (2017).	"Design and Analysis of Haptic-Audio Based System for Visually Impaired to Shop Online"	This study explores whether the VI individuals can shop online independently. A system using haptic feedback and voice recognition was developed, allowing users to browse products, interact with the shopping cart, and make payments through a voice-password system. The results show that these technologies enable independent online shopping for visually impaired users.	Malaysia & UK	Journal Article in *Journal of Telecommunication, Electronic and Computer Engineering*
Pino, B., Sánchez, M. D., and Sancha, Z. (2014)	"Toward Payment Systems for All: Accessible POS"	The study explores the development of an accessible payment system for VI individuals to ensure independent and secure transactions. It identifies challenges in traditional POS devices, which rely on visual information and often require external assistance and offers an auditory feedback system integrated into POS devices, providing distinct tones to indicate transaction steps with a user-centered design approach.	Spain	Journal Article in *Journal of Accessibility and Design for All*
Anderson, R.G., Williams, M.M., (2007)	"Currency design in the United States and abroad: counterfeit deterrence and visual accessibility"	The study focuses on currency design's visual accessibility and ability to combat counterfeiting. It underlines the integration of tactile markers and high-contrast numerals as security features with accessibility for visually impaired users. The findings underline the importance of public awareness and technological advances in the reliability and use of banknotes.	USA	Journal Article in *Review*

As technology has advanced, mobile applications designed to assist VICs with money recognition have become widely used by the VICs (Çelik et al., 2019; Singh et al., 2023). One of the commonly used applications in Türkiye is "Cash Reader", which can identify different currencies aloud and operates offline. Similarly, Turkish telecommunication company -Türk Telekom developed the "Accessible Life" (Erişilebilir Yaşam) application, and offered free of charge (Cash Reader, n.d.; Türk Telekom, n.d.). Another example is "CopReader", a Colombian app that identifies the value of a currency by capturing its image via video or photo and provides this information to the user through auditory feedback (Bolaños-Fernández and Bacca-Cortes, 2024). While these mobile applications offer valuable assistance, smart glasses have been proposed as well. However, smart glasses' inability to process data independently while requiring constant internet connectivity and support from remote servers has been perceived as a limitation in their usability. Because of this limitation, applications operating offline are a more favorable for VICs (Lin et al., 2020).

An additional concern about cash payment is detecting counterfeit currency not only for VICs but also for all consumers. Therefore, counterfeit detection has been an important element of managing financial transactions securely. Ugale, Tambe, Kurhe, and Shubham (2023) focused on this issue in their study, pointing out the need for accessible tools to verify counterfeit banknotes. The integration of security features with tactile markers and high-contrast numerals would further strengthen the security and autonomy of VICs while performing financial transactions (Anderson and Williams, 2007).

Credit or Debit Card Payments, Challenges and Coping Mechanisms

In addition to cash payments, VICs can also use payment cards to avoid fraud or mistakes but always keep the fear of being cheated in mind (Kara et al., 2020). However, payment cards are preferred over complicated banking apps and wallets that need smartphone use and application setup, due to their perceived financial control and ease-of-use (Borowski-Beszta, et al., 2023). Thus, companies increasingly integrate inclusivity into their innovations for credit or debit card payments to make VICs' lives easier. For instance, Mastercard introduced an innovative card design in Türkiye in 2021, allowing VICs to distinguish among credit cards, debit cards, and prepaid cards in their wallets. This initiative, called the "Touch Card", features tactile notches on the side of the card: (1) a round notch for credit cards, (2) a wide square notch for debit cards, and (3) a triangular notch for prepaid cards. For VICs, this design offers a more creative and inclusive option than the conventional embossed names and numbers, which are being phased out in many cards (Selimoğlu, 2021).

Both credit and debit cards are preferred for transactions, especially those that don't require a PIN and allow contactless payments. Debit cards are particularly favored for their ease-of-use and capability of tracking expenses more effectively (Broekhoff et al., 2023). Similarly, contactless credit card payments also offer convenience. To improve security and ease-of-use, the Thales Voice Payment Card was developed in collaboration with the French fintech company Handsome. This card connects with a smartphone application through Bluetooth, offering audio feedback on transaction details about amount, PIN validation, and payment confirmation, providing a secure and accurate experience. Compared to existing EMV (European Mastercard Visa) payment terminals that do not require hardware upgrades, it doesn't necessitate extra accessories while focusing on simplicity, security, and inclusivity. By dealing with common issues like fraud and errors during transactions, this technology demonstrates Thales's commitment to developing accessible, equitable payment systems for all users. In Türkiye, Papara, a fintech company, first launched this Voice Card into the market in collaboration with Thales in 2022 and it can be seen as a good practice example (Thales, n.d.).

Finally, as a safer payment option in online shopping, VICs have been observed to consider virtual cards. Additionally, when they prefer 3D secure payment systems for enhanced security, a common challenge arises: the insufficient time provided to enter the code sent via SMS into the website (Çelik et al., 2019). This issue, while minor, is a significant barrier and represents a small but crucial step to be taken to ensure an inclusive payment experience (Broekhoff et al., 2023).

Digital Payment, Challenges and Coping Mechanisms

Digital payment options can be utilized by VICs in physical retail stores for contactless payments via smartphones, tablets, or smartwatches. Digital payment apps, equipped with screen readers and voice-over capabilities, can make financial transactions easier for VICs. Even if those applications may offer accessibility for VICs, they may still include design flaws related to screen reader compatibility, keyboard navigation, and the clear labeling of buttons and controls (Singh et al., 2024). At this point, the digital skills of VICs also become crucial. Broekhoff et al. (2023) revealed that the VICs tend

to have lower levels of trust in the payment services offered by their banks. Moreover, as the level of digital skills decreases, their trust in payment services also diminishes. This finding highlights that accessibility issues encountered by VICs when digital or physical payment systems are used, negatively impact their trust levels.

In online shopping, sellers must improve inclusivity by developing accessible websites that comply with accessibility standards and providing mobile payment options that are both accessible and user-friendly during the payment step. For VICs, both ease-of-use and accessibility play critical roles in adopting mobile payment methods (Parvathy and Durairaj, 2022). At this point, incorporating payment systems such as PayPal and Google Wallet, which prioritize accessibility, into payment acceptance processes is vital for creating an inclusive payment experience. Digital wallets, which securely store financial information like credit/debit cards and e-money accounts, ensure that the recipient of the payment cannot access the user's financial details (PAL, 2020).

As an example of developing e-wallet solutions for VICs, the 'VisiPay' application in Indonesia,demonstrate the progress in improving digital payment inclusivity (Kurnia Ningrum et al., 2023). VisiPay adopted the design thinking methodology and followed inclusive product development process by beginning with analyzing the needs of VICs. The outputs of this analysis help identify their challenges such as "lengthy transaction processes, issues with screen readers' ability to read certain elements, and access barriers like facial recognition". In the end, a user-friendly interface was developed, offering a level of accessibility comparable to that of sighted users. Beside VisiPay, another innovative system utilized the potential of artificial intelligence to develop a voice-based chatbot payment system using Amazon Lex and the Eyowo payment platform. The proposed system allows users to transcribe spoken commands into text and transactions can be executed based on the text input. Voice commands are processed by the system, appropriate responses are developed and shared with the user through speakers. The test results showed that the voice-enabled chatbot successfully executed financial transactions, providing a secure and comfortable user experience (Samuel et al., 2020). On the other hand, as a well-known NGO, the European Blind Union (EBU) emphasized that if visually impaired or vision-restricted consumers use a smartphone or smartwatch as a payment tool, the payable amount should be displayed on their device before the transaction is approved. Additionally, if the payment is made via a card, the transaction amount should be verifiable or rejectable through alternative secure methods like banking applications or phone notifications (EBU, 2023).

For VICs, "navigating complexly designed websites" and "entering card information into payment forms during online transactions" are common accessibility barriers in online shopping. A voice-based password payment system has been proposed as a potential solution to automate data entry process into the form and improve independency of the visually impaired while making online payments (Wong et al., 2017).

Wearable technologies also offer additional solutions to facilitate mobile payments for VICs. For example, the "Shimmer" device, currently available in the Asian market, operates as a contactless payment terminal worn around the neck. It has features like as a braille keyboard, a fingerprint scanner, a camera, and a screen that displays QR codes to support QR code-based payment processes (Bigumigu, 2023).

These examples illustrate ongoing efforts to achieve financial inclusion, defined as "a process that ensures access to, availability of, and ease of use of the formal financial system for all members of an economy" (Sarma and Pais, 2011). Without such initiatives, systems that limit financial access will lead to their financial exclusion for vulnerable groups (Leyshon and Thrift, 1995). To prevent this, adopting human-centered design principles is fundamental. This approach involves understanding the needs of diverse consumer groups and creating solutions based on user insights through an empathetic approach. A prototype is then developed to bring the solution to life, tested on the market, and, if effective, introduced to ensure that inclusive products meet consumer needs (Pian, 2018).

Accessible Payment Terminals for Inclusive Payment Experience

Under that theme, VICs' challenges in payment process through payment terminals are presented under *challenges with payment terminals*, and the initiatives of NGOs, governments and companies are articulated under the *actions taken by stakeholders* category.

Challenges with payment terminals

One of the primary challenges faced by VICs while shopping is the lack of trust and security in the payment process, which restricts their independence and creates

significant discomfort. Key concerns include verifying whether the price of purchased goods or services is accurate, ensuring correct cash payments and receiving proper changes, avoiding fraud during credit card transactions, and addressing the inaccessibility of POS devices. These issues constitute the core difficulties experienced by VICs during payment processes (Zufelt, 2010; Pino, et al., 2014; Yu, et al, 2015; Çelik, et al., 2019; Umut, et al., 2021). Studies focusing on these challenges consistently emphasize the importance of voice-assisted systems in payment processes (Pino, et al., 2014; Çelik, et al., 2019; Umut, et al., 2021). For example, Pino, et al. (2014) advocate the use of auditory feedback to guide VICs through payment steps. Their proposed system includes distinct voice signals to inform users about the critical stages, such as "successful card reading, the need for PIN entry", during payment transactions. Guo et al. (2019) proposed the StateLens system, which reconstructs a structured model of the interface and provides audio and conversational instruction to make dynamic touchscreens accessible for blind users. It offers interactive guidance via conversational agents accompanying the user during transaction. Additionally, with 3D-printed accessories, it prevents unintentional touches on capacitive screens and facilitate nonvisual use. Since touchscreens often pose significant accessibility challenges for blind users because of their inherently visual nature, the risk of unintended interactions during transaction, and the lack of options to modify or select more accessible platforms, this system transforms inaccessible devices into navigable tools. In that way the aim of enhancing the independence and usability for visually impaired individuals can be achieved (Guo et al., 2019).

Actions taken by the Stakeholders

Visually impaired individuals have lower-than-average levels of trust in payment systems provided in digital banking (Broekhoff et al., 2024). At this point, one of the critical tools to strengthen the autonomy of VICs while shopping, increase their self-confidence and make them feel comfortable in retail environment is the availability of reliable payment terminals. For this issue, the European Blind Union (EBU) successfully advocated for the inclusion of payment platforms in *the European Accessibility Act*, introduced by the European Commission in 2015, to improve market accessibility for elderly people and those with visual impairments. With this Act a regulatory framework was established to mandate all products and the payment terminals introduced after June 28, 2025, must meet accessibility standards. Those will be the operational parameters to be obeyed for industry stakeholders. That action signifies a remarkable advancement in developing inclusivity and equity in the market. Additionally, the EBU's Payment Terminals Working Group published recommendations to provide valuable insights into user needs and expectations and they offer guidance to manufacturers on designing payment terminals aligned with the principles of universal design. These recommendations serve as invaluable resources, promoting the development of inclusive payment systems while catering the unique needs of visually impaired users (EBU, 2020).

With these recommendations EBU emphasize the need for tactilely distinguishable buttons with appropriate size, the provision of haptic feedback through vibrations to confirm button activation, and the integration of tactile overlays for flat touch panels to increase accessibility. Additionally, as a general principle, payment terminals should have large, easily readable screens, a speaker to enable auditory feedback, and either a standard 3.5 mm headphone jack or an alternative mechanism for audio transmission (EBU, 2023). There are studies drawing the attention the accessibility challenges of blind individuals while interacting with dynamic touchscreen interfaces and propose the use of a hybrid crowd-computer vision pipeline, which creates state diagrams that enable interactive conversational agents and tactile exploration through 3D-printed accessories (Guo, et al.,2019).

Additionally, to ensure a fully accessible user interface (UI), specific visual, auditory, and speech-related features have been remarked as necessary by EBU. Their recommendations not only include blind users but also the users with low vision and they advise to customize the interface by adjusting the text size, text/background color, screen brightness, and similar settings, all in a user-friendly and easily accessible manner. The interface should provide voice commands for key transaction stages, such as "card entry,""amount to be paid,""PIN entry,""contactless payment confirmation," and "transaction status" (success/failure). Speech-related functionality is also emphasized, with recommendations for allowing customization of the speech voice, specifying the amount to be paid, editing the entered PIN, and performing all functions related to transaction steps and messages through speech interaction. These features are considered critical for achieving an inclusive and accessible user interface (EBU, 2023).

In the U.S., the *Americans with Disabilities Act* also requires banks to comply with the accessibility rules for their online banking and mobile apps that disabled people may utilize while shopping for payment. The

main requirements for accessibility to be followed to make their services accessible include screen reader compatibility with alternative text for images, proper headings and structures, keyboard navigation, focus indicators, color contrast and text scaling, contrast ratios and text scaling (Milbergs, 2024).

In Canada, at the federal level, the *Accessible Canada Act* allows the development of accessible electronic payment terminals (Government of Canada, n.d.). In 2024, with the funding of the Government of Canada, accessible payment terminals project was realized through the collaboration of CNIB(Canadian National Institute for the Blind) and Moneris® Core corporation. Electronic payment terminals featuring accessibility modes for both touchscreen and manual payment terminals were launched into the market. These payment terminals enable VICs to independently navigate the terminal using audio prompts and a high-contrast screen, without the need to disclose their PIN or request assistance (CNIB, n.d.).

In Türkiye Yapı Kredi Bank introduced the "Engelsiz POS" (Accessible POS) device in collaboration with Ingenico and the Six Point Blinds Association as a stakeholder in an R&D project. This initiative, first in both Turkey and globally, introduced the device into the market in 2011. The POS terminal, which was part of the Ingenico iCT series, was equipped with a specially integrated audio module enabling the VICs to hear the transaction amount through auditory prompts while shopping and receive voice feedback on the accuracy of their PIN entry, aiming to address and mitigate their security concerns regarding payments (BT Haber, 2011; Yapı Kredi, n.d.). Despite its innovative design and potential impact, the adoption and widespread use of this POS device in the market remain limited, and its overall effect appears to have been constrained.

In the UK, Ingenico collaborated with RNIB(the Royal National Institute of Blind People) on a project focused on accessible payment terminals with touchscreens, aiming to provide blind and partially sighted individuals with a secure method to input their PIN on touchscreen POS devices. They developed a new interface for the Android AXIUM series with input from blind and partially sighted individuals through user testing, effectively accommodating various levels of visual impairment. For example, the AXIUM DX8000 leverages its large color touchscreen and text-to-speech functionality to provide an accessible and PCI-approved solution, ensuring the secure entry of PINs (Ingenico, 2023).

Aligned with these features, accessible payment terminals can contribute to establishing the "two-sided market" structure described by economists. A two-sided market refers to a platform or system that facilitates interactions between two distinct participant groups, enabling mutually beneficial transactions that would otherwise occur inefficiently. The key characteristic of a two-sided market is the platform's ability to create value by connecting participants from both sides, often incentivizing engagement through reduced transaction costs or increased benefits. Credit card networks linking consumers and businesses, online marketplaces connecting buyers and sellers, and ride-sharing platforms pairing drivers and passengers are of examples two-sided platforms that facilitate interactions between distinct user groups. (Zywicki, 2010).

In the context of a two-sided market, the adoption of accessible payment terminals for VICs eliminates a critical barrier by facilitating seamless interactions between VICs and retail businesses. These terminals, akin to the role of credit card networks in enabling transactions (Morris, 2024), act as intermediaries that provide inclusivity and enable the transactions to be completed that might otherwise be limited by accessibility challenges. This approach not only enhances the inclusivity of financial systems but also supports sustained participation and value creation for both VICs and retail businesses.

THEORETICAL IMPLICATIONS

The findings of this study enlighten the role of designing accessible payment systems in customer journey to address the elements of consumer normalcy, particularly 'I'm in control' and 'I belong here,' in the shopping experience of visually impaired individuals. Inclusive payment systems enable visually impaired consumers to make secure payments and independently complete their shopping, just like other consumers. From that point of view, findings also offer significant theoretical implications for understanding and advancing accessibility in financial systems, particularly for VICs. First of all, it enhances the definition of financial inclusion not only "the share of the population who use financial services with a multitude of dimensions, reflecting the variety of possible financial services, from payments and savings accounts to credit, insurance, pensions, and securities market (WB, 2014)", but also with a new definition "a process ensuring equitable access to financial tools, including the accessible payment systems which eliminates the barriers faced by VICs and enabling them to experience consumer normalcy". As accessible payment systems can be seen as a component

of consumer normalcy while shopping, the relation between financial inclusion and consumer normalcy should be emphasized in the literature for future research.

The findings of the study also point out that to design accessible retail environments, accessible payment systems should also be considered to support visually impaired consumers' autonomy and inclusion in the marketplace. Since, under the current circumstances, the VICs feels "the state of powerlessness arising from an imbalance occurring during marketplace interactions (Baker, 2006)" which may make them feel vulnerable in the marketplace. To decrease the level of consumer vulnerability, accessibility should be evaluated as not only a moral imperative but also an economic necessity that will be utilized by both consumers and service providers through broader market participation.

Another theoretical implication can be about the accessibility's role in the visually impaired consumers' technology adoption, besides the perceived ease of use and trust. Aligning with Technology Acceptance Model, accessibility can be considered as a crucial determinant of these perceptions, which may require integration into consumer behavior models. Besides, the role of coping mechanisms, such as reliance on tactile features, assistive technologies, or mobile applications, expands the understanding of adaptive consumer behaviors in constrained environments.

Conclusion

Visual impairments or reductions in visual capacity, coupled with increasing life expectancy and a growing elderly population, have heightened the need for inclusive design in goods and services. Supporting the independence of visually impaired consumers during their shopping experiences requires that the design of services offered to them be inclusive, aligned with their current needs and expectations, and that the payment step of the shopping process should be considered. To achieve this goal, it is crucial to closely examine the payment tools used by visually impaired consumers in both physical and online shopping contexts, addressing the challenges they face and offering accessible solutions for them. This will enable the delivery of messages such as "you are in control" and "you belong here," which are fundamental for fostering consumer normalcy in the retail environment. In this way, VICs could be able to independently manage a seamless shopping process, co-creating the experience with sellers while feeling comfortable, and could be treated equally without discriminated based on their impairments.

In this study, the use of various payment tools, including cash, virtual, credit, and digital payment options, was discussed, along with the challenges faced and their coping strategies. Among the prominent factors for ensuring the inclusivity of payment methods are their accessibility, achieved through compatibility with assistive technologies; their usability, facilitated by a user-friendly interface; and the integration of voice command systems, which help VICs feel secure during payment transactions. In particular, the delivery of accessible digital payment systems developed with a design-thinking approach to VICs would provide their financial inclusion in the market, empowering consumer normalcy. By using the Braille alphabet, tactilely distinguishable buttons, haptic feedback through vibrations to guide payment steps, and integrating tactile overlays for flat touch panels, along with conversational and audio features in a user-friendly interface, VICs can complete their shopping experiences with their independence fully supported throughout the physical shopping process. In online shopping, providing VICs with user-friendly, accessible websites that are easily adaptable for screen readers, comply with WCAG guidelines, and leverage new AI-powered technologies through a design thinking approach is crucial for enabling VICs to experience consumer normalcy in retail environments.

Eliminating accessibility barriers addresses the trust and security concerns that consumers may experience while shopping. Achieving financial inclusion necessitates the widespread adoption of accessible payment terminals, which are crucial for enabling VICs to conclude their transactions with confidence. Drawing on the example of the "Accessible POS" initiative by Yapı Kredi Bank in Türkiye, which failed to achieve sustained implementation, it can be argued that if market demand for inclusive products does not arise spontaneously, policymakers should introduce regulations mandating the use of such products to ensure financial inclusion.

The widespread adoption of inclusive practices in the market is made possible through the effective participation of nongovernmental organizations (NGOs) as stakeholders in relevant processes, as exemplified by the European Blind Union. At this juncture, it is imperative for public authorities to ensure the active involvement of pertinent NGOs as stakeholders in establishing the legal framework concerning practices that may impact the lives of individuals with disabilities. Moreover, all

the steps undertaken within these accessibility and financial inclusion initiatives should be embraced and executed through a human-centered design thinking approach accompanied by the advocacy group's support about monitoring compliance with the accessibility standards and their needs. Adopting this approach could help prevent financial exclusion for individuals with disabilities, ensure inclusivity, and establish a two-sided market structure. And providing seamless interactions between VICs and retailers, would create value for both consumers and businesses, redefining market inclusivity as a strategic advantage.

LIMITATIONS and FUTURE DIRECTIONS

The primary limitation of this study is its reliance solely on secondary sources of accessible payments for VICs. In this context, conducting a field study in Türkiye that directly engages visually impaired consumers could provide a more concrete understanding of their challenges and proposed solutions, contributing to the design of a more inclusive payment experience. Nevertheless, the present study offers originality by combining theoretical contributions with practical insights and recommendations. This dual approach is expected to guide practitioners in the market by promoting more inclusive designs in customer communication and customer journey mapping, enabling businesses to better address the needs and expectations of their visually impaired customers in retail.

Although accessible payments in retail are currently perceived as a niche subject with limited interest from practitioners, the concepts of inclusivity and equality are increasingly gaining prominence on the global agenda as part of the Sustainable Development Goals. Therefore, further research could focus on the design of disability-friendly environments. Such studies should not only focus on sensory impairments but also encompass other forms of disability, including cognitive impairments. Furthermore, given the aging populations in many countries, there is a critical need to redesign goods and services based on the field research findings to ensure they are accessible and inclusive for all.

DECLARATION OF GENERATIVE AI IN SCIENTIFIC WRITING

During the preparation of this work, the author used Chatgpt to improve the readability and language of the manuscript. After using this tool, the author reviewed and edited the content as needed and took full responsibility for the content of the published article.

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Economic Effects of Earthquakes 1999 Marmara/Türkiye Earthquake Case

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ABSTRACT

Frequent earthquakes are a reality of Türkiye. It is crucial to be prepared for these earthquakes, take the necessary measures before the earthquake, and recover the losses quickly when an earthquake occurs. In this study, the literature about the economic effects of earthquakes is examined and the impact of earthquake on the Kocaeli province, the epicenter of the 1999 Marmara Earthquake, is analyzed. As an important indicator of economic activity level, the effects of the earthquake on the city's exports were examined with panel data regression covering the years 1996-2021 and 163 countries. The results of the regressions show that despite the large magnitude of the earthquake and the heavy losses, the economy of Kocaeli province recovered rapidly and returned to its export performance rapidly, even surpassing its previous performance in a short time.

Keywords: Türkiye, Earthquake, Kocaeli, Panel Data, Exports.

JEL Classification Codes: Q54, C33, O50

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INTRODUCTION

Many regions of Türkiye are placed on fault lines and earthquakes are frequent. Earthquakes cannot be prevented and predicted; it is necessary to take extensive measures in advance to minimize the possible damages. In the aftermath of the earthquakes, the most important issue is the rapid assessment of damage and the compensation of the losses.

In this study, the literature about earthquake's economic effects are examined and the impact on the Kocaeli province of Türkiye, the epicenter of the 1999 Marmara Earthquake, was analyzed.

The Marmara earthquake occurred on 17 August 1999 at 03:02, and its epicenter was Kocaeli/Gölcük/Türkiye. Its size was measured at 7.8 Mw (moment magnitude) It is one of the biggest earthquakes in the history of Türkiye, felt in a wide area as far as Ankara and in the whole Marmara Region. 18,373 people died and 48,901 people were injured due to the earthquake (SBB, 2023). Since the earthquake region is one of the most important industrial regions of the country, the economic losses caused by it were also very high. 285,211 houses and 42,902 workplaces were damaged in the earthquake (SBB,2023).

This article examines the effects of the earthquake on exports of Kocaeli city, an important indicator of the level of economic activity. For this purpose, two-panel data models were estimated; in the first cross sections are the countries Kocaeli City exports to between 1996-2021, and in the second cross sections are the sectoral exports of Kocaeli City in the same period. These regressions enable us to comment on both the market structure of the exports of the city and the sectoral composition of the export basket. To our knowledge, there are no econometric studies examining the effects of the 1999 earthquake on exports of Kocaeli city.

The results of our analysis show that despite the magnitude of the earthquake and the heavy losses, the economy of Kocaeli province recovered rapidly and returned to its export performance rapidly, even surpassing its former performance in a short time.

In the second part of the article, the literature on analysis methods of natural disasters, the studies on Türkiye's earthquakes, and the studies on policy suggestions for before and after earthquakes were examined. In the third part method of analysis, the data and results of the gravity regressions, and in the fourth part data, method, and results of sectoral panel data analysis were explained. The fifth part was devoted to evaluation and discussions. In the sixth part, concluding remarks were made.

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LITERATURE SURVEY

There are many factors to consider when examining the economic effects of earthquakes. Buildings, workplaces, machinery equipment, stocks of raw materials and finished goods, loss of labor and working days, and destruction of infrastructure are calculated as direct effects, while employment losses, migration, changes in business methods, environmental damage of cities affected by the earthquake, connections with cities, input-output relations are calculated as second-degree losses. The effects of the post-earthquake recovery process must also be taken into account. The data used in the analysis must be healthy and reliable. Likewise, the advantages and disadvantages of the analysis methods used should be considered.

Methods of Analysis

Basically, 4 analysis methods are used to analyze the economic effects of earthquakes and other disasters:

Econometric models: In the regression models in the literature, the effects of the disaster are estimated with the disaster dummy variables, usually by establishing export panel equations (where cross sections are countries) of the affected region. Gravity models are frequently used for this purpose (Oh and Reuveny 2010, Hadri, Mirza and Rabaud 2018, Dadakas ve Tatsi 2021). The studies show that disaster has negative effects on exports and imports. Hadri, Mirza, and Rabaud (2019) found that the effects were similar for low-income, high-income, large, or small countries, while Oh and Reuveny (2010) found that negative effects were stronger in small countries and countries with autocratic rule. Hayahsi (2012) estimated the log-linear panel model using risk and vulnerability factors as explanatory variables; used the model to estimate the economic damage of the March 2011 North East Haponia Tsunami and earthquake, showing that the actual damage could be twice as much as the government's estimate. Dadakas ve Tatsi (2021) examine the global agricultural trade impact of the 2011 triple disasters in Japan, earthquake, tsunami, and nuclear accident in Fukushima employing the panel gravity model. The authors find that the disasters had negative effects on both exports and imports and these effects were extended up to 2014.

In addition, difference in differences models are also widely used models. Jalan (2022) examines the effects of the 2004 Indonesian tsunami on tourism and GDP using a panel difference in differences model. The analysis results show that the tsunami did not affect the GDP growth rate of the countries exposed to the tsunami, but after the disaster tourists visiting these countries increased (which can be explained by the possibility of disaster tourism, dark tourism, and blue tourism) and this led to a rise in tourism revenues. Ayumu (2015) examined the effects of the earthquake in Hanshin-Awaji on the growth of factories in Kobe employing the difference in differences method. Pagliacci and Russo (2019) examined the effects of the Emilia-Romagna earthquake that took place in 2012 in Italy using the difference in differences method. The authors concluded that some Regions and some Municipalities within it performed better.

The disadvantage of econometric models is that it takes years to form the time series after the disaster. Although econometric models have predictive capacity, they are also criticized for needing large data sets and not being able to distinguish between direct and secondary effects (Rose and Guha, 2004; Aloughareh, Ashtiany, and Nasserasadi, 2016).

This study also employed econometric techniques of gravity analysis and sectoral panel export analysis. A frequently cited disadvantage of econometric models is that it takes years to form the time series after the disaster is not a problem for this study. Since in this article the effects of the earthquake on exports of Kocaeli after 26 years were examined, there is enough data to constitute a big enough panel for analysis. Also, the criticism for econometric models about not being able to distinguish between direct and secondary effects is not a problem for our purposes since the aim of the study is to observe the total direct and secondary effects of the disaster on the exports of the city, without concentrating on which part are due to direct and which part are due to secondary effects.

Input-output models are important in terms of revealing intersectoral links such as raw material-final product and imported input. Some studies integrate input-output models with engineering models and transportation networks (Sohn, Hewings, Kim, Lee, Jung 2004; Cho, Gordon, Moore, Richardson, Shinozuka and Chang, 2001). The disadvantage of input-output models is that up-to-date data is often not available, since data collection takes a long time. In addition, input-output analyses are criticized for being rigid against input and import substitutions, uncertain resource constraints, unresponsive to price changes (Rose and Guha, 2004), and therefore overestimating economic effects (Aloughareh et al., 2016).

General equilibrium models (CGE): General equilibrium models eliminate many of the disadvantages of input-output models by being sensitive to price changes, considering input and import substitutions, and taking into account supply constraints (Aloughareh et al., 2016). However, CGE models are generally amenable to long-term analysis, and the flexible adjustment feature often underestimates economic effects; it also needs a lot of data, and that much data is often not available (Aloughareh et al., 2016). Selçuk and Yeldan (2001) analyze the effects of the 1999 Marmara earthquake on the Turkish economy using the CGE method. Xie, Rose, Shantong, Jianwu, Ning, Tariq (2018) examine the effects of dynamic economic resilience factors on the recovery efforts after the 2008 Wenchuan earthquake with the CGE method.

The social accounting matrix (SAM) is mostly used to measure secondary effects. These are the methods generally used by researchers interested in regional sciences and socio-economics (Cole; 1998, 2004; Aloughareh et al., 2016).

Studies Examining Earthquakes in Türkiye

There are few studies examining the effects of earthquakes in Türkiye. Selçuk and Yeldan (2001) examined the GDP impacts of the 1999 Marmara earthquake with a general equilibrium model, in which the neoclassical growth theory formed the analytical basis of the intertemporal dynamics. They estimated the possible GDP impacts of various policy scenarios. The results of the analysis show that the initial GDP effects of the earthquake will vary between 4.5% contraction and 0.8% growth in GDP, depending on the results of government policies. The authors' policy recommendation from the results is that the government should compensate for the capital losses of the sectors with a negative indirect tax (a subsidy funded by foreign aid). On the other hand, financing the increase in government expenditures caused by the earthquake by imposing additional indirect taxes is not recommended as it will cause production losses.

Durukal and Erdik (2008) make a comprehensive analysis of the effects of the 1999 Marmara earthquake on the Kocaeli city. The authors examined the physically damaged industrial facilities and job losses in the region in detail and conducted surveys and damage assessments. In the article, the effects of the earthquake on the industrial sectors due to the interruption of buildings, machinery and equipment, stocks, and production were estimated. Kocaeli is a city where Türkiye's heavy industry facilities are densely located; 15.3% of Turkey's manufacturing industry production is carried out in the city. There are many factories and production facilities in petrochemicals, automobiles, motor vehicles and railway vehicles, base metals, synthetic yarn, paint, rubber, paper, iron-steel, pharmacy, sugar, cement, and energy. 345 out of 1062 members of the Kocaeli Chamber of Industry report that they have been damaged by the earthquake. Durukal and Erdik (2008) present a detailed balance sheet of the loss.

Özceylan and Coşkun (2012) analyzed the 2011 Van earthquake within the framework of the concept of vulnerability. The vulnerability index is calculated using various socio-economic indicators like migration from the countryside, urbanization, construction permits, healthiness of growth, the age structure of the population, average household size, adequacy level of health services, level of national income per capita, adequacy of accommodation alternatives (Özceylan and Coşkun, 2012).

Immediately after the Marmara earthquake, the World Bank (1999) evaluated the earthquake's economic effects and the costs of rebuilding with a team of experts and academicians and made policy recommendations for the prevention of future disasters. WB estimates 3-6.5 billion dollars (1.5%-3.3% of GDP) loss of wealth due to the devastation in the earthquake, and 0.6%-1% of GDP was projected to shrink due to the indirect consequences of the earthquake (1.2-2 billion dollars). The Bank estimated that at least some of this GDP loss would be offset by production elsewhere in the country, and rebuilding activities in 2000 to push GDP one percentage point above previous estimates. WB predicted that the current account deficit would increase by 1.5% ($3 billion) of GDP in the 1999-2000 period, above the baseline estimate, largely due to the increase in construction activities (World Bank, 1999). The government's post-earthquake policies were praised for giving confidence to the markets, signaling that fiscal and monetary discipline would not be abandoned.

OECD (2000) provides detailed information on the effects of the 1999 Marmara earthquake in many areas. The earthquake region is the heart of Turkish industry and if we include Istanbul, one-third of Türkiye's GDP is produced in this region. The region's income per capita is almost twice the Turkish average; although only 4% of Turkey's population lives in the area, its contribution to budget revenues is 16%. The report states that large-scale migration movements started after the earthquake. SMEs provided shelter, health support, etc. to their employees

in order not to lose their qualified personnel and this has been a working solution in many workplaces. It is observed that workshops and other micro-enterprises with up to 10 employees are among the sectors most affected by the earthquake. Many of them lost their workplaces on the ground floors of the buildings, their working capital disappeared; and family members, many of whom were employees, died. OECD (2000) predicted that 20-50% of all employment would be completely lost as a result of the earthquake. The report estimates that the negative effect of the earthquake on GDP will be around 2-2.5% in 1999, but GDP will rise 1.5% above the baseline estimate in 2000 due to reconstruction activities.

Aktürk and Albeni (2002) examined the economic effects of the 1999 Marmara earthquake. The following information, quoted by the author from TURKSTAT, is important: "Out of 889 workplaces whose production capacity was affected in the manufacturing industry, 364 reached their normal production capacity in 16 days, while 521 reached their normal production capacity in an average of 18 weeks" (Aktürk and Albeni, 2002, 7). Again, the following summary information given by the authors can give an idea about the budgetary effects of the earthquake: "The total loss of resources or income transferred by the public sector to the earthquake zone in 1999 is 1774 million dollars (1 percent of GNP); For the year 2000, it is 3796 million dollars (1.7 percent) (Aktürk and Albeni, 2002, 7).

When after data was observed, it is seen that GNP of Türkiye declined by 6,1% in 1999 and recovered in 2000 by a growth rate of 6,3%. So, downturn was bigger that what many studies expected but next year economy was quickly recovered.

DPT (1999) analyzed the various dimensions of the damage with the first data obtained in the first months immediately following the earthquake. In their damage/loss analysis, in addition to the damaged buildings, machinery equipment, finished goods, and raw material stocks, the losses caused by stopping production for a certain period were also tried to be estimated.

Şahin (2020) examines the legal and administrative infrastructure of disaster management in Türkiye. It evaluates the responsible institutions in this field, the legislation, and the strategy documents created.

There are no econometric studies examining Türkiye cases of how earthquakes affect the economics of the disaster region and how they recover after the disaster. This article aims to fill in this gap. Although 26 years passed since the Marmara Earthquake it is worth studying since "the Marmara earthquake is considered one of the largest earthquakes of the last century in terms of magnitude, the extent of the affected area, and material losses" (SBB, 2023, 23). The earthquake hit cities that are the industrial heart of the country. Türkiye is a country on many fault lines; earthquakes occur frequently. Examining the effects of past earthquakes and the recovery process of the economy of the affected regions after the earthquake would help policymakers make plans to ensure the country's resilience to disasters. In Türkiye, two even bigger earthquakes of magnitude 7.7 M_w and 7.6 M_w occurred in 6th February 2023 and 20th February 2023 in Kahramanmaraş (in fact, the biggest earthquakes in the history of Türkiye Republic), which should also be studied from many perspectives. However, since it occurred a very short time ago, there is not enough data to study after effects econometrically.

Studies on Policy Suggestions for before-Earthquake and after-Earthquake

Earthquakes cannot be predicted or prevented. Taking precautionary measures before the disaster and after an earthquake occurs to ensure quick recovery requires sound policies. There is a large interdisciplinary literature on the subject.

Dalziel and Saunders (2012) state that when assessing whether regional economic strategies need to be changed after the earthquake, two issues need to be considered: i) did the earthquake change the key strengths and opportunities that are the main drivers of economic development of the region?, ii) will short-term effects of the earthquake, including the transition path of adoption in the process, have long-term effects on the development of the region (hysteria effect)? (Dalziel and Saunders, 2012, 119)

The concept of vulnerability/resilient city emerges as an important concept in the formulation of policies before and after earthquakes.

Ergünay (2009) defines vulnerability as follows:

> It is defined as "the probable measure of damage or harm that a community, structure or service may suffer when danger occurs". In other words, vulnerability can also be defined as "the measure of physical, social, environmental or economic losses and damages that an element or group of elements exposed to danger (such as human, structure, life, socio-economic order) may experience in case of danger"... Mathematically; we can also express disaster risk as Risk = Danger x Assets x Vulnerability." (Ergunay, 2009, 5-6).

Vulnerability/resilient city concepts have come to the agenda of Türkiye and the world, especially in recent years.

> "In the "Making Cities Resilient: My City is Getting Ready" campaign, launched in 2010 by the United Nations International Strategy for Disaster Risk Reduction, the resilient city was defined as "a transparent local government with public contributing to planning, providing adequate infrastructure, have the ability to reduce disaster risks through planning, took steps to predict disaster and protect their assets, minimizing physical and social losses in extraordinary conditions, have the ability to self-regulate before, during and after a disaster, quickly repair basic services after disaster, and a system that can continue its social, institutional and economic activities" (quoted from UNISDR, 2010: 14; Hayrullahoğlu et al., 2018).

Weichselgartner (2001) says that vulnerability includes the ancient characteristics of society; these are mainly preparedness and preventive measures, post-disaster actions, and recovery capacity.

Hayashi (2012) used three variables as an indicator of vulnerability in his regression analysis: i) private capital stock and social capital per capita, ii) the proportion of the region's population aged 15 years and younger (assuming that recovery will be faster in regions with younger populations), iii) The ratio of post-disaster rescue and rehabilitation expenditures to public total investments in the region. The author also draws attention to the importance of the savings rate per household, the unemployment rate, the share of forest and flood control investments in total public investments, and population density.

The variables frequently used in the calculation of vulnerability to disasters in the vulnerability literature include population density, migration rate, average household size, public awareness, safety and health conditions, social equality, population below the poverty line, home ownership, average housing value, average rent, unemployment, female employment rate (Özceylan and Coşkun, 2012).

One of the main elements of a city to be a disaster-resistant city is to return the city to its normal life as quickly as possible after the disaster; for this, the infrastructure of the city should be prepared for disasters; damage to the infrastructure deepens the disaster damage experienced by the city and leads to the cessation of life in the city (Hayrullahoglu, Aliefendioğlu and Tanrıvermiş, 2018). Great importance should be given to the soundness of transportation networks before the earthquake, and the maintenance of main arteries, public transportation networks, bridges, and viaducts should be done periodically (Hayrullahoğlu et al., 2018). The city's drinking and utility water, sanitary installation, energy, communication, and transportation infrastructure should be sound, the buildings should be suitable for earthquakes, public buildings should be kept safe and able to serve in the event of an earthquake, as they will be used as assembly and service areas during and after the earthquake; special attention should be given to health and education structures, military structures and parks with large areas (Hayrullahoğlu et al., 2018).

Durukal and Erdik (2008) draw attention to the necessity of paying special attention to the dangers of the spread of substances harmful to human health, which may cause environmental pollution. The spread of chemicals and other harmful substances emitted from various production facilities after a disaster, out of control, can become another disaster by causing environmental pollution, fires, and damage to human health.

Hayrullahoglu et al. (2018) within the framework of the resilient city approach draw attention to the importance of the state's cooperation and harmony with non-governmental organizations, academia, the private sector, and the public; ensuring inter-institutional coordination, and clearly defining everyone's duty. Peker and Orhan (2020) emphasize that the inclusion of climate and earthquake components in local-scale urban planning as well as national and regional plans and policies has become a necessity.

OECD (2000) states that for safe houses there is a need for a well-established insurance system and for insurance premiums to be adjusted according to risk.

Padli, Habibullah, and Baharom (2010) display that the national income of the country has a significant impact on the economic effects of natural disasters; citizens of rich countries are better prepared for disasters; therefore, the impact of disasters is also smaller. Similarly, Felbermayr and Gröschl (2014) show that the negative effects of natural disasters on GDP are strong and state that poorer countries are more affected by geographical disasters.

Jalan (2022) argues that the growth effects can even be positive in the long run if restructuring after a natural disaster is done by establishing a better capital stock and adopting newer technologies. Hallegatte and

Dumas (2009) state that the "productivity effect" may occur due to the rapid loss of capital stock because of a natural disaster; technological change will not be able to turn a disaster into a positive event, but the quality of post-disaster reconstruction can reduce the cost of the disaster. Cuaresma, Hlouskova, and Obersteiner (2008) examine the long-term effects of replenishing the post-disaster capital stock and conclude that only developed countries can benefit from it. Cheng and Zang (2020) state that economically stronger countries suffer less from disasters and recover faster after disasters.

Peker and Orhan (2020) draw attention to the importance of the city's growth in harmony with its geography:

> The natural resources in the geography where the city is located should be determined as the thresholds of the carrying capacity and development boundaries of the city. In terms of climate crisis, protection of water and soil resources, and in terms of earthquake risk, defining the habitability limits in areas with suitable ground conditions gain importance… Creating air corridors in the city with open and green space systems, increasing water absorption surfaces, providing thermal comfort with microclimatic effect, constituting pharynx areas, increasing surface permeability is possible. On the other hand, these areas can take on roles such as creating assembly areas during an earthquake, gathering together in an emergency, distributing aid and ensuring the flow of information." (Peker and Orhan, 2020, 7).

Peker and Orhan (2020) propose the establishment and dissemination of renewable energy systems that can produce energy independently of the urban infrastructure network as a policy proposal that will increase the resilience of cities in the face of earthquake risks. This will enable the city to benefit from clean energy and will be able to respond to emergency energy needs immediately after the disaster, as it will be independent of power units that are interrupted in disaster situations.

Essentially, environmental policies and disaster management policies should go hand in hand. Policies for one area will often give support to the other. For example, creating green areas in the city, making bicycle paths, making clean energy investments, and avoiding narrow streets and high-rise apartments in the city will help alleviate environmental problems and reduce the damage caused by earthquakes (Peker and Orhan, 2020).

GRAVITY EQUATION FOR THE EXPORTS OF KOCAELI

Literature on Gravity Equations

In this study, panel data analysis for the exports of Kocaeli province, the epicenter of the 1999 Marmara Earthquake, on the basis of countries, between the years 1996-2021 is performed. The gravity model was used in the analyses.

Gravity models are inspired by Newton's universal gravitation law. The law says that the attraction between two masses is directly proportional to the weights of the masses and inversely proportional to the square of the distance between them. This has been applied to trade movements between countries; trade between two countries is expected to be directly proportional to the economic size of the countries (to represent the mass; measured usually by national income) and inversely correlated with the distance between the countries. The theory, which was first put forward by Tinbergen (1962) and Poyhonen (1963), has been widely used since then to measure the effects of trade flows and trade agreements between countries. Over time, the theoretical bases of the models were proven and the gravity equations were extended to include populations of each trading partner, tariffs, prices, institutional factors like economic freedom level and trade restrictiveness of the partners, dummy variables for the effects of geographical, cultural and institutional factors like common border, language or religion on trade. For a comprehensive review of the gravity literature, Head and Mayer (2013) can be seen.

Almost all of the gravity export models in the literature use the national income (or per capita income) of the two countries, their populations, the distance between them, and price indicators (real exchange rate, import/export unit prices, CPI, etc.) as independent variables of the export gravity regression (Westerlund and Wilhelmsson, 2011; Nardis, 2008; Rojid, 2006; Harb, 2007; Kien, 2009; Bhattacharya and Wolde, 2010; Abiad et al., 2011; Tumbarello, 2007; Bussiere et al., 2008; Ekanayake and Ledgerwood, 2009, Tamaş ve Miron, 2021). The difference in GDP per capita of the two countries (Trotignon, 2010, Saputra, 2019), trend and cyclical parts of GDP (Abiad et al., 2011), domestic demand (Abiad et al., 2011), relative GDPs of trading partners and relative factor densities (measured by the difference in national income per capita) (Egger, 2002; Zarzoso and Lehmann, 2003, McPherson and Trumbull, 2008) are among the other independent variables used. National incomes of both exporting and importing countries are positively affecting exports in

nearly all studies, as expected. Greater national income usually means greater production capacity and more variety of the goods produced (from the perspective of the exporting country) and greater purchasing power (from the perspective of the importing country) thus having a positive effect on exports.

Distance is expected to reduce foreign trade by increasing transportation costs. Since data on direct transportation costs are not generally available, distance is used as an approximate indicator in many studies. However, distance is not an adequate indicator as it does not take into account border trade between countries, difficulties arising from the country's transportation infrastructure or geographical shapes (mountains, access to seas, etc.), and bureaucratic costs related to transportation. Abiad et al. (2011) and Bhattacharya and Wolde (2010) defined a dummy variable that indicates whether a country is landlocked or not, and take into consideration the disadvantaged position of landlocked countries in terms of transportation. Zarzoso and Lehmann (2003) added the public infrastructure investments to the model by measuring them with the public capital stock and road network.

Endoh (1999) pioneered the approach of using dummy variables to see the trade creation and trade diversion effects of free trade agreements and trade blocks and then this approach also followed by many studies like Rojid (2006), Kien (2009), Tumbarello (2007), Bhattacharya and Wolde (2010), Horsewood and Voicu (2012), Soeng and Cuyvers (2018), Khati and Kim (2023), Islam et al. (2024).

Among the other dummy variables used to represent cultural, geographical, and political affinities between countries, the most frequently used ones are common language and common border (Abiad et al., 2011; Tumbarello, 2007; Rojid, 2006; Kien, 2009; Bhattacharya and Wolde, 2010; Bussiere. et al., 2008; Trotignon, 2010; Ekanayake and Ledgerwood, 2009, Kamel 2021, Tamaş & Miron, 2021, Islam et al. 2024). There are studies that include the common currency in the model as a dummy variable (Nardis et al., 2008; Abiad et al., 2011; Trotignon, 2010). These variables are expected to affect the trade between countries positively by decreasing social distances, easing communication, and doing business between the countries.

In gravity models economic crisis periods are also usually represented by dummy variables and their coefficients measure how much trade was affected by these crises (Kamel, 2021, Neyaptı et al. 2007, Akkemik and Göksal 2010). Kamel (2021) in her study examining trade relations among the Middle East North African countries by gravity model, defines a dummy variable taking the value of 1 for the Arab Spring period for affected countries in MENA, to account for the effects on trade of this political and social turbulence period. She also defines dummy variables for wars and conflict periods in the MENA region. Hadri, Mirza, Rabaud (2019) use gravity equation to estimate effect of disasters on exports of the countries, including in the equation variables indicating intensity of four types of disasters (floods, storms, earthquakes, extreme temperatures) experienced by various countries in various times. Dadakas and Tatsi (2021) explore the effect of global agricultural trade impact of the 2011 triple disaster in Japan (earthquake, tsunami, and nuclear accident in Fukushima) by employing a panel gravity model and defining dummy variables for the disaster periods.

In this study, with a similar approach, the earthquake was represented by using dummy variables. Earthquakes are also a kind of crisis to the production and export structure of the region; it is an unexpected adverse shock affecting factories, suppliers, and employees.

There are many studies examining Türkiye's export and import data with gravity models. Lehman, Herzer, Martinez-Zarzoso, and Vollmer (2007) make panel data analysis of sectoral exports from Türkiye to European Union countries between 1988-2002. Neyapti, Taşkın, Üngör (2007) estimated the import and export equations of Türkiye's 150 trading partner countries using panel data between 1980 and 2001. Adam and Moutos (2008) measured the effects of the Türkiye -EU Customs Union on both Türkiye and EU-15 countries in the gravity equation involving OECD countries. The data set covers the years 1988-2004. Akkemik and Göksal (2010) examined Türkiye's exports to 110 countries between the years 1990-2006. In addition to the classical gravity variables, the authors also added China's exports in each market as a variable to measure whether Türkiye's export markets were adversely affected by China's exports. Suvankulov and Güç (2012) examined the exports of China, Russia, Iran, India, and Türkiye to Central Asian countries with a panel data set containing 165 countries and the years 1996-2009. Bayar (2014) analyzed Türkiye's exports to developed countries and Middle East and North African countries between 1993 and 2012 with two separate panel data gravity models and analyzed both the differences between estimation methods and regions. Bilgin, Gözgör, and Demir (2018) analyze the determinants of exports of Türkiye to 43 member countries of the Islamic Development Bank for 1996 –

2015, using the panel gravity method. The authors also try to measure the effect of political risks, in addition to classical gravity variables. Akçay and Saygılı (2019), for 1996-2015 estimated the panel gravity model of Türkiye's exports and examined the effects of regional economic organizations on exports.

This is the first study in the literature using gravity model in analyzing the effects of a disaster in Türkiye.

Zero Problem and Estimation of Gravity Models

In the estimation of many gravity models, there is "zero problem"; that is presence of zero trade flows between some countries in some periods. Gravity equations are usually estimated in logarithmic form since in logarithmic form heteroscedasticity problem is decreased. Also, since estimated coefficients give elasticities; interpretation gets simpler. But the logarithm of zero is undefined; so, in gravity models where there exist zero trade flows, logarithmic transformation cannot be used. Some economists tried to deal with this problem by excluding zero trade flows or adding a very small number to zero observations or using a Tobit estimator but these methods can cause biases in estimations since usually "zero observations" are not distributed randomly. They usually correlate with dependent and explanatory variables of the gravity model, for example, national income, distance, or various types of trade costs. Moreover, as Silva Santos and Tenreyro (2006) indicated, even in the case of the non-existence of "zero observations", if the gravity model was estimated in logarithmic form, the dependent variable estimated is not the trade, it is the logarithm of trade; because as Jensen's inequality says (E(lny)≠ln E(y)), estimation becomes biased. Also, even without any zeros in the data, the OLS estimator of the model in logarithmic form is inconsistent since the error term's logarithm will depend on the data's higher moments, like the variance of it and if heteroscedasticity exists, the explanatory variables and the expected value of the error (in logarithm) can be correlated (Silva Santos and Tenreyro 2006). To account for these problems, various estimation methods were developed (For a survey of the methods used, see Bacchetta et al. 2012, Shepherd 2016, Bayar 2018).

Heckman (1979) is the leading study on the problem. Heckman (1979) emphasizes "sample selection bias"; when a sample is selected if there are omitted observations if they are non-random and if they are correlated with the error term or the regressors; estimations must account for this correlation, otherwise, coefficients will be biased. If zero observations were simply removed from the data, an important variable of "the probability to be included in the sample" (that is, in a gravity model, the probability that there is positive trade relation between the countries), is omitted and this causes omitted variable bias. In a gravity model, if zero observations were omitted, the dependent variable ceases to be "bilateral trade"; it becomes "bilateral trade given that a trade relationship exists". Heckman (1979) suggested a two-equation estimation model as a solution to these problems. In the first equation, the probit model of being included in the sample (in gravity models probability of having a positive trade relation) was estimated. After that, probabilities estimated from this equation were used as independent variable in the main equation (in gravity, trade equation) thus probability of being included in the sample is accounted for and omitted variable bias was prevented. Those two equations can be estimated simultaneously employing maximum likelihood methods or a two-step estimation procedure can be used.

Silva Santos and ve Tenreyro (2006) show that if the model is estimated in multiplicative form, it is possible that both zero observations can be included and biases are avoided. Since data is in multiplicative form, non-linear estimation techniques need to be used. Authors show that the use of Poisson Pseudo Maximum Likelihood gives the best unbiased results; even if there is heteroscedasticity and even if data is not Poisson distributed. Also, the inclusion of importer and exporter fixed effects is possible in this method. Another benefit of the Poisson Pseudo Maximum Likelihood method is that although in the Poisson regression, the dependent variable is specified in its levels (instead of in logarithms, due to the existence of zero observations in gravity models), coefficients of the independent variables entering into the equation in logarithms can still be interpreted as elasticities (Shepherd 2016). Silva Santos and ve Tenreyro (2009) also wrote the code of PPML estimator for the econometrics package Stata (name of the command is ppml) in an effort to handle convergence problems appearing in the Poisson estimation (if the regressand variable has many zeros, has too large values, or if the independent variables have different scales, include many dummy variables or there is high collinearity among them).

Shepherd (2016) makes a comparison between Poisson and Heckman estimation methods. Poisson method deals effectively with heteroscedasticity but the Heckman model cannot. Fixed effects Poisson models have desirable statistical properties while in the Heckman model fixed effects cause incidental parameters problems, thus bias and inconsistency, in the

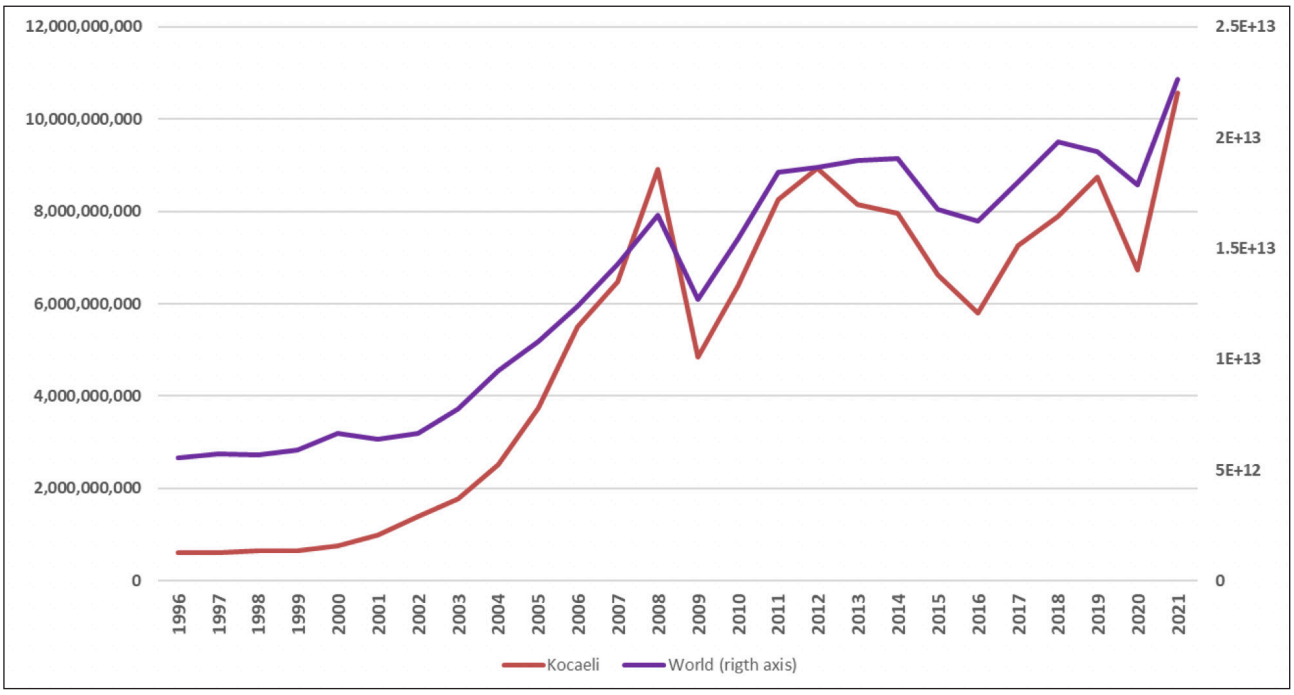

Figure 1: Kocaeli's Exports and World Imports
Source: TURKSTAT and World Trade Organization

probit selection equation. Although Heckman's model allows for a separate data generating process for non-zero and zero observations, Poisson's assumption is that all data are drawn from the same observation (Shepherd, 2016). Heckman model retains another advantage of including in the model explicitly the information the zero observations have. Overall, Shepherd (2016) concludes that in gravity models, Poisson is more commonly used as a workhorse estimator; mostly since even under relatively weak assumptions it produces consistent estimates, deals effectively with heteroscedasticity, consistent in the existence of fixed effects (which may be included in the form of dummy variables), includes zero observations naturally and without any additions to the basic model.

In this article also PPML model is used to estimate the gravity equation of exports of Kocaeli City. Estimations were done also using fixed effects and random effects OLS, Hausmann-Taylor, and Heckman models but the main results do not differ much[1].

Data

Kocaeli's exports increased from 616.7 million dollars in 1996 to 12.5 billion dollars in 2022. Figure 1 shows Kocaeli's exports (current dollars) and world imports (second axis, current million dollars). The export of the province shows an increasing trend above the rate of increase of world imports. During the crisis years of world trade, the export of the city is also decreasing. While the share of Kocaeli in world imports was around 0.01% in 1996, it increased to 0.047% in 2022. From the visual inspection of Figure 1, it is seen that the exports of the province continued to increase from 1999 to 2000, and even increased the rate of increase in the following years post-earthquake.

Figure 2 shows the shares of the top 10 countries which Kocaeli exports the most. The Netherlands has the highest share of Kocaeli's exports with 12.7%. It is followed by the Republic of South Africa with a share of 11.1% and the USA with a share of 10%.

The panel gravity model of Kocaeli city was estimated using export data of Kocaeli to 163 countries whose statistics are available between 1996-2021. Yearly data were used due to data availability problems. One of the most important variables of gravity analysis is the national income of trade partners and national income data is not available for many countries at higher frequency than annual (quarterly or monthly). Also, the reason for not going to years before 1996 is due to data availability reasons; difficulty of obtaining a consistent time series of the variables before 1996 for many countries. However, these data limitations do not affect the main purposes of the analyses adversely, 26 years and 163 cross-sections give enough degrees of freedom for reliable analysis.

[1] Results can be requested from the author.

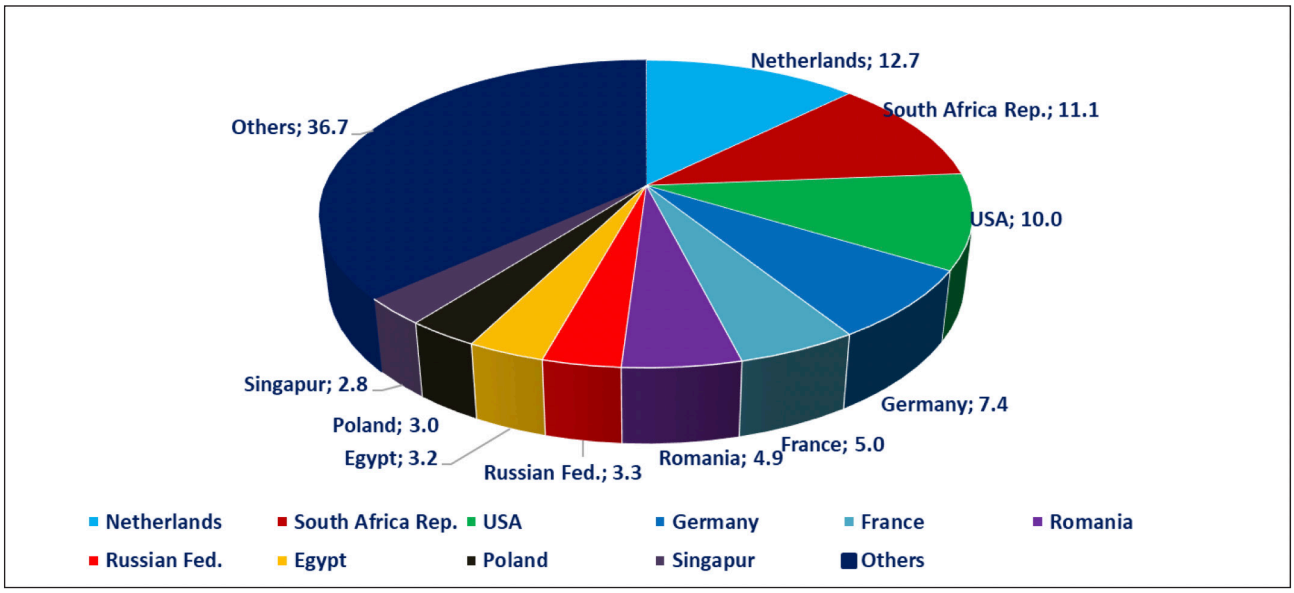

Figure 2: First 10 Countries in Exports of Kocaeli (2022)

Source : TURKSTAT

$$\text{RealExp}_{\text{it}} = \beta_0 + \beta_1 \text{lnGDP\_TradePartner}_{\text{it}} + \beta_2 \text{lnDistance}_{\text{it}}$$
$$\beta_3 \text{lnKocaeliRGDP}_{\text{it}} + \beta_4 \text{Dummy\_CU}_{\text{it}} + \beta_5 \text{Dummy\_Border}_i$$
$$\beta_6 \text{Dummy\_FTA}_{\text{it}} + \beta_7 \text{lnTR\_Rexch}_t + \beta_8 \text{DummyEQ}_i + \beta_9 \text{Trend}_t$$

RealExp is exports of Kocaeli in current dollar value, deflated by the export unit price index; taken from TURKSTAT (Turkish Statistical Institute). lnGDP_TradePartner is the real GDP of trade partners of Kocaeli (in constant 2015 dollars) and taken from the World Bank database; in logarithmic form. Ln_distance is the log of distance; taken from CEPII, Mayer, and Zignano (2011); calculated using longitudes and latitudes of the most important cities/agglomerations (population-wise) of the countries. In Türkiye this city is İstanbul. Since İstanbul is very near to Kocaeli city, this works as a good proxy for the distance between Kocaeli and its trade partners. As an indicator of the level of economic activity in the City, the real GDP of the city was included; again TURKSTAT data. Türkiye entered into customs union (CU) with EU countries in 1996; so, in the regression, a dummy variable showing whether the trade partner is a customs union member or not was included to see whether Kocaeli exports more to CU member countries. Türkiye has several free trade agreements and so a dummy variable for FTA was included to represent these. A list of countries and entering into force dates of FTAs were obtained from the Türkiye Ministry of Trade web page.

In Türkiye exports have an increasing trend; so, a trend variable was also included to account for it. Border dummies were defined for neighbors of Türkiye (Syria, Iran, Iraq, Azerbaijan, Georgia, Bulgaria, and Greece) to see whether Kocaeli has more intense trade relationships with border neighbors of Türkiye. The real exchange rate of Türkiye is from calculations of the Türkiye Republic Central Bank. Real exchange rate calculations of the Central Bank are based on trade shares of 36 countries comprising 80% Türkiye's total trade in the period 2006-2008. The series takes 2003 as the base year. The rise in the series of real exchange rates shows the appreciation of the Turkish lira. CU dummy is later eliminated from the regression since its coefficient is statistically insignificant. To check for the effects of the 1999 Marmara Earthquake a dummy variable taking values of 0 up to 1999 and 1 beginning from 2000 was defined (DummyEQ).

Gravity Regression Results

The resulting PPML estimation of the equation is given in Table 1:

Coefficients of the variables in logarithms are interpreted as elasticities as mentioned before. Thus, results show that as the GDP of the city increases by 1%, exports of the city increase by 0.71%. The GDP of trade partners is also another important factor in exports of the city, as expected. As the GDP of trade partners increases by 1%, exports of the city increase by 0.65%. Again in line with the expectations, Kocaeli exports less to more distant countries; as distance increases by 1%, Kocaeli's exports decrease by around the same percentage. Kocaeli exports more to border neighbors of Türkiye and to the countries that have free trade agreements with Türkiye. The positive trend of exports is seen from the significantly positive coefficient of the trend variable.

Table 1: PPML Estimation Results

Number of Observations: 3874						
Pseudo log-likelihood: -6.501e+08						
R-squared: .44466965						
Vari.	***Coeff.***	***Robust St. Err.***	***z***	***P>|z|***	***[95% Confidence- Interval]***	
ln_GDP_TradePartner	0.653	0.025	25.76	0.000	0.604	0.701
ln_Distance	-1.018	0.040	-25.24	0.000	-1.097	-0.939
ln_KocaeliGDP	0.714	0.401	1.78	0.075	-0.072	1.492
Dummy_Border	0.385	0.123	3.12	0.002	0.143	0.626
Dummy_FTA	0.462	0.185	2.49	0.013	0.098	0.825
ln_TR_Rexch	1.794	0.436	4.12	0.000	0.940	2.649
Dummy_EQ	0.577	0.167	3.46	0.001	0.250	0.904
Trend	0.0492	0.020	2.43	0.015	0.005	0.089
Constant	-19.860	8.630	-2.3	0.021	-36.774	-2.946

The coefficient of the earthquake dummy is surprisingly positive and significant. Indicating that the City recovered very quickly after the earthquake and in time even increased its export performance. The real exchange rate's coefficient is also significantly positive; meaning that when there is appreciation in the real exchange rate, exports of the city increase. This can be thought of as counter-intuitive but this is in line with what is observed in Türkiye's total exports also.

Even though studies examining exports of Türkiye covering the period up to the onset of the 2000s frequently find a negative relationship between appreciation of the real exchange rate and Turkish exports, the research covering the period after the 2000s detect either no relationship or even some find a positive relationship (for references of these studies see; Bayar, Ünal, and Tokpunar (2015)). This is largely due to that Türkiye transformed its production and export structure significantly from low technology, low value-added sectors like textile and garments to medium technology sectors of automotive and machinery. This process caused prices to cease to be the main source of competition, rather quality, design, and after-sales services became the main competitive advantage of Türkiye. Thus, the importance of the real exchange rate decreased to a great extent.

SECTORAL PANEL DATA ANALYSIS

Data and Methodology

The first regression aimed to observe country dynamics of exports of Kocaeli. Another important dimension of the exports of the City is its sectoral composition. To observe the sectoral dynamics behind Kocaeli's export performance, in this section the sectoral panel equation was estimated. Exports of the sectors constitute cross sections and 1996-2021 period constitutes the time series (in years). When a disaster occurs, usually different sectors are affected in divergent ways and to different degrees. Sectoral panel data analysis enables one to see how each sectors was affected in which ways and to which degree. This in turns facilitates policy makes in formulation policies according to distinct needs of the sectors.

For the sector classification, the classification system of the World Trade Organization (WTO) was used. WTO forms the main sectors by aggregating on the basis of SITC Rev3.; i) Food, ii) Agricultural Raw Materials, iii) Mining Products, iv) Iron and steel, v) Chemicals, vi) Office and telecommunication equipment, vii) Automotive products, viii) Textiles, ix) Clothing[2].

Regression equation can be represented as:

$$\ln\mathrm{Exp}_{\mathrm{it}} = \beta_0 + \beta_1 \ln\_\,\mathrm{WImp}_{\mathrm{it}} + \beta_3 \ln\mathrm{KocaeliRGDP}_t$$

$$\beta_4 \ln\_\mathrm{TR\_Rexch}_t + \beta_5 \ln\_\mathrm{TR\_ExpPrice}_t + \beta_7 \mathrm{DummyEQ}_i$$

The export variable (lnExp) is the dollar value of Kocaeli's exports on the basis of years and sectors, and it is TURKSTAT data. Wimp is world imports in each sector in current dollars; taken from World Trade Organization statistics. The real GDP of Kocaeli province is TURKSTAT data. DummyEQ variable is a dummy taking a zero value up to and including the earthquake year 1999 and

[2] SITC equivalent of each sector can be obtained from the author.

taking the value of 1 beginning from the year 2000 and afterward up to the year 2021.

Since there are no zero observations, thus no "zero problem" in the sector equation, all variables are included in the equation in logarithmic form and the coefficients indicate the elasticities. In the estimation, one of the second-generation panel estimation techniques, the Augmented Mean Group method, which takes into consideration the cross-section dependencies and parameter differences between the cross sections was used.

Panels are composed of both cross-sections and time series; so time series characteristics of the system need to be taken into consideration. If the variables entering the equation are not stationary, the existence of the cointegration among the variables should be searched for as in time series analysis. Otherwise, a "spurious regression" problem can occur.

In testing stationarity characteristics of the series, in early times, first-generation unit root tests were formulated and the presence of cointegrating relationships among the variables entering the regression was searched using again first generation cointegration tests.

First-generation unit root tests and cointegration tests do not take into consideration cross-sectional dependencies and parameter heterogeneities. However, in most panels considerable dependencies among cross-sections exist. For example in a panel estimation of sectoral production in years, sectors will be affected by events common to them (perhaps to differing degrees) like problems in the domestic economy or conditions in world markets. All these create dependencies between cross-sections and if not accounted for, will cause biased estimation. Similarly, in most panels, coefficients will be different for each cross section and an estimation method forcing for all cross sections a single coefficient will cause bias.

To deal with cross-sectional dependencies and parameter heterogeneities, second-generation tests of panel unit root and second-generation tests of cointegration were developed. Also, second-generation panel estimation models accounting for parameter heterogeneities and cross-sectional dependencies were formulated. Refer to Eberhardt (2009) for a comprehensive panel estimation methods review and related references in historical order.

Here, the existence of cross-sectional dependencies in the model was tested by the cross-section dependence (CD) test formulated by Pesaran (2004). The test is based on the mean of pairwise correlation coefficients of ordinary least squares residuals of separate cross-sectional regressions. The null hypothesis is "cross sections are independent". The test was shown to have desirable properties even in small N and small T samples and give good results even in cases where residuals are not distributed normally and some of the variables are not strictly exogenous but weakly exogenous.

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\widehat{\rho_{ij}}\right)\widetilde{asy}N\left(0,1\right) \text{ where i, j=1,2,…..,N} \quad (1)$$

Where $\hat{\rho}_{ij}$ is the sample estimate of pair-wise correlations of the residuals obtained from OLS.

Test results given in Table 2 indicate the presence of cross-sectional dependencies in both cross-sectionally and time-variant variables, exports of Kocaeli, and world imports for each sector. So, second-generation tests of unit root and second-generation tests of cointegration and second generation estimation methods were used.

Table 2: Cross Sectional Dependency Tests

	lnExp	***lnWexp***
Pesaran (2004) CD Test Stat.	2.355	22.26
P-value	0.009	0.000

To test unit root in variables that vary in both cross sections and time, that is sectoral exports of Kocaeli (lnExp) and world imports in each sector (lnWexp), a simple, intuitive and commonly used test was employed, Cross-Sectionally Augmented Dickey-Fuller test (CADF) of Peseran (2007). The test also has the advantage that it has desirable properties even in small samples and where N and T are close to each other (Peseran, 2007). Peseran (2007) estimated the model in equation (2) for each cross-section:

$$\Delta y_{it} = a_i + b_i y_{i,t-1} + c_i \overline{y_{t-1}} + d_i \Delta \overline{y_t} + e_{it} \quad (2)$$

The test's null hypothesis is non-stationarity, $H_0=b_i=0$. If the null hypothesis was rejected, this means that there is no unit root, and the series is stationary. The test accounts for cross-sectional dependencies by including in the estimation differences and lagged values of cross-sectional averages at each period. Parameter heterogeneities also were taken into account by estimating the equation for every cross-section separately. Then, for the panel as a whole, the tests were obtained by averaging t-statistics from estimating every cross-sectional regression:

$$CIPS\Big(N,T\Big) = t - bar = N^{-1}\sum_{i=1}^{N} t_i(N,T) \quad (3)$$

Where $t_i(N,T)$ is the t-ratio of the coefficient of $y_{i,t-1}$ from the estimation of equation (2) for cross-section i.

The results of the CIPS test are given in Table 3. Test results show that both variables are stationary at the first difference, integrated to order one, I(1) series (lnExp is significant at 5% level, lnWexp significant between 5%-10% level).

In the regression equation estimated, there is one variable that is cross sectionally invariant; the real GDP of Kocaeli, so stationarity properties of this variable were tested using time series stationarity tests. To test the stationarity characteristics of the series, the Ng-Perron test (Ng and Perron, 2001) was employed. The test shows that the GDP of Kocaeli is stationary in the first difference, I(1) variable (Table 4).

To test for whether a cointegration relationship exists among the variables, a second-generation test of cointegration that takes into consideration cross-sectional dependendencies and heterogeneities in the parameters was used; Westerlund's (2008) Durbin-Hausman cointegration test. Moreover, the test has the advantage that it can be used even if the variables are integrated to different orders. At the first stage of calculation of the test, the first candidate cointegration relation was estimated and the residuals were obtained. Afterward, common factors were decomposed using principal components methods (to deal with cross-sectional dependencies). Then, the remaining error terms (after eliminating the common factors) were tested for stationarity. If the error terms were found to be stationary, this indicates that there is a cointegration relationship among the variables.

Westerlund offers two tests; namely, Durbin-Hausman panel and Durbin-Hausman group tests. The null hypothesis in both tests is "no cointegration". Durbin-Hausman panel test, examines the whole panel for the existence of the cointegrating relationship, assuming that the autoregressive parameter is the same for all sectors; thus, rejecting the null hypothesis means that there is a cointegrating relationship among the variables for the panel as a whole. On the other hand, the Durbin-Hausman group test permits different coefficients among sectors. The null hypothesis is again "cointegration does not exist". The alternative is the existence of a cointegration relationship in one or more of the cross sections. Thus, rejecting the null hypothesis indicates that there is a

Table 3: CIPS Unit Root Tests

	lnExp	**d_lnExp**	**lnWexp**	**d_lnWexp**
Pesaran (2007) CIPS Test Stat.	-2.1352	-3.9085	-1.7492	-3.2943
Critical Value at 5%*	-3.36	-3.36	-3.36	-3.36
Critical Value at 10%*	-2.97	-2.97	-2.97	-2.97

*for N=10 ve T=30 (model with intercept)

Table 4: Ng-Perron Tests

ln_KocaeliRGDP		MZa	MZt	MSB	MPT
Ng-Perron test stat.		0.65626	0.33189	0.50574	21.523
Asymptotic critical values*:	1%	-13.8	-2.58	0.174	1.78
	5%	-8.1	-1.98	0.233	3.17
	10%	-5.7	-1.62	0.275	4.45
d(ln_KocaeliRGDP)		***MZa***	***MZt***	***MSB***	***MPT***
Ng-Perron test stat.		-10.278	-2.2031	0.21435	2.62455
Asymptotic critical values*:	1%	-13.8	-2.58	0.174	1.78
	5%	-8.1	-1.98	0.233	3.17
	10%	-5.7	-1.62	0.275	4.45

cointegration relationship in at least one of the cross sections. Table 4 shows Durbin-Hausman cointegration test results between lnExp, lnWexp, and lnRGDP. Durbin-Hausman panel test rejects "no cointegration" null hypothesis at less than 1% level. Durbin-Hausman group test cannot reject the "no cointegration" null hypothesis at the 10% level, but the test statistic is very near to the critical value at the 10% level.

Table-5: Durbin-Hausman Panel Cointegration Test

Durbin-Hausman Panel Test Stat.	2.837
Durbin-Hausman Group Test Stat.	1.221
Critical Values: 10%=1.28---5%=1.645---1%=2.333	

The Durbin-Hausman cointegration test gives the best results when we exclude other variables, real exchange rate, export prices, and the dummy for the earthquake. In fact, also when we do AMG regression, the coefficients of these variables turn out to be statistically insignificant. So, the model below was estimated:

$$lnExp_{it} = \beta_0 + \beta_1 lnWimp_{it} + \beta_2 lnKocaeliRGDP_t$$

To estimate the model, again a second-generation estimation methodology was used; which takes into consideration parameter heterogeneities and cross-sectional dependencies. The augmented mean group model was first formulated by Eberhardt and Bond (2009) and then improved by Eberhardt and Teal (2011). The method also has the advantage that variables having different integration degrees can be estimated in the same model. The model was represented as:

$$\begin{aligned} &y_{it} = \beta_i' x_{it} + u_{it} \quad u_{it} = \alpha_i + \lambda_i' f_t + \varepsilon_{it} \\ &x_{mit} = \pi_{mi} + \delta'_{mi} g_{mt} + \rho_{1mi} f_{1mt} + \ldots + \rho_{nmi} f_{nmt} + v_{mit} \\ &m = 1, \ldots k \quad and \quad f_{.mt} \subset f_t \\ &f_t = \phi' f_{t-1} + \varepsilon_t \quad and \quad g_t = \kappa' g_{t-1} + \varepsilon_t \end{aligned} \tag{4}$$

Here, x_{it} represents the vector of the observed variables. f_t represents factors affecting all cross sections. Sector-specific factor loadings are represented by λ_i and enable us to take into account common factors affecting different cross sections in different ways. The second equation is estimated to account for unobservables f_t and g_t on observed variables. In this way, the authors include dependencies between cross-sections in both unobservable and observable variables.

Eberhardt and Bond (2009) and Eberhardt and Teal (2011) estimate the model in two stages:

$$\begin{aligned} &\Delta y_{it} = b' \Delta x_{it} + \textstyle\sum_{t=2}^{T} c_t \Delta D_t + e_{it} \\ &\Rightarrow \hat{c}_t = \hat{\mu}_t^{\bullet} \end{aligned} \tag{5}$$

In the first phase, the model is estimated in first differences. Also, time dummies were included in the first differences. The main motivation behind estimating the model is preventing non-stationary variables and unobservable variables from biasing the results. Then, the second stage regression was estimated; in this regression time dummies' coefficients obtained from the first stage regression were employed among independent variables. Second-stage regression was also formulated such that parameter heterogeneity between the cross-sections was allowed. Afterward, the coefficients of the panel as a whole were obtained by averaging each cross-section's coefficients (Eberhardt and Bond, 2009; Eberhardt and Teal, 2011).

$$\begin{aligned} &y_{it} = a_i + b_i' x_{it} + c_i t + d_i \hat{\mu}_t^{\bullet} + e_{it} \\ &\hat{b}_{AMG} = N^{-1} \sum_i \hat{b}_i \end{aligned} \tag{6}$$

Regression Results

Earthquake dummy variable, real exchange rates, export price index, and coefficients were excluded from the equation as they were statistically insignificant. The panel equation on the basis of sectors also confirms our observation that the exports of the city of Kocaeli were not adversely affected by the earthquake. Again, it is seen that exchange rate and price variables do not have an important role in the exports of the city.

In the AMG equation, the coefficient of world imports from the average coefficients is positive and insignificant (table 6). However, the variable was not excluded from the equation since the cointegration test Westerlund (2008) indicates that there is a cointegration relationship and the coefficient of the Wimp variable is statistically significant in some sectors. Since the Augmented Mean Group method also estimates the sectoral coefficients separately, it allows us to comment on how the exports of the sectors are affected by the world imports in that sector and the GDP of the City and the differences between sectoral effects.

Table 7 shows the coefficients and p-values of ln_Wipm and ln_KocaeliRGDP for each cross-section. World imports are a positive and significant factor affecting sectoral exports of Kocaeli in 5 sectors; the highest coefficient is in chemicals, with an elasticity of 1.6%. As world chemicals imports increase by 1%, Kocaeli's chemicals exports increase by 1.6%. Similarly, the automotive sector has also had good performance; as world automotive imports increase by 1%, Kocaeli's automotive exports increase by

Table 6: Regression Results

Number of Observations: 234 Wald chi2(2) = 58.02 Prob > chi2 = 0.0000						
Variable	***Coefficient***	***Standard. Error***	***z***	***P>|z|***	***[95% Confidence- Interval]***	
ln_Wimp	0.312	0.397	0.79	0.431	-0.466	1.090
ln_KocaeliRGDP	2.325	0.573	4.06	0.000	1.201	3.448
__00000R_c	1.1425	0.340	3.36	0.001	0.471	1.809
Constant	-33.777	8.224	-4.11	0.000	-49.893	-17.659
Variable __00000R_c refers to the common dynamic process. Root Mean Squared Error (sigma): 0.4236						

Table 7: Coefficients of ln_Wipm and ln_KocaeliRGDP in Individual Sector Regressions

	ln_Wimp	***P-value***	***ln_KocaeliRGDP***	***P-value***
Food	1.206	0.034	0.485	0.546
Agricultural Raw Mat.	-0.525	0.683	2.383	0.068
Mining Products	0.950	0.000	0.937	0.014
Iron and Steel	-0.714	0.229	4.485	0.000
Chemicals	1.604	0.000	0.945	0.046
Office and telecom equip.	-0.962	0.472	5.233	0.002
Automotive	1.377	0.105	2.633	0.005
Textiles	1.293	0.070	0.711	0.260
Clothing	-1.419	0.247	3.108	0.028

1.38% (at a 10% significance level). Thus, Kocaeli increases its share in world markets in these sectors in response to market expansion. Similarly, the textiles sector's response to a 1% increase in world textile imports is 1.29% and the food sector's response to a 1% increase in world food imports is 1.2%; both sectors increase their exports more than an increase in world imports in their respective sectors; which means Kocaeli can increase its share in world markets in these sectors also. The mining sector has elasticity near to 1, a 1% increase in world chemicals imports increases Kocaeli's mining exports by 0.95%; that is, the city can more or less protect its market share. In other sectors, the coefficients of world imports are not significant.

Kocaeli's real GDP, as a supply-side determinant of exports, turns out to be a significant factor affecting sectoral exports of the city, in all sectors except the food and textiles sectors. Coefficients of the variable can be ranked from highest to lowest as; office and telecommunication equipment, iron and steel, clothing, automotive, agricultural raw materials, chemicals, and mining products. In all these sectors, except chemicals and mining products, elasticities are above 1, suggesting that, as Kocaeli city's real GDP increases by 1 percent, exports of these sectors increase more than in proportion.

EVALUATION AND DISCUSSIONS

Türkiye is an earthquake country. Protecting from the harmful effects of earthquakes, taking the necessary precautions before the earthquake, eliminating the damage after the earthquake, and returning to economic life quickly are the issues that should be given great importance for Türkiye.

In this study, the literature about the economic effects of earthquakes is summarized and the effects of the 1999 Marmara earthquake, which is one of the biggest earthquakes in Türkiye history, on the exports of Kocaeli province, which is the epicenter, were examined with the panel gravity model and sectoral panel model.

The model results show that the GDP of the trading partner, which is one of the classical gravity variables, and the GDP of Türkiye, which is also among the classical gravity variables, are the variables that affect bilateral exports of Kocaeli positively. In line with the research in the literature, distance affects exports of the City negatively. Again in line with the expectations of gravity models, Kocaeli exports more to Turkey's border neighbors and countries having Free Trade Agreements with Türkiye. It is observed that after the 1999 Marmara earthquake, the exports of the City recovered rapidly and even improved its former performance in the following years.

Results of sectoral panel analysis show that real GDP of Kocaeli and the world imports (in some sectors) are the most important factors affecting sectoral exports of the City. In line with panel gravity results, it seems that the earthquake did not affect the export performance of the City negatively. In 5 of 9 sectors examined, the City increases its share in world markets in response to the widening World market in these sectors.

Many factors could have contributed to this quick recovery from the devastating earthquake; which should be explored in detail in further studies. Our initial observations suggests that one of the important reasons may be that there was great solidarity from the whole nation, from every region of Türkiye to help the disaster region. Kolukırık and Tuna (2009) reviewed newspapers of that days and put light on the economic and social environment after the disaster. There are many news about how big cooperation and solidarity experienced in the region, both by the inhabitants of the region and volunteers from all regions of Türkiye. This should have big impact on the quick recovery of the region. As OECD (2020) mentions, SMEs in the region provided shelter, health support, etc. to their employees in order not to lose their qualified personnel. Also, increased government expenditures to the region may have helped quick recovery. In the second part of 1999 1.4 billion dollars were expended for the region (0.8% of GNP) from government budget, and in 2000 budgetary expenditures to the region increased and appeared at 1.2 billion dollars (Aktürk and Albeni, 2002).

As mentioned in literature survey part, Dalziel and Saunders (2012) state the two dimensions to evaluate for policy formulation : did the earthquake change the key strengths and opportunities that are the main drivers of economic development of the region and will short-term effects of the earthquake, including the transition path of adoption in the process, have long-term effects on the development of the region (hysteria effect)? (Dalziel and Saunders, 2012, 119). In the these dimensions findings of this study makes us to think that earthquake did not change main strengths, opportunities and drivers of economic development as we observe from increasing export performance of the City and adverse effects of the disaster did not persit in the long term. In fact, at that time the region had a strong industrial base and high income level; and this was not changed even in the short-term; suggesting that the vulnerability of the region is low.

CONCLUDING REMARKS

As an important extention area of this study, causes of resilience and quick recovery of Kocaeli from the devastating earthquake should be analysed. Searching for strengths of the City that enabled it to recover quickly from a big disaster contain information that can be helpful for both Türkiye and other countries in being prepared for the disasters and in recovering from it quickly whenever it occurs.

As another expansion area of the study, the reasons behind the export performance of Kocaeli province can be examined with micro data on firm basis. Due to the fact that firm-based data are more accessible, especially in recent years, and the important role of microanalysis in revealing the dynamics behind macroeconomic results, microanalysis become widespread in the literature recently. How producers and exporters in Kocaeli coped with the consequences of the earthquake and even increased export performance in the following years can be an example for firms in other cities of Türkiye and other countries affected by earthquakes.

Türkiye experienced two even bigger earthquakes in 6th February 2023 and 20th February 2023. Epicenter of the first was Pazarcık district of Kahramanmaraş City and magnitude was 7.7 M_w. The second had center in Elbistan district of Kahramanmaraş and magnitude was 7.6 M_w Due to this disaster 48, 448 people died, 3.3 million people have been displaced; it cost Turkish economy around 103,6 billion dollars or, around 9% of GDP of Türkiye (SBB, 2023). From the disaster 11 provinces and more than 14 million people were affected (SBB, 2023). Further studies should focus on this disaster and ways to quick rehabilitation of the 11 provinces adversely affected from the event. Experiences of Kocaeli earthquake can provide useful information for the policies aiming quick recovery of the business activity in the region.

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