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Factors Affecting Bank Profitability in Türkiye

Türkiye'de Banka Karlılığını Etkileyen Faktörler

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ABSTRACT

The purpose of this study is to examine the factors affecting commercial bank profitability in Türkiye using panel data analysis for the period 2012-2023. In this framework, there are 240 observations of 20 deposit banks in the analysis. Return on assets (ROA) and return on equity (ROE) are used as an indicator of profitability and dependent variables. The results of the analysis show that bank-specific determinants such as bank size, equity size and non-performing loans play a significant impact on bank profitability. The only macroeconomic factors affecting bank performance is the inflation. Bank size, equity size and inflation play significant and positive role in explaining bank profits, while the effect of non-performing loans is negative. It means that the high profitability of Turkish banks is generally associated with well-capitalized banks with high lending capacity and low credit risk with effective cost management is important for the banking system. Finally, the estimated effect of external variables except inflation did not support the significant effect on bank performance.

Anahtar Kelimeler:
Banka Karlılığı,
Ticari Bankalar,
Panel Veri Analizi

Jel Kodları:
C23, E44, O16

ÖZET

Bu çalışmanın amacı, Türkiye'deki ticari banka kârlılığını etkileyen faktörleri 2012-2023 dönemi için panel veri analizi kullanarak incelemektir. Bu çerçevede analizde 20 mevduat bankasına ait 240 gözlem yer almaktadır. Kârlılığın ve bağımlı değişkenlerin göstergesi olarak aktif kârlılığı (ROA) ve özsermaye kârlılığı (ROE) kullanılmaktadır. Banka büyüklüğü, özsermaye büyüklüğü ve takipteki krediler gibi bankaya özgü belirleyiciler banka karlılığı üzerinde önemli bir etkiye sahiptir. The only macroeconomic factors affecting bank performance is the inflation. Banka büyüklüğü, özsermaye büyüklüğü ve enflasyon değişimi banka karlarını açıklamada anlamlı ve pozitif rol oynarken, takipteki kredilerin etkisi ise negatif yöndedir. Bu durum Türk bankalarının yüksek kârlılığının genel olarak iyi sermayeli, yüksek kredi verme kapasitesine sahip bankalarla ilişkilendirildiği ve etkin maliyet yönetimi ile düşük kredi riskinin bankacılık sistemi açısından önemli olduğu anlamını taşır. Son olarak enflasyon dışındaki dışsal değişkenlerin banka performansı üzerinde tahmini etkisi anlamlı düzeyde değildir.

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1. INTRODUCTION

All transactions involving money require trust. A certain level of profitability is important for the healthy operation of the banking system and effective real sector financing. Additionally, they affect the distribution of capital, private firms' operations expansion, industrial, and economic growth. According to the BRSA report (Banking Regulation and Supervision Agency), the share of banks' assets in the financial sector is 82.6 percent (BRSA, 2023: 13). Hence, the smooth operating of the banking system is necessary not only for its operational profitability, but also for the well functioning of the economy. Therefore, identifying the factors that affect bank profitability in terms of macroeconomic, bank-specific and industry-specific factors has received great attention in the literature.

The increase in global (the economic problems experienced after the Russia-Ukraine war and the Covid-19 epidemic) and national risks (especially the Kahramanmaraş-centered earthquake and others), the structural transformations brought about by digitalization, and the increased risks as a result of the phenomenon of sustainability affect the functioning of the banking sector and the credit market.

Actually, the Turkish banking sector has increased credit risk in banks due to negative macroeconomic balances. It faces serious problems such as high exchange rate, interest rate, inflation rate, liquidity risks and moral hazard problems. The increase in interest rates, the depreciation of the Turkish Lira and the economic contraction negatively affect the profitability of banks. It emphasized that financial crises have some effects on the determinants of banks' profitability. At least it is clear that it affects the lending behavior of banks.

On the other hand, technological innovations, digitization, and artificial intelligence have continued to influence the change in banking practices. In summary, it is necessary for monitoring the financial situation and risks of the banking sector and the compliance of its activities with the legal legislation, and to analyze all this together with macroeconomic developments and applied policies.

Determining internal and external factors affecting bank performance in both crisis and normal market conditions has received and continues to get attention in the financial literature. Because, understanding the factors affecting bank profits is an important data and indicator for the well-functioning of financial institutions and policy makers. That's why, the potentials and risks of the banking system should be evaluated at the micro and macro level jointly.

Bank profitability is a crucial indicator of a financial institution's health and its ability to sustain operations, reward shareholders, and fulfill its role in the economy. Understanding the drivers of bank profitability has been a central concern in academic research, given the role deposit banks play in economic development. However, the factors that affect profitability can vary greatly depending on economic cycles, regulatory systems, and the competitive environment. This research stems from the need to understand how these changes affect bank performance in emerging markets such as Türkiye, where economic growth is more volatile and regulatory environments are still evolving. The main source of motivation for this study is to understand the bank-specific and macroeconomic factors impact on bank profitability for the analyzed period of 2012-2023.

2. LITERATURE REVİEW

There have been an extensive study that seeks to identify the variables affecting bank profitability, which is measured mostly by return on assets, return on equity and net interest margin. Bank profitability is sensitive not only to bank level factors but also liable to macroeconomic conditions. The determinants of bank profitability are typically divided into two main groups in literature which are named internal (bank's specific characteristics) and external (financial industry and economic environment) factors.

The internal factors are defined as the individual bank characteristics which affect the bank's performance and are basically influenced by the internal decisions of bank management. Internal factors include bank size, capital adequacy ratio, management efficiency, diversification income, liquidity risk, and credit risk. External factors are outside bank management´s control but impact its economic and financial structure. External factors are listed as market concentration, inflation, and gross domestic product.

The studies conducted in the literature focused on the profitability factors of the cross country (Abdilahi & Davis, 2023; Peterson,2021; Le & Ngo, 2020; Kohlscheen et al., 2018; Djalilov & Piesse, 2016; Petria et al., 2015; Flamini et al, 2009; Goddard et al., 2004; Demirguc-Kunt & Huizinga, 1999) or individual countries' banking systems. However, most studies heavily concern the individual country analysis. Table 1 shows the individual

country literature review including the data set, analyzed time period, method and the findings. This literature review summarizes some of the important findings and insights from those studies.

Table 1. Literature Review

Author(s)	Scope of Study	Method	Positive impact on Profitability	Negative impact on Profitability
Mashamba & Chikutuma (2023)	11 deposit banks of Zambia for the period 2011 to 2020	Panel data, GMM Estimation Technique	Non-interest income, Liquidity, Cost-to-income ratio, Tier 1 capital, and Bank stability	Asset quality, Bank quality
Javaid et al (2015)	10 top deposit banks of Pakistan between 2004-2008	Pooled Ordinary Least Square Model (POLS)	Loans, Equity size, Deposits	Bank size
Davydenko (2011)	Ukraninian banking sector between 2005 and 2009	Arellano Bond GMM estimation	Bank size, Concentration ratio, GDP, The exchange rate depreciation, Inflation	Administrative expenses as percent of total assets, Provions for loans
Ramadan et al. (2011)	10 Jordanian banks over the period 2001 to 2010	Fixed Effects Regression Model	Capital adequacy, Loans	Credit risk, Cost management
Dietrich & Wanzenried (2011)	453 Commercial banks in Switzerland between 1999 and 2008	Arellano Bond GMM estimation	Equity size	Cost-to-income
Sufian & Chong (2008)	Philippines commercial banks for the period 1990 to 2005	Fixed and Random Effects Regression Model	Non-interest income, Capitalization	Bank size, Credit size, Non-interest expense, Inflation
Athanasoglou et al. (2005)	Banks in Greece over the period 1985-2001	Fixed Effects and GMM Estimation Technique	Equity size, Labor productivity, Cyclical output, Inflation	Credit risk, Operating expenses
Erdoğan (2024)	24 commercial banks in Türkiye between 2016-2023	Panel data analysis	Capital adequacy ratio, BIST100 Index	Non-performing loans, Bond yields
Karadayi (2023)	8 privately-owned deposit banks operating in Türkiye over the period 2002 to 2022	Panel data analysis	Liquidity ratio, deposit ratio, The non-interest rate of income and loan ratio	Equity ratio (Equity/Total Assets)
Doğan &Yildiz (2023)	23 public, private and foreign banks in Türkiye for the period 2007 to 2020	Dynamic Generalized Method of Moments (GMM) and Fixed Effect Model (FEM)	Inflation rate and GDP growth rate, equity to total assets rate - ROA/ROE based, positive relation between ROA and ROE, and 1-year and 2-year lagged ROA and ROE-GMM method	Operating expenses-ROA/ROE based
Büyükoğlu (2023)	11 domestic and 11 foreign banks in Türkiye between 2011 and 2021	GMM Estimation Technique	Ratio of total deposits to total assets, ratio of total loans to total assets ratio of interest income to total	Capital adequacy-foreign banks

			assets -Domestic banks GDP-Foreign banks	
Bayrakcı (2022)	10 top deposit banks in 2020, ranked according to their asset size in 2020	LASSO Regression Method	Securities portfolio / Total assets ratio variables, Equity-ROA/ROE based GDP- ROE based	Inflation, Nonperforming loans and -ROA/ROE based ROA-based
Bal & Sönmezer (2022)	36 Deposit banks in Turkey between 1989 and 2015	Fixed Effects Regression Model	Credit risk, Funding cost, GDP growth, Illiquidity	Operating cost
Topak & Talu (2017)	10 Commercial banks in Turkey between 2005 and 2015	Panel Data Analysis	Bank size, Interest revenue from loans/interest expense on deposits, Net fees and commissions revenues/total expenses	Credit risk, Capital adequacy, The ratio of other operating expenses to total operating revenues
Belke & Unal (2017)	23 Turkish Deposit banks for the period 2005Q1-2015Q4	Panel Data Analysis	The ratio of interest on loans over deposits, The ratio of net fees and commissions revenues to total operating expenses, Bank size	Credit risk, Capital adequacy, Other operating expenses over total operating revenues, Nonperforming loans ratio
Ozcan (2017)	26 Commercial banks in Turkey between 2005 and 2015	Fixed and Random Effects Panel Data Analysis	Income diversification, Deposit level, Bank scale, and Bank stability	Credit risk, lending level, operating expenses, capital adequacy
Ozgur & Gorus (2016)	Turkish deposit banks between 2006:1 and 2007:2	Multiple Regression Model with OLS Method	Net interest revenues/Average total assets, Equity size	Nonperforming loans ratio, Policy interest rate
Turgutlu (2014)	30 Deposit banks in Turkey for the 2006Q4-2012Q2 period	System Generalized Method of Moments	Bank size, Capital ratio, Total loans, managerial efficiency, Financial soundness	Cost-to-income ratio (managerial efficiency), Off-balance-sheet liabilities
Demirhan (2013)	Turkish commercial banks between 2003Q4 and 2012Q2	GMM Estimation Technique	Equity size, Non-interest Revenues/Total Assets	GDP growth, Inflation
Akbaş (2012)	26 Turkish deposit banks in Turkey for the 2005-2010 period	Panel Data Analysis	-	Loan loss provisions/ gross loans, Total costs/total income, HHI for deposits /assets, Inflation, Equity, Bank size,
Alper & Anbar (2011)	10 Turkish deposit banks between 2002-2010	-	Asset size, Non-interest income, Real interest rate	Loans/assets, Loans under followup/loans
Sayilgan & Yildirim (2009)	Turkish commercial banks over the period 2002 to 2007	Multi-Variable Single-Equation Regression Method	Industrial production index, GDP, Capital adequacy	Consumer price index inflation, The first difference of ratio of offbalance sheet assets to total assets

Some studies are specifically focused on the determinants of bank profits for the pre-crises, in the crisis or after the crises period (Taylor et al., 2022; Bouzgarrou et al., 2018; Adelopo et al., 2017; Demirhan, 2013; Beltratti & Stulz, 2012; Dietrich & Wanzenried, 2011; Sufian & Habibullah, 2010; Abbasoglu et al., 2007). Most of these studies reveal that internal and external independent variables are sensitive to pre-crise, in-crise and post-crise period.

Taylor et al.'s (2022) research for five (5) Sub-Saharan African countries shows that cost efficiency and revenue diversification during the epidemic have a positive impact on bank profitability. Bouzgarrou et al. (2018) reveal that foreign banks were more profitable than domestic banks both pre-crises (2000-2006) and during the financial crisis (2007-2012) period for 170 commercial banks operating in France measured by the ROA, NIM and ROE. Likewise, Abbasoglu et al. (2017) findings indicate that foreign banks operating in the Turkish banking system outperform domestic banks using ROA and ROE in 2001 banking crises.

Adelopo et al.'s (2017) study for West African states indicate that there is a significant relationship between bank-specific determinants (size, cost management, and liquidity) and bank profitability (ROA) before (1999-2006), during (2007-2009), and after (2010-2013) the financial crisis. Demirhan find that there is no statistically significant difference between ROA before (2003-September 2008) crisis and ROA (December 2008-June 2012) after crisis.

Beltratti & Stulz (2012) investigates the validity of various hypotheses put forward as to why banks performed so poorly during the crisis for 440 deposit banks in 32 countries over the period of July 2007–December 2008. Their results give an evidence for large banks from countries with more restrictions on bank activities performed better and decreased loans less in crises period. Dietrich & Wanzenried (2011) investigate the factors affecting the profitability of 372 commercial banks in Switzerland separately for the pre-crisis period (1999–2006) and the crisis (2007–2009) period to analyze the impact of the recent financial crisis. The analysis results confirm the findings of previous studies on bank profitability.

Studies have generally suggested significant negative relationships between bank profitability and operating costs, based on the view that cost distorts profit and is negatively related to performance. This effect exacerbates especially in crisis period (Taylor et al., 2022; Bouzgarrou et al., 2018; Adelopo et al.,2017; Beltratti & Stulz, 2012; Dietrich & Wanzenried, 2011; Sufian & Habibullah, 2010).

Credit risk: The loan loss provisions did not have a statistically significant and negative effect on bank profitability before the crisis, but have significantly increased during the crises (Taylor et al., 2022; Adelopo et al., 2017; Beltratti & Stulz, 2012; Dietrich & Wanzenried,2011).

The relationship between bank size and profitability in precrises, crises and post crises period is positive (Adelopo et al.,2017; Beltratti & Stulz, 2012; Dietrich & Wanzenried,2011). But some studies find no find no relationship with bank performance (Tallor et al., 2022). Some studies find a positive and significant relationship between size and capital strenght with profitability (Adelopo et al.,2017;), while others find no relationship (Taylor et al., 2022; Dietrich & Wanzenried, 2011).

Most studies find no relationship between GDP and financial profitability before and in crisis period (Taylor et al., 2022; Adelopo et al.,2017; Beltratti & Stulz, 2012; Dietrich & Wanzenried, 2011). Inflation has a significant but negative (Taylor et al., 2022; Adelopo et al.,2017) relationship with profitability during the financial crisis.

As seen in the literature review given in Table 1, distinctive studies produce different results. Factors explaining bank performance demonstrate variability even in the analysis made for the same country depending on the methods and time period that is used. However, most individual country analysis results reveal that the same variables affect bank performance at different levels due to differences in country dynamics as economic, social, political and cultural practices.

3. DATA AND METHODOLOGY

Annual bank level data of 20 private deposit banks in Türkiye is used for the period of 2012-2023. The profitability levels of 20 deposit banks operating in the Turkish banking system are analyzed by using panel data analysis. Because public banks operate with different motives, the analysis in this study is limited only to private deposit banks. The source of data is the annual reports of commercial banks taken from The Banks Associations of Türkiye's (TBB) website which includes financial reports such as balance sheet, income statement. Key financial indicators data are employed from the Central Bank of Türkiye (TCMB) and the Turkish Statistical Institute (TUIK). The number of bank observations in the study is 240.

Bank profitability is usually measured by the return on assets (ROA), the return on equity (ROE) and/or the net interest margin (NIM) reported by a bank. Following the general trend in the literature this study uses ROA and ROE as the dependent variable. ROA is calculated by dividing net profit after tax by total assets and represents the return obtained from the bank's invested assets. The asset profitability ratio is one of the commonly used measures of how efficiently a financial institution uses its assets to generate profit. An increase in the ROA indicates that the financial institution can generate more profit with fewer assets. In this sense, it is seen as an important measure of managerial efficiency.

ROE is a measure of a company's financial performance. ROE is the rate used to measure the profitability of the capital invested by the shareholders of the business. It allows business owners to see how effectively their invested capital is being used. In other words, it shows the management performance of the financial institution.

This study uses macro-economic and bank-specific financial variables for determining the profitability indicators which are widely used in the literature (Table 2). Therefore, bank-specific and macroeconomic variables are included in the regression. The regression model is in the following form:

$y_{jt} = \delta_j + \alpha' X_{ijt} + \beta' X_{et} + \varepsilon_{jt}$

Here:

y_{jt} refers to the dependent variable and observation on profitability (ROA) and/or (ROE) for bank i at time t

j refers to an individual bank

t refers to year

X_i refers to the internal variables of a bank

X_e refers to the external variables of a bank

δ refers to the speed of adjustment to equilibrium

α and β are coefficients while ε_{jt} is the error term.

The study's data sources and relevant information are given in Table 2. As indicated in Table 2, return on assets (ROA) and return on equity (ROE) are used as independent variables. Independent variables are classified into two groups. The first group includes bank-specific (controlled) internal factors such as bank size, credit risk, income diversification, management of expenses, and capital strength. The second group includes macroeconomic (uncontrolled) factors such as economic growth, inflation, and stock market capitalization. The panel data regression results and significance levels obtained are given in Table 5.

Table 2. Summary Information of the Variables

Variables	Notation	Description
Dependent variables		
Return on Assets	ROA	Profitability measure
Return on Equity	ROE	Profitability measure
Internal variables		
Bank size	TA	Natural log of total assets
Nonperforming loans over total loans	NLP/TL	Credit risk measure
Non-interest income over total assets	NII/TA	Diversification and business mix measure
Non-interest expense over total assets	NIE/TA	Management of expenses
Equity over total assets	EQ/TA	Capital strength measure
External variables		
Economic growth	GDP	Gross domestic product per capita
Inflation	INF	Annual inflation rate
The ratio of stock market capitalization	CAP	Financial development measure

In analyzing the factors affecting bank profitability, the following two general hypotheses were formed:

H_1: Bank-specific factors such as bank size (TA)**,** credit risk (nonperforming loans over total loans, NPL/TL)**,** capital strength (equity over total assets, EQ/TA)**,** income diversification (NII/TA), and expense management (NIE/TA) significantly affect the profitability of Turkish private deposit banks.

Based on the literature, larger banks (greater TA) are expected to be more profitable due to economies of scale. Moreover, higher capital strength is anticipated to have a positive relationship with profitability since well-capitalized banks are generally considered to be more stable and resilient. In contrast, a higher NPL/TL ratio, which represents credit risk, is expected to negatively impact profitability, as non-performing loans represent a loss for banks. The study posits that better income diversification and expense management are also likely to positively influence profitability.

H_2: Economic growth (GDP) and inflation (INF) are expected to positively affect the profitability of Turkish banks.

During periods of economic expansion, banks tend to perform better, with higher demand for loans and financial services. On the other hand, inflation may affect profitability in different ways: while moderate inflation could indicate a growing economy, high inflation is typically associated with higher operational costs and lower consumer purchasing power, which could harm profitability. Stock market capitalization (CAP), as a measure of financial development, is expected to have a less direct impact, though it may still be important for financial market stability and investor confidence.

4. EMPIRICAL FINDINGS

Table 3. Descriptive Statistics of Variables

	Mean	Standard Deviation	Minimum	Maximum
ROA	0.015	0.020	-0.115	0.137
ROE	0.108	0.294	-3.986	0.502
TA	17.434	1.792	13.470	21.621
NPL/TL	0.053	0.073	0.000	0.649
NII/TA	0.007	0.013	0.000	0.167
NIE/TA	0.022	0.014	0.005	0.158
EQ/TA	0.116	0.042	0.029	0.397
GDP	9.284	0.124	9.060	9.481
INF	21.024	21.664	7.490	72.310
CAP	26.586	.535	25.821	27.503

Descriptive statistics for the variables are computed panel level and the findings are displayed in Table 3. ROA mean is 0.15±0.020 with -0.115-0.137 range. ROE mean is 0.108±0.294 with -3.986-0.502 range. TA mean is 17.434±1.792, NPL/TL mean is 0.053±0.073, NII/TA mean is 0.007±0.013, NIE/TA mean is 0.022±0.014 and EQ/TA mean is 0.116±0.042. Although the GDP value follows a horizontal course over the time series, INF shows serious fluctuations over the years (Table 3).

Table 4. Correlation Matrix for the Explanatory Variables

Independent variables	ROA	ROE	TA	NPL/TL	NII/TA	NIE/TA	EQ/TA	GDP	INF	CAP
ROA	1	0.701**	0.180**	-0.300**	0.193**	-0.102	0.531**	0.163*	0.466**	-0.026
ROE	0.701**	1	0.229**	-0.246**	0.051	-0.136*	0.181**	0.159*	0.305**	0.027
TA	0.180**	0.229**	1	0.153*	-0.114	-0.356**	-0.297**	-0.041	0.273**	-0.061
NPL/TL	-0.300**	-0.246**	0.153*	1	-0.042	-0.090	-0.195**	-0.267**	0.041	-0.096
NII/TA	0.193**	0.051	-0.114	-0.042	1	0.221**	0.350**	0.040	0.017	-0.035
NIE/TA	-0.102	-0.136*	-0.356**	-0.090	0.221**	1	0.165*	.371**	-0.254**	0.117
EQ/TA	0.531**	0.181**	-.297**	-0.195**	0.350**	0.165*	1	0.022	-0.041	0.018
GDP	0.163*	0.159*	-0.041	-0.267**	0.040	0.371**	0.022	1	0.201**	0.106
INF	0.466**	0.305**	0.273**	0.041	0.017	-0.254**	-0.041	.201**	1	-0.120
CAP	-0.026	0.027	-0.061	-0.096	-0.035	0.117	0.018	0.106	-0.120	1

*p<0.05, **p<0.01

The correlation matrix for the explanatory variables is reported in Table 4. Correlation analysis provides information on the direction and size of the relationship between variables. ROA is significantly correlated with TA (r=0.180; p<0.01), NPL/TL (r=-0.300; p<0.01), NII/TA (r=0.193; p<0.01), EQ/TA (r=0.531; p<0.01), GDP (r=0.163; p<0.01) and INF (r=0.466; p<0.01). Based on these findings, we can infer that key variables such as bank size (TA), diversification (NII/TA), capital strength (EQ/TA), economic growth (GDP) and inflation (INF) affect the financial performance of commercial banks (ROA) in a significant and positive way. The correlation matrix shows a positive relationship between GDP and both ROA (0.163*) and ROE (0.159*), although the coefficients are relatively small. On the other hand, the management of credit risk (NPL/TL) is a factor that affects the bank profitability (ROA) in a significant and negative way.

In summary, ROE is significantly correlated with TA (r=0.229; p<0.01), NPL/TL (r=-0.246; p<0.01), NII/TA (r=0.193; p<0.01), EQ/TA (r=0.181; p<0.01), NIE/TA (r=-0.136; p<0.01), GDP (r=0.159; p<0.01) and INF (r=0.305; p<0.01). This means that the second dependent variable of ROE is significantly and positively affected by bank size (TA), diversification (NII/TA), capital strength (EQ/TA), economic growth (GDP) and inflation (INF). But, management of credit risk (NPL/TL) and management of expenses (NIE/TA) affect bank performance (ROE) significantly and in a negative way.

Table 5. Factors Affecting Turkish Deposit Banks' ROA and ROE

Regressions	ROA fixed	ROA random	ROE fixed	ROE random
Constant	-0.2084	-0.1483	-4.6801	-3.3065
		Bank characteristics		
TA	0.0049**	0.0032**	0.0716*	0.0405**
NPL/TL	-0.0509**	-0.0557**	-0.6599*	-0.9247**
NII/TA	-0.0557	-0.0290	-1.3597	0.0733
NIE/TA	-0.0521	-0.0537	-1.6550	-1.8697
EQ/TA	0.2986**	0.2866**	3.0662**	1.6008**
		Economic and Market Conditions		
GDP	0.0096	0.0065	0.2740	0.2052
INF	0.0003**	0.0004**	0.0023*	0.0030**
CAP	0.0004	0.0004	0.0253	0.0242
R^2	0.6014	0.6276	0.2224	0.2489
F-statistic	35.64		7.67	
Wald $\chi 2$		337.49		76.56
$\chi 2$		0.0000		0.0000
No. of observations		240		240
Haussman Test	X^2: 11.88	p: 0.1567 (Random)	X^2: 16.00	p: 0.0423 (Fixed)

*p<0.05, **p<0.01

According to the Hausmann test, the random model is valid for the ROA model (p>0.05). According to the random effect results of ROA panel data analysis, the effect of TA (B=0.0032; p<0.01), NPL/TL (B=-0.0557; p<0.01), EQ/TA (B=0.2866; p<0.01) and INF (B=0.0004; p<0.01) series on the ROA value of banks is statistically significant. The effect of bank size (TA), capital strength (EQ/TA) and inflation (INF) is positive, whereas the effect of credit risk (NPL/TL) is in negative way. The explanatory value of the model is 0.6276 meaning that the model explains 62.76% of total variance (Table 5).

According to the Hausmann test, the fixed model is valid for the ROE model (p<0.05). According to the random effect results of ROE panel data analysis, the effect of TA (B=0.0716; p<0.05), NPL/TL (B=-0.6599; p<0.05), EQ/TA (B=3.0662; p<0.01) and INF (B=0.0023; p<0.05) series on the ROA value of banks is statistically significant. That is, the effect of bank size (TA), capital strength (EQ/TA) and inflation (INF) are positive, whereas the effect of credit risk (NPL/TL) is in negative way. The explanatory value of the model is 0.2224 meaning that the model explains 22.24% of total variance (Table 5).

As stated earlier, ROA and ROE are the most commonly used independent variables in the literature for bank profitability. As emphasized by Turgutlu (2014), ROE gives the expected rate of return on a fixed investment based on the firm's past performance. This situation means that the ROE will diverge from the ROA in debt-dominated institutions. ROA measures how efficiently a company uses its assets to generate earnings, while ROE measures how much profit a company generates from shareholders' equity. ROA doesn't take into account financial leverage, while ROE increases with higher financial leverage. Goddard et al. (2004) stress that ROE is

a better measure of profitability than ROA, especially when off-balance sheet items have a significant contribution on bank profits. The findings stress that the random effect of ROA and fixed effect results for the ROE model are in the same direction as shown in Table 5.

Bank Size (TA): The positive relationship between bank size (TA) and profitability (both ROA and ROE) is consistent with previous studies, such as Topak & Talu (2017), Belke & Unal (2017), Adelopo et al. (2017), Turgutlu (2014), Dietrich & Wanzenried (2011) and Davydenko (2011), which suggest that larger banks benefit from economies of scale, leading to more efficient operations and, consequently, higher profitability. However, this study's results indicate that while bank size is positively correlated with profitability, the relationship is more pronounced with ROE (B = 0.0405 for ROE) than with ROA (B = 0.0032 for ROA), suggesting that larger banks in Türkiye are better able to generate profits from shareholder equity rather than from asset utilization. This finding is in line with Goddard et al. (2004)**,** who argue that ROE is a better indicator of profitability in institutions with high financial leverage, such as large banks.

Credit Risk (NPL/TL): The negative relationship between Non-Performing Loans (NPL) and bank profitability, predominantly in the form of ROA and ROE**,** aligns with the findings of studies such as Erdoğan (2024), Bayrakcı (2022), Topak & Talu (2017), Belke & Unal (2017), Ozcan (2017), Ozgur & Gorus (2016), Akbaş (2012), Alper & Anbar (2011), Ramadan et al. (2011), Sufian & Chong (2008) and Athanasoglou et al. (2005). High non-performing loans (NPLs) reduce a bank's ability to generate profits by increasing provision costs and impairing asset quality. Our results (B = -0.0557 for ROA and B = -0.9247 for ROE) strengthen this view, showing that Turkish banks with higher credit risk have significantly lower profitability. The more stringent management of credit risk, as suggested by Goddard et al. (2004)**,** is essential for maintaining profitability during periods of economic uncertainty.

Capital Strength (EQ/TA): Capital strength remains a critical factor in enhancing profitability. The results show a robust positive relationship between capital adequacy (measured as equity over total assets) and profitability, which is consistent with studies like Erdoğan (2024), Mashamba & Chikutuma (2023), Doğan &Yildiz (2023), Bayrakcı (2022), Demirhan (2013), Dietrich & Wanzenried (2011), Sufian & Chong (2008), Athanasoglou et al. (2005), Sayilgan & Yildirim (2009), Demirgüç-Kunt & Huizinga (1999) and Goddard et al. (2004). Banks with higher capital levels are better positioned to absorb shocks, invest in opportunities, and ensure long-term stability. A well-capitalized banks tend to outperform their peers in terms of profitability (B = 0.2866 for ROA and B = 1.6008 for ROE), which further confirms the findings of Turgutlu (2014)**,** who suggested that capital strength is a key driver of financial performance in Türkiye.

Expense Management (NIE/TA): Bal & Sönmezer (2022), suggest that efficient expense management correlates positively with profitability. Both ROA and ROE regressions reveal a negative association with non-interest expenses over total assets (NIE/TA), suggesting that poor management of operational costs reduces profitability. This is consistent with findings from Doğan &Yildiz (2023), Bouzgarrou et al. (2018)**,** Topak & Talu (2017), Belke & Unal (2017), Ozcan (2017), Davydenko (2011), Sufian & Chong (2008) and Athanasoglou et al. (2005)**,** who also find that high operating costs erode profit margins. Despite the prevailing view in the literature on this issue, the study found that expense management (NIE/TA) did not have a significant impact on profitability.

Macroeconomic Factors (INF-GDP-CAP): The researh findings (B = -0.0004 for ROA and B = -0.003 for ROE) support the view that inflation (INF) has a significant positive impact on profitability, indicating that banks are able to generate higher profits during inflationary periods. The effect of inflation on bank profitability is heavily debated in the literature. Some studies find a negative relationship between inflation and profitability (Bayrakcı, 2022; Demirhan, 2013; Akbaş, 2012; Sayilgan & Yildirim, 2009; Sufian & Chong, 2008), as rising costs may erode profit margins. Conversely, others suggest that banks can hedge against inflation through interest rate adjustments, benefiting from higher nominal returns (Doğan &Yildiz, 2013; Davydenko, 2011; Athanasoglou et al., 2005).

Most studies have found that economic growth (measured by GDP) has positive impact on bank profitability (Doğan &Yildiz, 2023; Büyükoğlu, 2023; Bayrakcı, 2022; Bal & Sönmezer, 2022; Davydenko, 2011; Dietrich & Wanzenried, 2011; Sayilgan & Yildirim, 2009). However, the expected positive relationship of economic growth (GDP) and stock market capitalization (CAP) was not statistically significant in explaining profitability for the analyzed period.

5. CONCLUSION AND DISCUSSION

The objective of this study is to analyze bank-specific and macroeconomic factors affecting bank performance of private deposit banks in Türkiye. Banks play a central role in financing economic activity and acting as financial intermediaries. Here, the banking sector is one of the core elements of economic growth. Therefore, analyzing the bank profitability factors and the other dynamics of the banking system is crucial for the smooth functioning of the financial system and the general well-being of the economy.

The article investigates the factors affecting the profitability of private deposit banks in Türkiye over the period 2012-2023, focusing on bank-specific and macroeconomic variables. The two main hypotheses explored in the study concern the impact of these variables on bank profitability, as measured by the return on assets (ROA) and return on equity (ROE). The average asset profitability ratio (ROA) and the average equity profitability ratio (ROE) are used as dependent profitability measures. Besides, there are five internal (bank size, nonperforming loans over total loans, non-interest income over total assets, non-interest expense over total assets, equity over total assets), and three external (gross domestic product per capita, annual inflation rate, the ratio of stock market capitalization) independent variables are used in the analysis.

The first hypothesis suggests that bank-specific factors such as bank size (TA)**,** credit risk (nonperforming loans over total loans, NPL/TL)**,** capital strength (equity over total assets, EQ/TA)**,** income diversification (NII/TA), and expense management (NIE/TA) significantly affect the profitability of Turkish private deposit banks. The study finds that bank size (TA), capital strength (EQ/TA), and nonperforming loans (NPL/TL) are indeed significant predictors of profitability. Larger banks tend to show better profitability, reflecting the advantage of economies of scale, while higher capital and lower NPL/TL ratios contribute positively to bank performance. Interestingly, while diversification (NII/TA) and expense management (NIE/TA) were expected to significantly impact profitability, but they were not found to have a strong effect in the analysis. This suggests that while these factors are important in theory, their role in determining profitability in the Turkish context may be less significant compared to other factors like bank size and credit risk.

The second hypothesis examines the impact of macroeconomic factors such as economic growth (GDP)**,** inflation (INF), and stock market capitalization (CAP) on bank profitability. The findings support the hypothesis that inflation (INF) has a significant positive impact on profitability, indicating that banks are able to generate higher profits during inflationary periods. However, the expected positive relationship between economic growth (GDP) and profitability was less pronounced, and the effect of stock market capitalization (CAP) was not statistically significant in explaining profitability.

In summary, the study's findings reveal that bank size, capital strength, and the level of nonperforming loans (credit risk) have a significant impact on the profitability of Turkish private deposit banks, with a positive influence from bank size and capital strength and a negative impact from nonperforming loans. Inflation also plays a key role in increasing profitability. However, other bank-specific factors such as diversification and expense management, as well as macroeconomic factors like economic growth and stock market capitalization, did not show strong or statistically significant effects. The findings align with and expand upon the existing literature, offering both confirmations and new insights.

The limitations of this study should be considered when interpreting our findings. In this study, except for public banks only private deposit banks are included in the analysis. Although an important role in the Turkish banking system, public banks are excluded as they work with different motives. Politically public benefit motive is more important than profitability in public banks.

In summary, the banking sector as a dominant in the Turkish financial system is of critical importance in terms of meeting financing requests and ensuring economic growth and financial stability by mediating investment financing. Therefore, we can conclude that this study contributes to the literature by providing empirical evidence on the factors affecting bank profitability in the Turkish context, especially for private deposit banks, and highlights the importance of managing credit risk, scaling up, and maintaining strong capital levels. How can Turkish banks better manage inflationary pressures and credit risk in a high inflationary environment to maintain or improve profitability, and what role do regulatory frameworks play in supporting these objectives? Comparing the effectiveness of internal management strategies versus external regulatory measures could provide valuable insights for policymakers and bank managers alike. In conclusion, the findings can guide bank management and policymakers in improving the financial performance and stability of banks in Türkiye.

AUTHORS' DECLARATION:

This paper complies with Research and Publication Ethics, has no conflict of interest to declare, and has received no financial support.

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The entire research is written by the author.

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The Effect of Employees' Attitudes Towards Digital Technology on Their Perceptions Towards Remote Working and Other Forms of Flexible Working

Çalışanların Dijital Teknolojiye İlişkin Tutumlarının, Uzaktan Çalışma ve Diğer Esnek Çalışma Biçimlerine Yönelik Algılarına Etkisi

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ABSTRACT

The changes created by digital transformation in the business world have changed traditional working models and brought new flexible and remote working styles to the forefront. The attitudes of employees towards digital technologies have directly affected their adaptation processes and productivity towards these new working styles. In this context, understanding the relationship between employees' perspectives on digital technologies and remote working and other flexible working styles is of great importance in terms of modern business management strategies. This study was conducted on 446 people residing in Istanbul and working in companies operating in the field of technology. The testing of hypotheses created in accordance with the purpose of the research was carried out using SPSS and AMOS programs. As a result of the analyses, it was determined that employees' attitudes towards digital technology affect their perceptions towards remote working and other flexible working styles in terms of demographics.

Anahtar Kelimeler:
Uzaktan Çalışma,
Esnek Çalışma,
Dijital Teknoloji

Jel Kodları:
L15, M31, M30

ÖZET

Dijital dönüşümün iş dünyasında yarattığı değişim, geleneksel çalışma modellerini değiştirmiş ve yeni esnek ve uzaktan çalışma biçimlerini ön plana çıkarmıştır. Çalışanların dijital teknolojilere karşı geliştirdikleri tutumlar, bu yeni çalışma biçimlerine olan adaptasyon süreçlerini ve verimliliklerini doğrudan etkilemiştir. Bu bağlamda, çalışanların dijital teknolojilere olan bakış açıları ile uzaktan çalışma ve diğer esnek çalışma biçimleri arasındaki ilişkiyi anlamak, modern iş yönetimi stratejileri açısından büyük önem taşımaktadır. Bu çalışma, İstanbul'da ikamet etmekte olan ve teknoloji alanında faaliyet gösteren şirketlerde çalışan 446 kişiye uygulanmıştır. Araştırma amacına uygun olarak oluşturulan hipotezlerin testi SPSS ve AMOS programları kullanılarak yapılmıştır. Yapılan analizler sonucunda çalışanların dijital teknolojiye ilişkin tutumlarının, uzaktan çalışma ve diğer esnek çalışma biçimlerine yönelik algılarını demografik açıdan etkilediği belirlenmiştir.

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1. INTRODUCTION

The mandatory curfews and restrictions brought about by the pandemic forced many sectors to review their working methods. This process led to the rapid adoption of the remote working model and the questioning of its effectiveness. As businesses discovered the flexibility and efficiency advantages provided by the remote working method, they decided to make this model permanent or adopt hybrid working methods. Although remote working was initially associated with some negativity, it has undergone a significant conceptual transformation with the development of digital technologies. The effective use of digital technologies plays a key role in the success of remote working. Employees have developed the ability to effectively use information and communication technologies (ICT) in order to maintain their performance in the office environment. This has allowed employees to continue their activities both individually and on a team basis, thus increasing work efficiency (Bany et al., 2024; Abbas, 2016; Alcañiz et al., 2019).

The health and safety advantages provided by remote working have made it easier for employees to establish a work-life balance, and this has been a source of psychological relief for many employees. For employers, significant reductions have been achieved in physical facility costs and administrative expenses.

The spread of remote work has changed not only the way work is done, but also the way employees interact socially. The transition from traditional workplaces to virtual workplaces has caused physical, social and psychological changes. Employees have had to develop their own problem-solving skills in remote working conditions. This process has affected employees' attitudes towards digital technologies and their perceptions of remote working and other flexible working styles (Altın, 2016). Employees' positive perspectives on digital technologies have paved the way for them to develop a more open attitude towards the remote working model and the flexibility it brings. The remote working model requires the integration of various digital tools to enable employees to focus on their work and work efficiently even while they are away from the workplace. However, this situation also brings some challenges. Problems such as reduced social interaction, feelings of loneliness and lack of communication can be counted among the negative aspects of remote working (Haleem et al., 2022; Almer et al., 2004; Berkery et al., 2020; Coreynen et al., 2017; Demir & Gerşil, 2008; Filiz, 2011).

Employees' attitudes towards digital technology are an important factor affecting their ability to cope with these challenges and their overall job satisfaction. As a result, the remote working model has gained an important place in modern business life thanks to the opportunities provided by digital technologies. Employees' attitudes towards digital technologies are a critical element that determines their perceptions of remote work and their success in this model. This study aims to investigate the effects of employees' attitudes towards digital technologies on remote work and other flexible work styles. The future of remote work and flexible work methods largely depends on how these attitudes and perceptions evolve.

2. CONCEPTUAL FRAMEWORK

2.1. Attitude Towards Digital Technology

The term digital is defined by TDK as 'numerical' (TDK, 2024). Digital environments process all data through binary codes such as 0 and 1. With the rise of Industry 4.0, the importance of digital technologies has increased and has frequently come to the fore. Today, interest in the digital world is observed in a wide range of people, including young children. While most businesses have started to offer their services on digital platforms, individuals and governments have also turned to conducting their transactions in digital environments. In this context, it is seen that many businesses are involved in digital transformation processes for various reasons. The intensity of transformation processes varies depending on the characteristics of the businesses; while some complete this process quickly and become fully digital, others remain in the partial transformation phase or are still trying to adapt to this process (Li-Lun & Yao-Jen, 2023; Mosca, 2020; Oosthuizen, 2022; Özçelik, 2022). The ability of all employees in businesses to understand the digitalization process as well as the senior management and to adapt to this process plays a critical role in the rapid and successful transformation. In this context, the lack of digital skills is considered to be one of the biggest obstacles to digital-focused growth; This situation stands out as an important element in human resources planning and especially in recruitment processes (Nadkarni & Prügl, 2020; Gedik, 2021; Heavin et al., 2018; Kaya & Doğan, 2016). The rapid changes created by globalization and digitalization in the business world require companies to reshape their business models, corporate approaches and global strategies. Companies that can adapt to digital transformation and do not shy away from taking risks will gain the competitive advantage brought by this change. Digital transformation also

redefines the competencies expected from employees, and digital skills and abilities come to the fore among these competencies. In this context, one of the most discussed issues is that some people may become unemployed due to the changes that digitalization will create in the business world, but at the same time, new sectors and professions will emerge.

2.2. Flexible Working

There are several important reasons why flexible working is needed. First, flexible working allows employees to better balance their work and private life, which increases job satisfaction. Employees can be more productive by working at hours that suit them and can focus on their work while fulfilling their personal responsibilities. In addition, flexible working models make it easier for individuals with different living conditions, such as parents or those with dependents, to join the workforce (Kgarimetsa & Naidoo 2024). Thanks to technological developments, digital tools, and the internet, employees can perform their jobs without being physically present in the office, which is an important factor in the spread of flexible working. In addition, unexpected events such as crises and pandemics have further increased the importance of flexible working. For example, the COVID-19 pandemic has shown how critical flexible working models are for the business world (Vohra et al., 2024). Finally, flexible working allows businesses to access a wide workforce pool that can work in different time zones, which offers a great advantage in meeting global workforce needs.

Flexible working may involve employees having control over when or where they work (Kaçik & Aykan, 2022; Kelly et al., 2011; Glass & Estes, 1997). More specifically, flexible working hours refers to an individual having control over their work schedule. This may include the ability for the employee to change their work schedule (i.e., changing start and end times) and/or the number of hours worked per day or week, which in certain cases can be accumulated for days off. The biggest difference between flexible working hours and working time autonomy is that some restrictions still exist in flexible working hours; for example, restrictions such as adhering to core hours (e.g., 10:00–16:00) and the number of hours that can be worked in a day or week (e.g., 37 hours per week) are not present in working time autonomy in most cases. Flexible location, i.e., teleworking or homeworking, allows employees to work outside their regular work locations; for example, working from home. In addition, flexible working can also involve employees having control over their working hours; this usually refers to the (temporary) reduction of working hours to meet family demands. This includes situations such as part-time work, seasonal work, job sharing, and temporary reduction of hours (Kanberoğlu & Yıldırımçakar 2021).

2.3. Digital Transformation and Information Technologies

The digital age is fundamentally changing the way businesses and societies operate. Digital transformation leverages information technology (IT) to create significant changes in an organization's core processes, culture, and strategies. Digital transformation relies on IT to provide the tools and infrastructure necessary for change; it is driven by core technologies such as cloud computing, big data and analytics, artificial intelligence, and the Internet of Things. The impacts of DT on businesses include improved customer experience, increased operational efficiency, innovation, and competitiveness. However, DT also brings with it challenges such as resistance to change, cybersecurity threats, data privacy concerns, and integration costs (Zhang & Bu, 2024; Öztırak, 2023).

At the societal level, effects such as the growth of e-commerce, remote working, industrial disruption, and the rise of the sharing economy are observed. In the future, DT has the potential to reshape businesses and societies; it is envisaged that organizations can take a competitive edge and create a sustainable future by leveraging the power of IT and embracing change. Policymakers should address the social impacts of DT and support responsible innovation that promotes inclusive growth and workforce development. Future research should examine the long-term effects of DT on work, society, and ethical values. Additional areas of research include the impact of AI on specific sectors and labor markets, ethical considerations of data-driven decision-making and algorithmic bias, and responsible and inclusive digital transformation (Nadkarni & Prügl, 2020; Yazıcı & Kınay, 2021). Since the 2000s, technological advances such as AI, robotics, 3D printers, the Internet of Things, smart factory systems, and driverless vehicles have radically changed the structure of production. This period is called the Fourth Industrial Revolution or Industry 4.0. In this context, the introduction of cyber-physical systems (systems that connect the physical world to the virtual information processing world through sensors) has initiated the digital transformation process. Each stage of the industrial revolution has led to significant changes in employment and working life as well as production processes. Today, production is carried out with processes that are quite different from the past; job descriptions, professions and roles are being reshaped. While new business areas, professions and working methods are emerging, automation in production is increasingly being driven by artificial intelligence and robotic technologies. This new era has the potential to fundamentally change labor relations.

However, it is foreseen that the increase in robots in production may increase unemployment, reduce the social role of unions and make new regulations in labor law and social security inevitable. Production processes have significantly differed from the techniques used in the past, and new business models, professions and working methods have emerged. The role of increasing automation and artificial intelligence technologies in production is becoming central to working life, and this process not only creates new jobs and professions, but also has the potential to make transformative changes in working life (Yankın, 2019; Öztırak & Orak, 2022).

3. DEVELOPMENT OF RESEARCH HYPOTHESES AND METHOD

3.1. Problem

The rapid development and proliferation of digital technologies in recent years has led to significant changes in the business world. Especially remote working and other flexible working styles have brought about radical changes in the working methods of the workforce. The success and effectiveness of these changes are closely related to the attitudes of employees towards digital technology.

However, there is limited research on the effects of employees' attitudes towards digital technologies on their perceptions of remote working and other flexible working styles. Employees' positive or negative attitudes towards these technologies can have a direct impact on the adoption, productivity and job satisfaction of remote working. While the effective use of digital technologies shapes employees' perceptions of these new working styles, these perceptions can also affect the acceptance and success of practices in the workplace.

This article aims to examine the effects of employee attitudes towards digital technology on their perceptions of remote working and other flexible working styles. The problem will be shaped around the following questions:

1. How do employees' attitudes towards digital technologies affect their perceptions of remote working styles?
2. What is the role of positive attitudes towards digital technologies on the adoption of flexible working styles?
3. What are the effects of negative attitudes towards digital technologies on the level of acceptance of remote working and other flexible working styles?

3.2. Purpose of the Research

The purpose of this research is to examine the effects of employees' attitudes towards digital technologies on their perceptions of remote working and other flexible working styles. It aims to determine the role of these attitudes in the adoption of remote and flexible working models by analyzing both the positive and negative attitudes employees have towards digital technologies. Based on the findings, the research will provide strategic recommendations to employers on how to effectively integrate digital technologies into the workplace and implement flexible working styles successfully. In this context, the effects of attitudes towards digital technologies on job satisfaction, productivity, and performance will also be evaluated.

3.3. Significance of the Research

The importance of this research lies in understanding the increasing role of digital technologies in the business world and the rising trend of flexible working styles. Examining the effects of employees' attitudes towards digital technologies on their perceptions of remote working and other flexible working methods will provide critical information for the effective implementation of these technologies and working methods. In particular, revealing the potential effects of positive or negative attitudes towards digital technology on job productivity, satisfaction and overall job performance will provide data that will guide employers and managers when making strategic decisions. In addition, this research will help organizations manage digital transformation processes and flexible working policies more effectively and contribute to the creation of a sustainable work environment for both employees and employers by ensuring the successful integration of changes in the workplace.

3.4. The Universe and Sample of the Research

The universe of the research consists of 289,657 people working in the IT sector across Turkey. In the study, 446 IT sector employees were reached between 01.02.2024 and 30.08.2024 using the convenience sampling method (TÜİK, 2024). To ensure that this sample size is sufficient for representing the entire universe, a statistical

calculation was conducted. The calculation considered the total population size (289,657) and used a confidence level of 95% and a margin of error of 5%. Based on these parameters, the required sample size was determined to be 384, which means that the sample of 446 employees exceeds the minimum required sample size, making it statistically sufficient for the research.

Ethical permission for the study was obtained from the Ethics Committee of Esenyurt University. The approval was granted on 03.06.2024, with the decision number 2024/05.

3.4.1. Research Model and Hypotheses

In this study, it is assumed that employees' attitudes towards digital technology affect their perceptions towards remote work and other flexible working styles. In this direction, the following hypotheses are proposed:

H_1: Attitude towards digital technology affects the perception towards flexible working.

H_2: Attitude towards digital technology affects the perception towards remote working.

H_3: Attitude towards digital technology varies according to demographic variables.

H_4: Perception towards flexible working varies according to demographic variables.

H_5: Perception towards remote working varies according to demographic variables.

The research model regarding the effect of the attitudes of technology sector employees in Istanbul towards digital technology on their perceptions of remote working and other flexible working styles is shown in Figure 1 below.

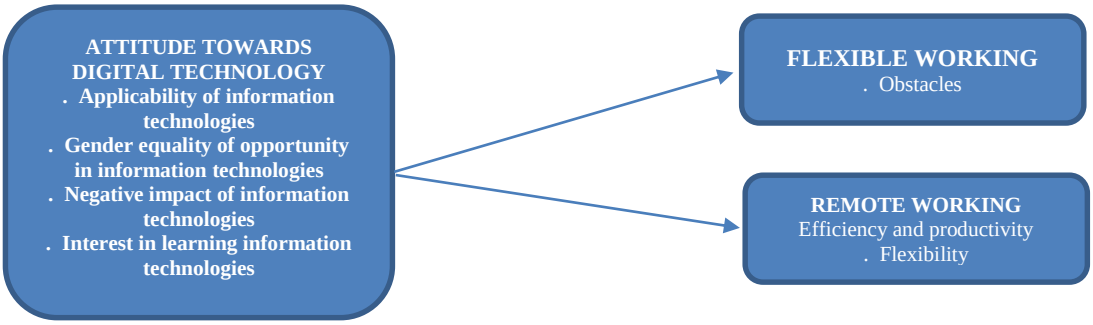

Figure 1. Research model

3.4.2. Limitations of the Study

The limitations of this study include the fact that it was applied only to personnel working in the field of informatics in Istanbul, which may limit the generalizability of the findings to other regions or sectors. Additionally, inhibitory factors encountered during the data collection process, such as limited access to certain participants or external conditions, may have impacted the data gathered. The relatively short duration of the data collection process also presents a limitation, as it may not fully capture the diverse perspectives or seasonal variations that could affect the results.

For future research, it is suggested to expand the sample size by including IT sector employees from other regions of Turkey to increase the generalizability of the findings. Extending the data collection period would also provide more comprehensive insights. Moreover, overcoming any barriers in data collection, such as improving access or addressing logistical challenges, would help ensure a more robust and representative dataset.

3.5. Information on the Scales of the Study

The attitude scale towards information technologies is used in the first part of the survey. This scale was taken from Şirin's doctoral thesis prepared in 2022. Şirin (2022) calculated the internal consistency of the scale as 0.914 in his study. The original version of the scale has 23 statements and 5 dimensions. These dimensions are interest in learning information technologies, the applicability of information technologies, the negative impact of information technologies, the positive impact of information technologies in business life, gender equality of information technologies. The internal consistencies of these dimensions determined in the doctoral thesis are as follows. The Cronbach alpha value of the interest in learning information technologies dimension is 0.937, the Cronbach alpha value of the applicability of information technologies is 0.927, the Cronbach alpha of the negative

impact of information technologies dimension is 0.938, the Cronbach alpha value of the positive impact of information technologies in business life is 0.920, and finally the Cronbach alpha value of the gender equality of opportunity in information technologies dimension is 0.964. According to the exploratory factor analysis, the scale explains 80% of the variance. The scale is a 5-point Likert-type scale. It consists of the options 1= Strongly Disagree, 2= Disagree 3= Undecided 4= Agree 5= Strongly Agree. The perception scale for remote working is used in the second part of the survey. This scale was also taken from Şirin's doctoral thesis in 2022. The internal consistency of the scale in the doctoral thesis study was determined as 0.962. The original version of the scale has 20 statements and 4 dimensions. These dimensions are effectiveness and efficiency, organizational trust, work-life conflict and flexibility. The internal consistencies of each dimension are as follows: The Cronbach's alpha value of the effectiveness and efficiency dimension is 0.954, the Cronbach's alpha value of the organizational trust dimension is 0.863, the Cronbach's alpha value of the work-life conflict dimension is 0.952 and finally the Cronbach's alpha value of the flexibility dimension is 0.943. According to the exploratory factor analysis results, the scale explains 81% of the variance. The scale is a 5-point Likert scale. It consists of the options 1 = Strongly Disagree, 2 = Disagree 3 = Undecided 4 = Agree 5 = Strongly Agree. The perception scale for flexible working is used in the third part of the survey. This scale was also taken from Şirin's doctoral thesis in 2022. The internal consistency of the scale in the doctoral thesis study was determined as 0.985. The original version of the scale has 10 statements and 2 dimensions. These dimensions are obstacles and work-life balance. The internal consistencies of each dimension are as follows: the Cronbach alpha value of the obstacles dimension is 0.975 and the Cronbach alpha value of the work-life balance dimension is 0.968. According to the exploratory factor analysis results, the scale explains 77% of the variance. The scale is a 5-point Likert scale type. It consists of the options 1= Strongly Disagree, 2= Disagree 3= Undecided 4= Agree 5= Strongly Agree.

The last section of the survey also includes a personal information form, which asks questions about gender, marital status, age, education level, status and workplace seniority.

3.6. Analyses Used in the Research

In order to reach the results of the research, the data is analyzed with the SPSS statistical package program and the SPSS AMOS graphic modeling program. The analyses used are descriptive statistics to determine the frequency and percentage distributions of personal information questions, descriptive statistics to determine the mean and standard deviation values of attitudes and dimensions towards information technologies, perceptions and dimensions towards remote working and perceptions and dimensions towards flexible working and kurtosis and skewness values to determine the closeness to normal distribution. In order to determine the differences of attitudes and dimensions towards information technologies, perceptions and dimensions towards remote working and perceptions and dimensions towards flexible working according to personal information questions, independent group t-test and one-way analysis of variance (ANOVA) from parametric tests and Kruskal Wallis and Mann Whitney U tests from non-parametric tests are used. Reliability analysis calculating Cronbach alpha coefficients is performed to determine the internal consistency of the scales. Confirmatory factor analysis is used to verify the validity of the scales. Structural regression analysis from structural equation modeling is used to determine the effect of attitudes and dimensions towards information technologies on perceptions and dimensions towards remote working and perceptions and dimensions towards flexible working.

4. FINDINGS

4.1. Findings Regarding Demographic Characteristics

The frequency and percentage distributions of employees' gender, marital status, education level, status, and workplace seniority are evaluated.

Table 1. Descriptive Statistics Values of Demographic Variables

		n	%
Gender	Male	311	69,7
	Female	135	30,3
	Total	446	100
Marital Status	Married	298	66,8
	Single	148	33,2
	Total	446	100

Age	24-29 years	59	13,2
	30-35 years	85	19,1
	36-41 years	138	30,9
	42 years and above	164	36,8
	Total	446	100
Education Level	Primary Education	4	0,9
	Secondary Education	15	3,4
	Associate Degree	42	9,4
	Undergraduate	259	58,1
	Postgraduate	126	28,3
	Total	446	100
Status	Team Member	269	60,3
	Manager/Supervisor	146	32,7
	Senior Executive	31	7
	Total	446	100
Workplace Seniority	1-5 years	174	39,0
	6-10 years	82	18,4
	11-15 years	81	18,2
	15-20 years	54	12,1
	20 years and above	55	12,3
	Total	446	100

Of the participants in the survey, 69.7% were male, the remaining 30.3% were female, 66.8% were married, the remaining 33.2% were single, 36.8% were 42 years old and over, 30.9% were 36-41 years old, 19.1% were 30-35 years old, and the remaining 13.2% were between 24-29 years old. 58.1% of the employees have a bachelor's degree, 28.3% have a postgraduate degree, 9.4% have an associate degree, 3.4% have a secondary school degree, 60.3% are team members, 32.7% are managers/supervisors and the remaining 7 % are senior managers, 39 % have 1-5 years of experience, 18.4% have 6-10 years, 18.2% have 11-15 years of experience, 12.3% have 20 years or more, and 12.1% have 15-20 years of experience.

4.2. Confirmatory Factor Analysis

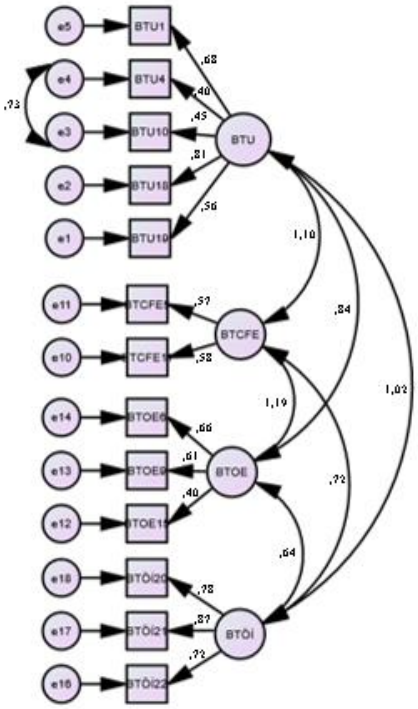

Figure 2. Linear Factor Analysis Model for Attitude Scale Towards Information Technologies

As a result of confirmatory factor analysis, it was concluded that the best model was the 4 factors and 13 observed variables of the attitude scale towards information technologies. 10 statements in the scale were not included in the analysis because they did not show a good fit.

Table 2. Good Fit Results of the Attitude Scale Model Towards Information Technologies

Compliance Indices	Calculated Compliance Indices
x2/sd ≤ 4	3,276
0,90≤NFI≤0,94	0,939
0,90≤GFI	0,946
0,06≤RMSEA≤0,08	0,072
RMR≤0,05	0,053

The overall fit of the model is within the acceptable fit indices. While the comparable fit indices (NFI, RMSEA) are within the acceptable fit values, the absolute fit index (GFI) is included in the good fit index. The residual based fit index (RMR) is among the good fit indices.

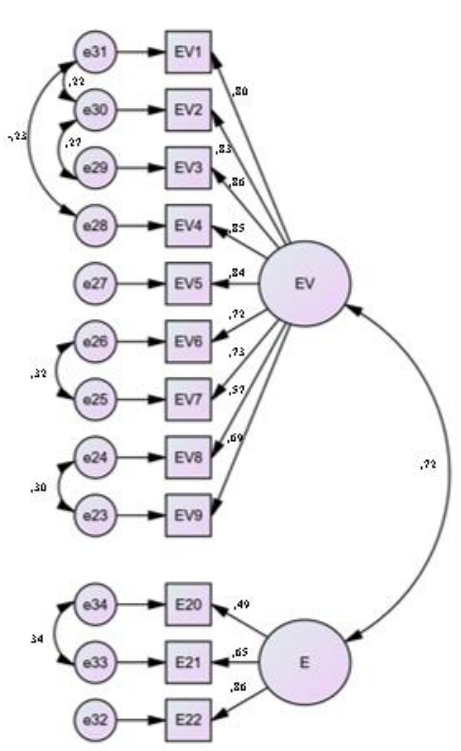

Figure 3. Model of the Confirmatory Factor Analysis of the Perception Scale Towards Remote Working

A model consisting of 2 dimensions and 12 observable variables shows a good fit as a result of the confirmatory factor analysis. The remaining 10 statements were not included in the analysis because they did not show a good fit in the model.

Table 3. Good Fit Results of the Perception Scale Model Towards Remote Working

Compliance Indices	Calculated Compliance Indices
x2/sd ≤ 3	2,368
0,95≤NFI	0,969
0,90≤GFI	0,960
0,06≤RMSEA≤0,08	0,055
RMR≤0,05	0,034

When the model fit indices of the perception scale towards remote working are examined, all values except the RMSEA value are among the good fit indices. The RMSEA value is among the acceptable fit indices.

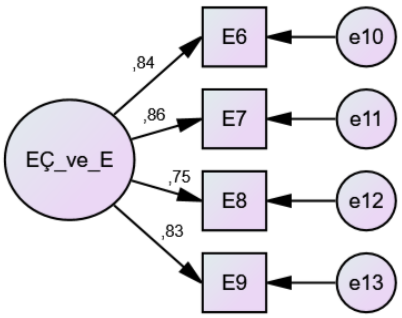

Figure 4. Model of Confirmatory Factor Analysis of Perception Scale Towards Flexible Work

The model consists of 4 observable variables with one dimension. The model includes the expressions of the obstacles dimension. This obstacle' s dimension constitutes the perception towards flexible work.

Table 4. Good Fit Results of Perception Scale Model Towards Flexible Work

Compliance Indices	Calculated Compliance Indices
x2/sd ≤ 4	3,829
0,95≤NFI	0,993
0,90≤GFI	0,991
0,06≤RMSEA≤0,08	0,080
RMR≤0,05	0,024

When the general fit of the model is evaluated, it is among the acceptable fit indices. GFI and NFI values show that the model is within the good fit indices. While the RMSEA value is within the acceptable fit indices, the RMR residual-based fit index is also within the good fit indices.

4.3. Descriptive Statistics and Findings Regarding Normal Distribution

The evaluation of the mean and standard deviation values of the attitudes and dimensions towards information technologies, the perception and dimensions towards remote working and the perception towards flexible working, and the kurtosis and skewness values are examined to test the closeness of all these variables to the normal distribution.

Table 5. Findings Regarding Descriptive Statistics

			Skewness		Kurtosis	
	Mean	**Std. Deviation**	**Statistics**	**Std. Error**	**Statistics**	**Std. Error**
Attitudes Towards Information Technologies	4,057	0,588	-1,560	0,116	2,901	0,231
Applicability of Information Technologies	4,064	0,694	-1,294	0,116	2,702	0,231
Gender Equal Opportunities in Information Technologies	4,217	0,692	-1,361	0,116	3,000	0,231
Negative Impact of Information Technologies	3,886	0,649	-0,674	0,116	1,427	0,231
Interest in Learning Information Technologies	4,072	0,783	-1,135	0,116	1,923	0,231
Perception of Remote Working	3,955	0,776	-0,954	0,116	1,039	0,231
Effectiveness and Productivity	3,996	0,842	-0,984	0,116	0,939	0,231
Flexibility	3,835	0,868	-0,516	0,116	-0,009	0,231
Perception of Flexible Working Barriers	2,523	1,136	0,509	0,116	-0,648	0,231

When the average attitude towards information technologies is examined, it is seen that the attitude of the employees towards information technologies is high (=4.057±0.588). When the dimensions of attitude towards information technologies are evaluated, it is concluded that the attitude towards the applicability of information technologies (=4.064±0.694), the attitude towards gender equality of opportunity in information technologies (=4.217±0.692), the negative impact of information technologies (=3.886±0.649) and the interest in learning information technologies (=4.072±0.783) are at a high level. The average values of the perception towards remote working (=3.955±0.776) and its dimensions of effectiveness and efficiency (=3.996±0.842) and flexibility dimensions (=3.835±0.868) are also high. The level of perception towards flexible working and its dimension of perception towards obstacles towards flexible working (=2.523±1.136) are at the indecisive level. Kurtosis and skewness values are used to determine the closeness of all variables to normal distribution. All scale variables are between ±3. This result shows that all variables are close to normal distribution and parametric tests should be used to test hypotheses.

4.4. Findings Regarding Reliability Analysis

Cronbach alpha values of perceptions and dimensions of information technologies, perceptions and dimensions of remote working and perceptions and dimensions of flexible working are measured with the reliability of scales and dimensions.

Table 6. Reliability Analysis Results of All Variables

	Cronbach Alfa	**n**
Attitude Towards Information Technologies	**0,874**	**13**
Dimension of Applicability of Information Technologies	0,767	5
Dimension of Gender Equality of Opportunity in Information Technologies	0,600	2
Dimension of Negative Impact of Information Technologies	0,619	3
Dimension of Interest in Learning Information Technologies	0,827	3
Perception of Remote Working	**0,923**	**12**
Efficiency and Productivity Dimension	0,930	9
Flexibility Dimension	0,754	3
Perception and Barriers to Flexible Working Dimension	**0,892**	**4**

Cronbach's Alpha (CA) is a measure of internal consistency, indicating how reliably a set of items within a scale measure the same construct. The commonly accepted thresholds for interpreting Cronbach's Alpha values are as follows: a value of 0.90 and above indicates excellent reliability, 0.80 - 0.89 indicates good reliability, 0.70 - 0.79 represents acceptable reliability, 0.60 - 0.69 is considered questionable reliability, 0.50 - 0.59 is poor reliability, and values below 0.50 are considered unacceptable. In this study, the dimensions of attitudes towards information technologies and interest in learning information technologies exhibit high reliability, with Cronbach's Alpha values likely falling within the 0.80 - 0.89 range, indicating good internal consistency. The dimensions measuring the applicability of information technologies, equal opportunities in information technologies, and the negative impact of information technologies demonstrate very high reliability, with their Cronbach's Alpha values likely exceeding 0.90, reflecting excellent consistency. Similarly, the effectiveness and efficiency dimension of remote working perceptions shows high reliability, with a Cronbach's Alpha between 0.80 - 0.89, suggesting solid internal consistency. The flexibility dimension of remote working, on the other hand, demonstrates very high reliability, with its Cronbach's Alpha exceeding 0.90, indicating excellent internal consistency. Finally, the perception of obstacles to flexible working also exhibits high reliability, with a Cronbach's Alpha in the 0.80 - 0.89 range. Overall, the Cronbach's Alpha values in this study suggest that the scales used to measure attitudes towards information technologies and perceptions of remote working and flexible working are reliable, with most dimensions showing very high or high internal consistency. This supports the validity of the results and indicates that the measurements used are robust and dependable.

4.5. Hypothesis (Difference) Tests

In order to test the difference between the mean scores of attitudes towards information technologies and dimensions, perceptions and dimensions towards remote working, and perceptions and dimensions towards flexible working according to demographic variables (gender, age, marital status, level of education, and work experience), independent group t-test, one-way analysis of variance (ANOVA), Kruskal Wallis H test, and Mann Whitney U test are used and the results are interpreted.

Table 7. Significance Results of the Differences in Mean Scores of All Variables According to Gender

Gender		n	Mean	Std. Deviation	t	P
Attitude Towards Information Technologies	Male	311	4,150	0,588	**5,393**	**0,000**
	Female	135	3,825	0,574		
Dimension of Applicability of Information Technologies	Male	311	4,192	0,656	**6,157**	**0,000**
	Female	135	3,769	0,691		
Dimension of Gender Equality of Opportunity in Information Technologies	Male	311	4,277	0,701	1,736	0,084
	Female	135	4,137	0,811		
Dimension of Negative Impact of Information Technologies	Male	311	3,967	0,691	**3,602**	**0,001**
	Female	135	3,716	0,637		
Dimension of Interest in Learning Information Technologies	Male	311	4,176	0,753	**4,463**	**0,000**
	Female	135	3,817	0,837		
Perception of Remote Working	Male	311	3,962	0,774	0,284	0,777
	Female	135	3,940	0,782		
Efficiency and Productivity Dimension	Male	311	3,995	0,838	-0,006	0,995
	Female	135	3,996	0,855		
Flexibility Dimension	Male	311	3,863	0,872	1,034	0,302
	Female	135	3,770	0,857		
Perception and Barriers to Flexible Working Dimension	Male	311	2,482	1,125	-1,171	0,242
	Female	135	2,619	1,157		

When the independent group t test results are examined, there is a statistically significant difference between the mean scores of the variables' attitude towards information technologies (p=0.000≤0.01), the applicability of information technologies (p=0.000≤0.01), the negative impact of information technologies (p=0.001≤0.01) and interest in learning information technologies (p=0.000≤0.01) according to gender. The attitudes of men towards information technologies, perception of applicability of information technologies, perception of negative impact of information technologies, and interest in learning information technologies are higher than those of women employees.

Table 8. Significance Results of the Differences in Mean Scores of All Variables According to Marital Status

Marital status		N	Mean	Std. Deviation	t	P
Attitude Towards Information Technologies	Married	298	4,100	0,609	**2,469**	**0,014**
	Single	148	3,952	0,578		
Dimension of Applicability of Information Technologies	Married	298	4,122	0,702	**2,519**	**0,012**
	Single	148	3,947	0,665		
Dimension of Gender Equality of Opportunity in Information Technologies	Married	298	4,297	0,726	**2,561**	**0,011**
	Single	148	4,108	0,748		
Dimension of Negative Impact of Information Technologies	Married	298	3,905	0,695	0,614	0,539
	Single	148	3,863	0,664		
Dimension of Interest in Learning Information Technologies	Married	298	4,129	0,800	**2,323**	**0,021**
	Single	148	3,944	0,776		
Perception of Remote Working	Married	298	3,967	0,783	0,439	0,661
	Single	148	3,932	0,763		
Efficiency and Productivity Dimension	Married	298	4,006	0,841	0,358	0,720
	Single	148	3,975	0,848		
Flexibility Dimension	Married	298	3,850	0,904	0,527	0,598
	Single	148	3,804	0,792		
Perception and Barriers to Flexible Working Dimension	Married	298	2,413	1,110	**-2,934**	**0,004**
	Single	148	2,745	1,158		

When the independent group t test results are examined, there is a statistically significant difference between the average scores of attitudes towards information technologies (p=0.014≤0.05), applicability of information technologies (p=0.012≤0.05), gender equality of opportunity in information technologies (p=0.011≤0.01), interest in learning information technologies (p=0.021≤0.05) and perceptions and barriers to flexible working (p=0.004≤0.01) according to marital status. Married employees' attitudes towards information technologies, perceptions of applicability of information technologies, perceptions of gender equality of opportunity in information technologies, and interest in learning information technologies are higher than single employees. Single employees' perceptions of flexible working and the barriers they encounter are higher.

Table 9. Significance Results of the Differences in Mean Scores of All Variables According to Age

	Age	n	Mean	S.d.	Lev. Test		ANOVA		Post HOC	
					F	p	F	P		
Attitude Towards Information Technologies	24-29	59	3,836	0,828	4,346	0,005	3,379	0,018	Tamhane	-
	30-35	85	4,043	0,587						
	36-41	138	4,061	0,562						
	42 and +	164	4,124	0,532						
	Total	446	4,051	0,603						
Dimension of Applicability of Information Technologies	24-29 (a)	59	3,797	0,932	3,567	0,014	4,710	0,003	Tamhane	(a-d)
	30-35 (b)	85	4,005	0,658						
	36-41 (c)	138	4,081	0,676						
	42 and + (d)	164	4,177	0,600						
	Total	446	4,064	0,694						
Dimension of Gender Equality of Opportunity in Information Technologies	24-29	59	3,975	1,056	5,791	0,001	2,986	0,031	Tamhane	-
	30-35	85	4,259	0,675						
	36-41	138	4,250	0,640						
	42 and +	164	4,302	0,693						
	Total	446	4,234	0,738						
Dimension of Negative Impact of Information Technologies	24-29	59	3,763	0,793	2,091	0,101	0,850	0,467	-	-
	30-35	85	3,922	0,701						
	36-41	138	3,891	0,631						
	42 and +	164	3,921	0,679						
	Total	446	3,891	0,684						
Dimension of Interest in Learning Information Technologies	24-29	59	3,881	0,980	2,517	0,058	1,334	0,263	-	-
	30-35	85	4,086	0,784						
	36-41	138	4,072	0,822						
	42 and +	164	4,120	0,698						
	Total	446	4,067	0,796						
Perception Towards Remote Working	24-29	59	3,864	0,890	1,530	0,206	0,655	0,580	-	-
	30-35	85	3,945	0,791						
	36-41	138	4,023	0,746						
	42 and +	164	3,936	0,751						
	Total	446	3,955	0,776						
Efficiency and Productivity Dimension	24-29	59	3,940	0,946	1,007	0,389	0,368	0,776	-	-
	30-35	85	3,969	0,857						
	36-41	138	4,056	0,809						
	42 and +	164	3,979	0,827						
	Total	446	3,996	0,842						
Flexibility Dimension	24-29	59	3,638	0,900	0,279	0,840	1,620	0,184	-	-
	30-35	85	3,875	0,845						
	36-41	138	3,925	0,859						
	42 and +	164	3,809	0,870						
	Total	446	3,835	0,868						
Perception Towards Flexible Working Barriers	24-29	59	2,826	1,167	2,718	0,044	2,433	0,064	-	-
	30-35	85	2,568	1,183						
	36-41	138	2,543	1,190						
	42 and +	164	2,373	1,033						
	Total	446	2,523	1,136						

When the one-way analysis of variance (ANOVA) results are examined, there is a statistically significant difference between the average scores of the variables of attitude towards information technologies ($p=0.018\leq0.05$), applicability of information technologies ($p=0.003\leq0.01$), gender equality of opportunity in information technologies ($p=0.031\leq0.05$) according to age. Levene test is used to test the homogeneity of significant variables according to age. For variables that are not homogeneous according to age, Tamhane multiple comparison model results are evaluated. The variable that differs between the categories in the Tamhane model result is the applicability of information technologies. Employees aged 42 and over have a higher perception of the applicability of information technologies than employees aged 24-29.

Table 10. Significance Results of the Differences in Average Scores of All Variables According to Education Level

Education Level		n	Mean	Std. Deviation	Kruskall Wallis H Test F	Kruskall Wallis H Test P	Mann Whitney U Test
Attitude Towards Information Technologies	Primary Education	4	4,385	0,562	7,630	0,106	-
	Secondary Education	15	3,897	0,769			
	Associate Degree	42	3,875	0,786			
	Undergraduate	259	4,089	0,567			
	Postgraduate	126	4,040	0,577			
	Total	446	4,051	0,603			
Dimension of Applicability of Information Technologies	Primary Education	4	4,250	0,823	2,320	0,677	-
	Secondary Education	15	4,000	0,793			
	Associate Degree	42	3,914	0,860			
	Undergraduate	259	4,103	0,659			
	Postgraduate	126	4,035	0,691			
	Total	446	4,064	0,694			
Dimension of Gender Equality of Opportunity in Information Technologies	Primary Education	4	4,625	0,479	6,824	0,145	-
	Secondary Education	15	3,933	0,961			
	Associate Degree	42	4,048	0,980			
	Undergraduate	259	4,264	0,696			
	Postgraduate	126	4,258	0,695			
	Total	446	4,234	0,738			
Dimension of Negative Impact of Information Technologies	Primary Education (a)	4	4,750	0,319	**9,999**	**0,040**	(a-b) (a-c) (a-d) (a-e)
	Secondary Educ. (b)	15	3,889	0,888			
	Associate Degree (c)	42	3,802	0,790			
	Undergraduate (d)	259	3,912	0,680			
	Postgraduate (e)	126	3,849	0,625			
	Total	446	3,891	0,684			
Dimension of Interest in Learning Information Technologies	Primary Education (a)	4	4,083	0,687	**9,986**	**0,041**	(b-d) (c-d) (c-e)
	Secondary Educ. (b)	15	3,711	0,950			
	Associate Degree (c)	42	3,770	0,927			
	Undergraduate (d)	259	4,124	0,758			
	Postgraduate (e)	126	4,093	0,788			
	Total	446	4,067	0,796			
Perception Towards Remote Working	Primary Education	4	4,375	0,771	6,735	0,151	-
	Secondary Education	15	3,889	0,962			
	Associate Degree	42	3,665	0,867			
	Undergraduate	259	3,995	0,760			
	Postgraduate	126	3,966	0,741			
	Total	446	3,955	0,776			
Efficiency and Productivity Dimension	Primary Education	4	4,333	0,816	4,230	0,376	-
	Secondary Education	15	3,889	1,085			
	Associate Degree	42	3,733	0,956			
	Undergraduate	259	4,038	0,817			
	Postgraduate	126	3,997	0,819			
	Total	446	3,996	0,842			
Flexibility Dimension	Primary Education (a)	4	4,500	0,638	**11,500**	**0,021**	(c-d) (c-e)
	Secondary Educ. (b)	15	3,889	0,709			
	Associate Degree (c)	42	3,460	0,871			
	Undergraduate (d)	259	3,865	0,902			
	Postgraduate (e)	126	3,870	0,789			
	Total	446	3,835	0,868			
Perception Towards Flexible Working Barriers	Primary Education	4	2,688	1,908	1,030	0,905	-
	Secondary Education	15	2,667	0,854			
	Associate Degree	42	2,530	1,036			
	Undergraduate	259	2,512	1,173			
	Postgraduate	126	2,522	1,107			
	Total	446	2,523	1,136			

Since the frequency of one or more of the education level categories is less than 30, one of the nonparametric tests is used to test the difference. When the Kruskal Wallis H results are examined, there is a statistically significant difference between the mean scores of the negative impact of information technologies ($p=0.040\leq0.05$), interest in learning information technologies ($p=0.041\leq0.05$) and the flexibility dimension ($p=0.021\leq0.05$), which is one of the dimensions of the perception towards remote working, according to the education level. Mann Whitney U test is used to test the difference according to education level categories. Primary school graduates have a higher

negative perception of information technologies than other education level graduates. Bachelor's degree graduates have a higher interest in learning information technologies than secondary school and associate degree graduates. Postgraduate graduates are more interested in learning information technologies than associate degree graduates. Bachelor's and Master's degree graduates perceive the perception of remote working more flexibly than associate degree graduates.

Table 11. Significance Results of the Differences in Mean Scores of All Variables According to Status

		n	Mean	S.d.	Lev. Test		ANOVA		Post-HOC	
					F	P	F	P		
Attitude Towards Information Technologies	Team Member	269	4,080	0,573	2,362	0,095	0,800	0,450	-	-
	Manager	146	4,007	0,645						
	Senior Executive	31	4,097	0,395						
	Total	446	4,057	0,588						
Dimension of Gender Equality of Opportunity in Information Technologies	Team Member	269	4,078	0,681	3,464	0,032	1,180	0,308	-	-
	Manager	146	4,008	0,755						
	Senior Executive	31	4,206	0,460						
	Total	446	4,064	0,694						
Dimension of Applicability of Information Technologies	Team Member	269	4,228	0,689	0,836	0,434	0,160	0,852	-	-
	Manager	146	4,192	0,729						
	Senior Executive	31	4,247	0,530						
	Total	446	4,217	0,692						
Dimension of Gender Equality of Opportunity in Information Technologies	Team Member	269	3,901	0,656	0,705	0,495	0,160	0,852	-	-
	Manager	146	3,892	0,654						
	Senior Executive	31	3,726	0,560						
	Total	446	3,886	0,649						
Dimension of Negative Impact of Information Technologies	Team Member	269	4,109	0,738	2,269	0,105	1,017	0,362	-	-
	Manager	146	3,978	0,871						
	Senior Executive	31	4,194	0,688						
	Total	446	4,072	0,783						
Dimension of Interest in Learning Information Technologies	Team Member	269	4,109	0,738	2,269	0,105	1,735	0,178	-	-
	Manager	146	3,978	0,871						
	Senior Executive	31	4,194	0,688						
	Total	446	4,072	0,783						
Dimension of Interest in Learning Information Technologies	Team Mem. (a)	269	4,069	0,716	4,129	0,017	**7,564**	**0,001***	Tam.	(a-b)
	Manager (b)	146	3,795	0,842						
	Senior Executive (c)	31	3,726	0,796						
	Total	446	3,955	0,776						
Efficiency and Productivity Dimension	Team Mem. (a)	269	4,122	0,776	4,097	0,017	**8,147**	**0,000***	Tam.	(a-b) (a-c)
	Manager (b)	146	3,825	0,912						
	Senior Executive (c)	31	3,703	0,868						
	Total	446	3,996	0,842						
Flexibility Dimension	Team Member	269	3,910	0,851	0,084	0,920	2,671	0,070	-	-
	Manager	146	3,705	0,900						
	Senior Executive	31	3,796	0,810						
	Total	446	3,835	0,868						
Perception Towards Flexible Working Barriers	Team Member	269	2,465	1,152	0,175	0,840	0,896	0,409	-	-
	Manager	146	2,615	1,110						
	Senior Executive	31	2,597	1,117						
	Total	446	2,523	1,136						

When the one-way analysis of variance (ANOVA) results are examined, there is a statistically significant difference between the average scores of the variables of attitude towards remote work according to status ($p=0.001\leq0.01$), effectiveness and efficiency dimension ($p=0.000\leq0.01$). When the Levene homogeneity test is examined, the results of the Tamhane multiple comparison model are evaluated for variables that are not homogeneous according to status. The variable that differs between the categories in the Tamhane model result is the perception towards remote work and the effectiveness and efficiency dimension. The perception of team

members towards remote work is higher than the employees who are managers/supervisors. The perception of effectiveness and efficiency in remote work is higher among the employees who are team members compared to the employees who are managers/supervisors and senior managers. Below are details regarding the range of P significance levels:

- *p < 0.01** indicates a statistically significant result at the 1% level.
- p < 0.05 indicates a statistically significant result at the 5% level.
- p < 0.10 indicates a statistically significant result at the 10% level.

Table 12. Significance Results of the Differences in the Average Scores of All Variables According to Work Experience

		n	Mean	Std. Deviation	Levene Homogeneity Test F	Levene Homogeneity Test p	ANOVA F	ANOVA p
Attitude Towards Information Technologies	1-5 years	174	4,074	0,610	1,718	0,145	0,920	0,452
	6-10 years	82	4,103	0,491				
	11-15 years	81	3,947	0,602				
	15-20 years	54	4,059	0,703				
	20 years and above	55	4,095	0,497				
	Total	446	4,057	0,588				
Dimension of Applicability of Information Technologies	1-5 years	174	4,061	0,713	1,297	0,271	0,660	0,620
	6-10 years	82	4,044	0,684				
	11-15 years	81	4,015	0,693				
	15-20 years	54	4,041	0,783				
	20 years and above	55	4,200	0,552				
	Total	446	4,064	0,694				
Dimension of Gender Equality of Opportunity in Information Technologies	1-5 years	174	4,213	0,749	1,419	0,227	0,778	0,540
	6-10 years	82	4,248	0,662				
	11-15 years	81	4,111	0,648				
	15-20 years	54	4,259	0,751				
	20 years and above	55	4,303	0,534				
	Total	446	4,217	0,692				
Dimension of Negative Impact of Information Technologies	1-5 years	174	3,856	0,641	2,813	0,025	1,279	0,278
	6-10 years	82	4,018	0,503				
	11-15 years	81	3,809	0,664				
	15-20 years	54	3,917	0,774				
	20 years and above	55	3,864	0,705				
	Total	446	3,886	0,649				
Dimension of Interest in Learning Information Technologies	1-5 years	174	4,148	0,804	0,818	0,514	1,897	0,110
	6-10 years	82	4,122	0,756				
	11-15 years	81	3,867	0,789				
	15-20 years	54	4,065	0,866				
	20 years and above	55	4,064	0,613				
	Total	446	4,072	0,783				
Perception of Remote Working	1-5 years	174	4,017	0,760	0,201	0,938	0,734	0,569
	6-10 years	82	3,900	0,831				
	11-15 years	81	3,897	0,691				
	15-20 years	54	3,869	0,835				
	20 years and above	55	4,012	0,807				
	Total	446	3,955	0,776				
Efficiency and Productivity Dimension	1-5 years	174	4,065	0,823	0,428	0,788	0,815	0,516
	6-10 years	82	3,957	0,912				
	11-15 years	81	3,916	0,742				
	15-20 years	54	3,887	0,913				
	20 years and above	55	4,057	0,869				
	Total	446	3,996	0,842				
Flexibility Dimension	1-5 years	174	3,874	0,879	0,356	0,840	0,417	0,796
	6-10 years	82	3,732	0,920				
	11-15 years	81	3,840	0,860				
	15-20 years	54	3,815	0,803				
	20 years and above	55	3,879	0,842				
	Total	446	3,835	0,868				
Perception and Barriers to Flexible Working Dimension	1-5 years	174	2,443	1,131	0,360	0,837	0,382	0,821
	6-10 years	82	2,552	1,174				
	11-15 years	81	2,571	1,113				
	15-20 years	54	2,616	1,155				
	20 years and above	55	2,573	1,130				
	Total	446	2,523	1,136				

When the one-way analysis of variance (ANOVA) results are examined, there is no statistically significant difference between the mean scores of all variables according to work experience.

4.6. Structural Regression Analysis

Structural regression analysis is performed with the SPSS AMOS program to determine the effect of the attitude towards information technologies on the perception and dimensions of remote work and the perception and dimensions of flexible work.

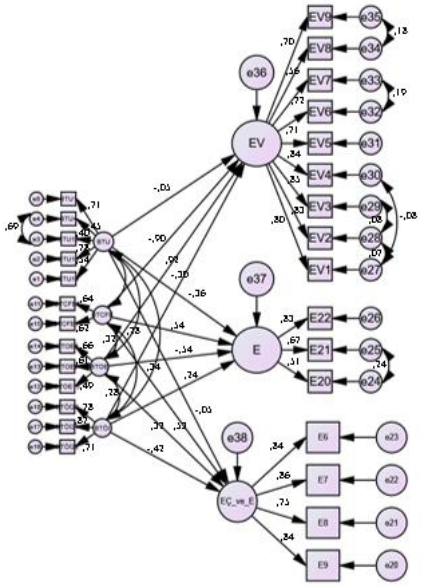

Figure 5. Structural Regression Model Regarding the Effect of Attitude Towards Information Technologies on Perception of Remote Working and Perception of Flexible Working

The structural regression analysis conducted to determine the effect of attitude towards information technologies on the perception of remote working and perception of flexible working shows the model that shows a good fit above.

Table 13. Good Fit Results of the Model Regarding the Effect of Attitude Towards Information Technologies on Perception of Remote Working and Perception of Flexible Working

Compliance Indices	Calculated Compliance Indices
x2/sd ≤ 3	1,950
0,90≤NFI≤0,94	0,915
0,90≤GFI	0,907
RMSEA≤0,05	0,046
6≤RMR≤0,08	0,058

In structural equation modeling (SEM), several fit indices are used to assess the adequacy of a model in explaining the relationships between variables. The most commonly used fit indices include the Normed Fit Index (NFI), Goodness of Fit Index (GFI), Root Mean Square Error of Approximation (RMSEA), and Root Mean Square Residual (RMR). An NFI value of 0.90 or above is generally considered acceptable, indicating that the model explains the data well. The GFI is considered a good fit when it is 0.90 or above, reflecting that the model's covariance matrix matches the observed data. The RMSEA is considered a good fit when it is 0.05 or below, with values between 0.05 and 0.08 indicating a reasonable fit, while values above 0.10 suggest a poor fit. The RMR should be 0.05 or below for a good fit, with values between 0.05 and 0.08 considered acceptable. In this study, the general fit of the model regarding the effect of attitudes towards information technologies on perceptions of remote working and flexible working was evaluated. The NFI index was found to be within the acceptable fit range, suggesting that the model explains the data adequately, although there may be room for improvement. The GFI index was within the good fit range, indicating a strong match between the observed and predicted covariance matrices. Similarly, the RMSEA value was within the good fit range, suggesting that the model has a reasonable

fit with only slight room for improvement. Finally, the RMR value was also within the acceptable fit range, further confirming the model's adequacy. These results indicate that the model fits the data well, with some areas for potential refinement to enhance the overall fit.

Table 14. Regression Results of the Model Regarding the Effect of Attitude Towards Information Technologies on Perception Towards Remote Working and Perception Towards Flexible Working

			Standardized Beta	Unstandardized Beta	Standard Error	P
EV	<---	BTU	-0,050	-0,085	0,420	0,841
E	<---	BTU	-0,360	-0,446	0,247	0,071
EÇ_ve_E	<---	BTU	-0,050	-0,119	0,279	0,670
EV	<---	BTCFE	-0,900	-0,675	9,340	0,143
E	**<---**	**BTCFE**	**0,540**	**0,645**	**2,700**	**0,025**
EÇ_ve_E	**<---**	**BTCFE**	**0,535**	**0,612**	**1,184**	**0,018**
EV	<---	BTOE	0,920	0,831	8,206	0,118
E	**<---**	**BTOE**	**-0,545**	**-0,262**	**2,444**	**0,031**
EÇ_ve_E	**<---**	**BTOE**	**0,325**	**0,227**	**1,056**	**0,035**
EV	<---	BTÖİ	-0,300	-0,326	0,253	0,198
E	<---	BTÖİ	0,245	0,204	0,146	0,163
EÇ_ve_E	<---	BTÖİ	0,245	-0,066	0,190	0,730

As a result of structural regression, gender equality of opportunity in information technologies affects flexibility ($p=0.025\leq0.05$) and flexible working perception and barriers ($p=0.018\leq0.05$) variables, which are perception dimensions towards remote working. The negative impact of information technologies affects flexibility ($p=0.031\leq0.05$) and flexible working perception and barriers ($p=0.035\leq0.05$) variables. The attitude towards information technologies partially affects the perception towards remote working and flexible working perception.

5. RESULT AND DISCUSSION

The results of this study reveal in detail the effect of attitudes towards digital technologies on perceptions towards remote working and other flexible working styles. The research findings show that employees who develop a positive attitude towards digital technology adapt to remote working and flexible working models more quickly and adopt these working styles more easily. This finding is consistent with studies in the existing literature indicating that positive attitudes towards information technologies positively affect the perception of flexible work.

Gajendran and Harrison's study on virtual work arrangements highlighted the importance of employees' digital competencies in facilitating remote work. Their research showed that employees who possess higher levels of digital competence adapt more easily to remote work environments and experience better job performance and satisfaction. Their findings support the idea that digital technologies enable smoother transitions into flexible work models.

Similar to Gajendran & Harrison (2007), your study confirms that employees with strong digital skills are more successful in adopting flexible work styles. Your study goes further by explicitly stating the critical role of digital skills in the adoption of flexible work arrangements, which parallels Gajendran and Harrison's conclusion about the importance of digital competence for job performance and satisfaction.

Mazmanian et al. (2013) explored how digital technologies impact work-life balance. They found that the constant connectivity afforded by digital tools can either enhance or hinder work-life balance, depending on how employees manage their use. Those who can set boundaries and control their digital technology use report higher levels of satisfaction and better work-life balance.

Your study also supports the positive effects of digital technologies on work-life balance, indicating that employees with positive attitudes towards digital tools experience an easier adaptation process to flexible working models. Both studies agree on the positive relationship between digital technology use and work-life balance, but Mazmanian et al. (2013) also discuss the dual impact of technology, depending on usage habits.

Choudhury et al. (2020) analyzed the effects of digital technologies on productivity, particularly during the COVID-19 pandemic when remote work became widespread. They found that employees who were accustomed to digital tools and technologies were able to maintain or even increase productivity when working remotely. The researchers emphasized that digital competence allowed employees to manage work effectively from a distance.

Your findings align with Choudhury et al. (2020), as you mention that positive attitudes towards digital technologies facilitate adaptation to flexible work models. This suggests that digital competence not only helps in adjusting to remote work but also improves job performance and efficiency, echoing the findings of Choudhury et al. (2020).

Ayyagari et al. (2011) explored how digital technology use impacts employee satisfaction. They found that employees who perceived digital technologies as enabling tools for their work were more likely to experience increased job satisfaction, particularly in environments where flexible work arrangements were available. This was attributed to the empowerment that comes with digital tools and the ability to manage work tasks efficiently from any location.

Your study concurs with Ayyagari et al. (2011) by highlighting that employees with positive attitudes towards digital technologies report increased job satisfaction and better job performance. Your study specifically emphasizes the human factor in the digital transformation process, suggesting that attitudes towards digital tools significantly influence the success of flexible work arrangements.
Your study's findings are in line with established literature, particularly concerning the positive effects of digital competencies on remote and flexible work arrangements. Studies by Gajendran & Harrison (2007) and Ayyagari et al. (2011) support your observation that employees with strong digital skills experience better job performance, increased job satisfaction, and more successful adaptation to flexible work models. Additionally, your research adds to the understanding of how positive attitudes towards digital technologies facilitate the transition to flexible work, further reinforcing the importance of digital competence in the modern workplace.

Previous studies have emphasized the importance of digital training programs and robust digital infrastructure in facilitating the adoption of flexible work models and increasing productivity. For instance, DeLisi and Cummings (2020) found that digital training programs significantly enhance employees' ability to adapt to remote and flexible work environments, as these programs increase employees' digital competence, making them more confident and productive. This aligns with the findings of your study, which also highlights that digital training programs reduce negative attitudes towards digital technologies and ease the transition to flexible work styles. Similarly, Cascio and Montealegre (2016) discussed the critical role of digital infrastructure, such as reliable internet access and cloud-based tools, in supporting flexible work arrangements. Their research suggests that a strong technological foundation enables employees to work effectively from a distance, a point echoed in your study, where the availability of such infrastructure is seen as essential for facilitating the adoption of flexible work models. Additionally, Kelliher and Anderson (2010) explored how digitalization positively impacts work-life balance and job satisfaction, noting that digital tools allow employees to better manage their personal and professional lives. Your study concurs with these findings, as it shows that digitalization can improve work-life balance, increase job satisfaction, and reduce stress levels. Overall, the results of your study reinforce the findings of previous research and offer practical solutions for enhancing the effectiveness of flexible working models, particularly through digital training and infrastructure support.

6. CONCLUSION

Our study shows that positive attitudes towards digital technologies facilitate adaptation to flexible working models, highlighting the importance of digital training and development programs. These programs should be continuously organized by businesses to enhance employees' digital competencies. By improving their digital skills, employees will become more effective in flexible working environments. Additionally, providing a strong digital infrastructure is essential for successful digital transformation. Our findings reveal that deficiencies in digital infrastructure can negatively affect perceptions of flexible working. Therefore, investing in digital tools and technologies will improve the effectiveness of remote and other flexible working models, ensuring seamless transitions for employees.

Furthermore, considering the positive impact of digitalization on work-life balance, businesses should develop policies to support employees in achieving this balance. Offering flexible working hours, remote working options, and support services accessible via digital tools can significantly enhance employee satisfaction and productivity. In line with this, businesses should also focus on developing a digital culture. Since our study emphasizes that attitudes towards digital technologies are directly linked to the adaptation of flexible working styles, cultivating a digital culture within organizations is crucial. Digitalization is not just a technical process but requires a cultural shift, which businesses must strategically foster.

In addition, businesses must update their performance and motivation systems to align with the digital transformation. Performance evaluation systems supported by digital tools will be critical for assessing the effects of digitalization and optimizing employee performance in a flexible work environment. The findings of our study align with existing literature, reinforcing that positive attitudes towards digital technologies enhance perceptions of remote and flexible working. This suggests that both employees and organizations must invest in increasing digital competencies, strengthening digital infrastructure, and expanding flexible working models to successfully navigate the digital transformation process. This approach should include strategic planning and the expansion of digital training programs to fully leverage the opportunities provided by digitalization.

However, our study also points to an important discussion regarding the post-pandemic return to traditional corporate work cultures, despite the widespread adoption of remote work during the pandemic. For instance, companies like Amazon, which initially embraced remote work during the pandemic, have started shifting back to more traditional office-based work cultures. This raises the question of whether the benefits of remote work are being fully recognized or whether there are underlying biases against the permanence of such working models. The assumption that remote work is an inherently good solution is not necessarily objective, and it is important to critically assess the challenges and limitations of remote work, especially in the long term. Our study suggests that while digital transformation has positive effects, it is not a one-size-fits-all solution, and further research is needed to understand the complexities of flexible working in the evolving business world.

AUTHORS' DECLARATION:

This study was produced from the master's thesis prepared under the supervision of the second author. This paper complies with Research and Publication Ethics, has no conflict of interest to declare, and has received no financial support. For the scale used in the article, it is declared by the authors that permission was optained from the original owner of the scale. The author(s) sent a signed "*Copyright Transfer Form*" to the journal. Regarding the conduct of this research, an "*Ethics Permission Certificate*" dated 03/062/024 and numbered 2024/05 was obtained from the Ethics Committee of the University of Istanbul Esenyurt.

AUTHORS' CONTRIBUTIONS:

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The Impact of Intellectual Property Payments and R&D on Economic Growth: A Panel Analysis on Highly Industrialized Countries

Fikri Mülkiyet Hakları ve R&D'nin Ekonomik Büyüme Üzerine Etkisi: Yüksek Endüstrileşmiş Ülkeler Üzerine Panel Analizi

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ABSTRACT

Research and development (R&D) activities play a crucial role in facilitating economic growth. Numerous studies suggest that R&D activities have a positive influence on economic growth. However, according to endogenous growth models, the impact of research and development on growth is expected to diminish over time due to the principle of diminishing returns. This scenario implies that the significance of research and development activities in relation to economic growth warrants further examination. A robust connection exists between research and development and intellectual property rights. The safeguarding of intellectual property and information is vital for technological advancement. The evolution of information, technology, and patent systems heavily relies on investment in intellectual property. Considering these factors, a study was conducted to analyze the effects of R&D and intellectual property investments on economic growth within nine highly industrialized nations. This analysis utilized annual panel data spanning from 2004 to 2023. The findings of the study indicate that both research and development efforts, as well as expenditures on intellectual property, contribute positively to economic growth in these highly industrialized countries.

Anahtar Kelimeler:
Ekonomik Büyüme,
Araştırma ve Geliştirme,
Fikri Mülkiyet Ödemeleri,
Panel Veri Analizi

Jel Kodları:
O11, O32, O34, O40

ÖZET

Araştırma ve geliştirme faaliyetleri ekonomik büyümenin önemli bir parçası olarak kabul edilmektedir. Birçok araştırma, Araştırma ve geliştirme faaliyetlerinin ekonomik büyümeye etkisinin olumlu olduğunu belirtmektedir. Fakat içsel büyüme modellerinin öngördüğü şekilde azalan verimler kanunu gereği araştırma ve geliştirme faaliyetlerinin büyümeye etkisinin zamanla azalması gerekmektedir. Bu durum araştırma ve geliştirme faaliyetlerinin ekonomik büyümeye etkisinin yeniden ele alınması gerektiğini göstermektedir. Araştırma ve geliştirme faaliyetleri ile fikri mülkiyet arasında güçlü bir ilişki bulunmaktadır. Fikri mülkiyet hakları, bilginin korunması teknolojinin gelişmesi için hayatidir. Bilgi, teknoloji ve patent yapısının gelişmesi ise fikri mülkiyet harcamaların gelişime bağlıdır. Bahsedilen gerekçeler ışığında araştırma ve geliştirme ile birlikte fikri mülkiyet harcamalarının ekonomik büyüme üzerine etkileri 9 yüksek endüstrileşmiş ülke için ele alınmıştır. 2004-2023 dönemi yıllık veriler ile panel veri analizi gerçekleştirilmiştir. Çalışma sonucunda araştırma ve geliştirme faaliyetleri ile fikri mülkiyet harcamalarının yüksek endüstrileşmiş ülkelerdeki ekonomik büyümeyi desteklediği sonucuna ulaşılmıştır.

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1. INTRODUCTION

While research and development (R&D) activities are vital components of endogenous economic growth models, they are affected by the law of diminishing returns (Solow, 1956). This indicates that although R&D expenditures positively influence economic growth (EG), the benefits derived from these expenditures tend to diminish over time. It is anticipated that advancements in technology, specialization, and information technology may help alleviate these diminishing returns. Growiec (2022) argues that to counteract the diminishing returns associated with R&D spending, there should be corresponding support through additional R&D investment. Similarly, Iwaisako (2023) emphasizes that in order to sustain the favorable impact of R&D on EG, an increase in R&D investments should be prioritized in sectors with a strong emphasis on research activities. These studies advocate for policy interventions to ensure that the returns on R&D expenditures continue to contribute positively to EG. Empirical research suggests that the influence of R&D spending on EG is more pronounced in developed countries; however, evidence shows that there is a convergence trend between developed and developing nations. In scenarios where diminishing returns occur, resources tend to shift towards areas with higher returns. As a result, R&D efforts in developed countries may redirect to more productive and effective sectors. This shift could lead to a reduced impact of R&D on EG in countries that lose their research capabilities. Several studies support this notion. For instance, Celli et al. (2024) found that the convergence rate between countries investing relatively less in R&D and those investing more is consistent among EU nations, reinforcing the idea that developed countries may not achieve adequate efficiency due to diminishing returns. Similar findings were reported by Gumus & Celikay (2015), where a comparative analysis of developed and developing countries revealed that R&D's effect on EG is more significant in developing nations. These discussions highlight the necessity of reevaluating the relationship between R&D and EG in developed countries, taking into account the implications of diminishing returns.

Intellectual Property Rights (IPR) and Intellectual Property Payments (IPP) are important for technology development and technology transfer between countries. The ideas developed by researchers are protected by a patent. The development of the patent structure in countries depends on the development of IPR. The development of IPR requires an increase in spending on intellectual property. The expenditures made by countries for this purpose cause researchers to increase innovation in science and technology (Kim et al., 2012: 359; Falvey et al., 2006: 701; Kwan & Lai, 2003: 854). In this sense, IPP and R&D are an inseparable whole and it is very important to consider them together. This study aims to contribute to the literature by examining the effects of IPP and R&D on EG together.

Investment is the foundation of macroeconomic growth. R&D activities are essential for the development of investments. The development of R&D takes place in the IPR and IPP timeline. It is important to consider the mentioned elements together in terms of the integrity of the subject. The literature has focused more on R&D and economic growth. This study emphasizes the importance of the issue by adding the IPP variable.

In the second part of the study, the theoretical structure of the subject is explained. The third part is a summary of the literature. This is followed by the results section. In this section, first the data and hypothesis, second the econometric method to be applied and third the empirical results will be shared. The last part presents the results and conclusions.

2. THEORETICAL BACKGROUND

According to the endogenous growth theory, EG is an internal process and arises under the influence of factors such as innovation, technology and intellectual property (Romer, 1990). As firms finance creativity and innovation, EG is stimulated. Spending on intellectual property is one of the most important elements of this process. Neoclassical growth theory, while examining the relationships between factors of production, suggests that technological progress and innovation are external (Solow, 1956). In an economy with strong IPR, the promotion of innovation and technological development accelerates EG.

IPR is an important positive economic externality that reflects the innovation and creativity of a society. IPR is a structure that ensures access to and control over works and the economic benefits they derive from those works. IPR has a structure that fundamentally affects many factors that support EG. Some of these are innovation, technological development, the growth of the knowledge economy, international competition, and social effects in the economic development process (Chang, 2001: 288).

IPR play a central role in promoting innovation and creativity. Property rights such as patents, copyrights and trademarks protect innovations developed by an individual or a firm. This protection encourages entrepreneurs

and investors to take risks because they know they can protect the value they create. In this context, the introduction of new products and services to the market allows the firm to gain a competitive advantage (Singh et al., 2019: 3). This situation ensures the promotion of innovation through IPR.

IPR are a structure that has a direct impact on technological development and the flow of knowledge. Strong intellectual property protection mechanisms allow companies to invest more in R&D activities. Firms try to maximize the commercial potential of this knowledge by protecting their knowledge and innovations. This creates a foundation for future technological development (Ghafele & Gibert, 2012: 3). This refers to the provision of technological development and knowledge flows through IPR.

In the 21st century, the knowledge economy has been transformed into a structure based on knowledge and technology. In this context, the role of IPR has a great impact on the development of the knowledge economy. IPRs contribute to the implementation of knowledge-based business models by ensuring the protection of knowledge products. With the new products and services developed, enterprises that have a competitive advantage in the knowledge economy contribute to EG. This situation illustrates the strong relationship between IPRs and the knowledge economy. In the context of the knowledge economy, the value of knowledge and intellectual property increases (Dinopoulos & Segerstrom, 2010: 15).

IPR is an important factor that increases competition in the international market. Countries with a strong IPR system become more competitive in global markets. This increases the ability to attract foreign investment and promotes technology transfer. IPRs are considered as a factor that supports innovation in countries around the world (Hammami, 2019: 861; Pouris & Pouris, 2011: 3). In this regard, it is accepted that the IPR increases in developed countries carry out a technology transfer to developing countries.

The relationship between R&D and EG is also a very important topic in the economic literature. Researchers have identified many direct and indirect effects between R&D and EG in the past. The first of the direct effects of R&D on EG is that R&D enables the development of innovative products and services. The existence of innovative products and services is a factor that positively affects demand in both domestic and foreign markets. The stimulation of effective demand in the country has a positive effect on total supply. Innovative products and services offered to foreign markets will make countries superior in international competition and will support EG by providing foreign exchange inflows to the country.

High R&D expenditures allow firms to increase their productivity. Studies show that R&D expenditures directly lead to increased productivity (Alam & Alvi, 2024: 3). Innovative processes improve production methods and optimize the use of resources. In this context, success in innovative processes leads to lower costs and higher profit margins. R&D helps companies increase their competitiveness and expand their market share. Innovative products and services exceed customer expectations and allow companies to be more dominant in the marketplace. Therefore, successful R&D studies contribute to EG by increasing companies' revenues. In addition, R&D investment has the potential to directly increase employment. Companies that develop new products and technologies usually need more workers. This leads to an increase in employment in the labor market. Increased employment also contributes to EG by increasing consumer spending.

R&D facilitates the transformation of knowledge and technology and supports its diffusion within the industry. Transforming the results of scientific research into practical applications accelerates the innovation process. For example, companies that collaborate with universities and research institutions can increase their competitiveness by acquiring the latest technologies and knowledge from external sources. This knowledge transfer contributes to EG by supporting the development of other firms in the sector (Wang et al. 2022: 525).

Developed countries are mobilized to develop R&D investments and global collaborations are established. This situation triggers EG by increasing international trade and foreign investment. Internationalization can strengthen the position of firms in the global market by enabling them to differentiate themselves.

Public policies can have an indirect effect on EG by encouraging R&D processes. Governments can encourage the private sector to focus on R&D by using tools such as tax incentives, grants and funding. These policies create a foundation that supports long-term EG (Cohen et al., 2002).

There are important links between intellectual property and R&D. The first is related to innovation management. Increasing R&D spending has a direct impact on the success of innovation processes. However, spending on R&D alone can reduce the competitiveness of the company if the products and services derived at the end of the process are not protected by intellectual property rights. Therefore, R&D and intellectual property strategies must work in harmony in the innovation management process. The second relates to market strategy. Intellectual property protection shapes a product's market entry strategies. If a company has strong intellectual property rights for the

product or service it develops in the R&D process, it will have an advantage in entering the market. In addition, intellectual property protection can increase investor interest and create additional financing opportunities. The third is risk management. R&D projects usually involve high risks. Effective management of intellectual property rights helps to minimize these risks. Patents and other intellectual property tools provide significant protection to firms in highly competitive sectors, allowing them to implement R&D investments more securely (Manap et al., 2016).

3. LITERATURE

The association of knowledge and technology with the concept of EG is based on Arrow's (1962) "learning by doing" model. The basic idea is that individuals develop their educational experiences while working. It is very important to consider this concept as an internal factor and it is believed that it will contribute significantly to EG. Later, Christensen et al. (1973) studied the effect of technology using many input factors on a generalized functional form, and the effect of technological change attracted attention in economic literature. In this model, technology was considered to be external. Romer (1986) emphasized the important role of knowledge and human capital in EG. Since increasing knowledge is the basic building block of human capital, the concept of human capital was evaluated as internal. Thus, human capital was no different from other internal factors. Lucas (1988) emphasized the important role of both knowledge and human capital in EG. Romer (1990) added significant richness to the literature with a growth model in which Romer accepted all the concepts of technology, innovation, and knowledge as internal. These studies are seminal in explaining the fundamental roles of information, technology, and human factors in EG. Researchers have tested the validity of these situations in different countries and different periods.

In exploring the link between research and development (R&D) activities and economic growth (EG), Inekwe (2015) carried out a study involving 88 developing nations. The countries were classified into two categories: high-income and low-income. The findings revealed that R&D expenditures in high-income countries have a beneficial impact on economic growth, whereas the impact in low-income countries was found to be negligible. Gumus & Celikay (2015) assessed 52 countries, comprising both developed and developing nations. Their study concluded that R&D spending positively affects EG in both categories; however, it is noteworthy that the coefficient for developing countries was higher compared to that for developed countries, indicating that the relationship between R&D and EG is more favorable for developing nations, with substantial results. Dogan & Yildiz (2016) concluded that R&D expenditures lead to improvements in financial indicators in capital markets. One of the significant outcomes from the research by Sokolov-Mladenović et al. (2016) highlights that the effect of R&D investment on EG is more than twice as substantial. Additionally, the study noted a negative correlation between rising fertility rates in EU countries and EG. In a separate study by Nair et al. (2020) focusing on OECD countries, it was demonstrated that R&D expenditure is a key component of sustainable EG in these nations. They also stressed the importance of infrastructure investments in the information and communication technology sector in supporting the R&D domain. Olaye et al. (2020) conducted a study in Africa, concluding that innovation driven by R&D expenditures is fundamental to achieve sustainable growth in African nations. Furthermore, Ahmet & Zheng (2023) examined the effects of patenting and R&D spending on EG across 36 OECD countries, utilizing both linear and nonlinear analytical methods. Their findings indicated that positive fluctuations in R&D investments contribute to EG during periods of economic expansion, while negative fluctuations during downturns can adversely affect growth. Iwaisako (2023) investigated the influence of R&D expenditures on EG and emphasized that for optimal economic growth, the allocation of R&D funds or subsidies should be directed towards industries with higher research intensity. Celli et al. (2024) analyzed the link between R&D spending and growth in EU nations, finding a positive influence of R&D on EG. Notably, the study observed that countries investing heavily in R&D do not necessarily gain more benefits than those investing less, suggesting a convergence trend among EU countries. Khezri et al. (2024) examined 46 nations and concluded that, despite low R&D spending, macroeconomic factors still positively impact growth. These findings illustrate that R&D significantly influences EG in developing countries.

Several studies have also looked at the combined effects of R&D and intellectual property rights (IPR) or intellectual property policies (IPP) on EG. Park (1999) conducted research on 60 nations, finding a positive influence of R&D on EG, though the impact of IPR was statistically insignificant. Schneider (2005) studied 47 developed and developing countries and concluded that both R&D and IPR positively affect EG. Xu & Cao (2019) focused on the role of IPR in sustainable EG in China and found that, while IPR had a positive effect on EG, the influence of R&D was not statistically significant. In a study of 12 European countries, Aricioglu & Ucan (2015) found a positive impact of IPR, yet R&D was not statistically significant. Liu (2016) examined 92 countries and

determined that both IPR and R&D positively affect EG, with R&D having a more substantial impact than IPR. Ambrammal (2023) surveyed 129 countries and categorized the results by income levels, demonstrating that R&D has a strong positive effect on sustainable EG, independent of income groupings. The effect of IPR on EG was observed to be U-shaped. Lastly, Cheng et al. (2024) conducted research on 107 countries, confirming that both R&D and IPR positively influence EG, with the authors indicating that IPR enhances EG by increasing the stock of knowledge capital through R&D endeavors.

4. EMPIRICAL ANALYSIS

This section will be divided into 3 parts. The first part discusses the data and the hypothesis. The second part introduces the panel data analysis to be used. The third part presents the results of the analysis.

4.1. Data and hypothesis

This study examines the impact of IPP and R&D variables on EG. The study was conducted on 9 highly industrialized countries (United States, Germany, China, France, United Kingdom, Italy, Japan, Canada, Russian Federation). A panel with the variables listed in Table 1 was constructed for the data period 2004-2023. The reason for choosing this data period is to study the effects of the specified variables on EG in developed countries over the last twenty years. The study used panel data analysis. The analyses were implemented in the Stata package program.

Table 1. Variables, Descriptions and Sources

Variables	Explanations	Source
Economic growth	GDP (constant 2015 US$)	World Bank
İnvestment	Gross capital formation (% of GDP)	World Bank
Employment	Employment to population ratio, 15+, total (%)	World Bank
Trade	Export plus import (% of GDP)	World Bank
Inflation	Inflation, GDP deflatör (annual %)	World Bank
Intellectual Property Payments	Charges for the use of intellectual property, payments (BoP, current US$)	World Bank
Research and Development	Patent applications	World Bank

All seven variables used in the study were obtained from the World Bank's, World Development Indicators database. Since the econometric regression model was constructed using the Cobb-Douglas production model, EG was used as the dependent variable; capital, employment, and other variables were used as explanatory variables.

$$ln\ gdp_{i,t} = inv_{i,t} + emp_{i,t} + inf_{i,t} + trd_{i,t} + ln\ ıpp_{i,t} + ln\ rnd_{i,t} + u_{i,t} \quad (1)$$

Equation (1) represents the panel regression to be applied. The explanations of the variables, whose short names are written, are shown in Table 1. In equation (1), i represents the units; t represents the time operator; u represents the error terms. A panel data consisting of 9 units and 20 time series was used in the study. Although other variables were used as ratios and percentages, since the variables of *Economic Growth*, *Intellectual Property Payments* and *Research and Development* were at level value, the logarithm of these three variables was taken.

Table 2. Descriptive Statistics of Variables

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
Economic growth	178	28.86	0.830	27.61	30.71
İnvestment	175	24.12	7.291	14.96	46.66
Employment	178	57.37	6.192	42.83	71.23
Inflation	178	3.022	4.133	-2.324	24.46
Trade	176	53.56	17.00	23.10	99.88
Intellectual Property Payments	178	23.21	0.717	20.77	24.83
Research and Development	156	10.68	1.627	8.307	14.17

Since data for some years in the series of the variables are missing in the data source, unbalanced panel data were used. Table 2 shows that the data for *Economic growth, Employment, Inflation,* and *Intellectual Property Payments* are complete in terms of observations, while the observations of other variables are missing. The highest standard

deviation is found in the *Trade* variable. In addition, the difference between the minimum and maximum values also occurred in the *Trade* variable.

4.2. Econometric Method

Panel data analysis is a combination of time series and cross-sectional analysis. Thus, information can be obtained from both unit and time dimensions.

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 T_{it} + \beta_3 Z_{it} \dots\dots\dots \beta_k M_{k,it} + \mathrm{u}_{it} \quad (2)$$

Equation (2) shows a panel data linear regression. Y represents the dependent variable, and X,T,Z and M represents the independent variable. The i symbol represents the number of units, and t represents the time dimension.

$$\begin{aligned} &a)\ Y_{it} = \beta_0 + \beta_1 K_{it} + \lambda_{\mathrm{i}} + \zeta_t + \mathrm{u}_{it} \\ &\mathrm{b})\ Y_{it} = \beta_0 + \beta_1 K_{it} + \zeta_t + \mathrm{u}_{it} \\ &\mathrm{c})\ Y_{it} = \beta_0 + \beta_1 K_{it} + \lambda_{\mathrm{i}} + \mathrm{u}_{it} \\ &\mathrm{d})\ Y_{it} = \beta_0 + \beta_1 K_{it} + \mathrm{u}_{it} \end{aligned} \quad (3)$$

Four different models are shown in equation (3). These models are models that incorporate unobservable effects specific to panel data in different ways. Unobservable effects can be unit or time related. In some panel data models, as shown in row a, unit and time effects are present together. These models are called "unit and time effect models". In some models there is only a time effect, as shown in row b. These models are called "time effect models". In some models, there is only a unit effect, as shown in row c. These models are called "unit effect models". In some models, there is neither a unit effect nor a time effect, as shown in row d. The models shown in row d are called the "classical model".

The presence of unit and time effects in the model can be determined using fixed effects and random effects estimators. There are two fixed effects estimation methods: Dummy Variable Least Squares and Within-Group estimators. In random effects there are Generalised Least Squares and Likelihood Ratio estimators. By selecting an estimator from the fixed effects and random effects estimators, the panel is first aligned by unit and the test results are obtained. Then the panel is adjusted for time and the test results are obtained again. This allows the unit and time effects in the panel to be determined.

Once the unit and time effects have been determined, it is necessary to determine whether the unit/time effects are correlated with the independent variables. This is done with the Hausman test. If there is a correlation, it is decided that the fixed effects estimator is consistent. If there is no correlation, it is decided that the random effects estimator is effective.

$$H = (\hat{\beta}_{fixed} - \hat{\beta}_{random})' \left[Avar(\hat{\beta}_{fixed}) - Avar(\hat{\beta}_{random})\right]^{-1} (\hat{\beta}_{fixed} - \hat{\beta}_{random}) \quad (4)$$

Equation (4) shows the Hausman test methodology. The terms $Avar(\hat{\beta}_{fixed})$ and $Avar(\hat{\beta}_{random})$ represent the asymptotic variance and covariance matrices obtained from estimators, respectively (Tatoglu, 2020: 196). Once the model has been selected using the Hausman test, the final estimation results are subjected to a number of tests. In the presence of cross-sectional dependence, autocorrelation and heteroskedasticity in the model, the panel data analysis is completed by re-estimating with robust estimators that produce robust standard errors.

4.3. Findings

If the series are not distributed around their mean, it is recommended that the series' first be subjected to unit root analysis, as the changes in the series have a permanent effect and create a risk of spurious regression. However, when the time dimension is short, unit root analysis may not perform well (Afriyie et al, 2020: 660). Moreover, if one examines the studies in the literature that conduct panel data analysis and have a short time dimension similar to this study, it is seen that they apply the analysis without performing a unit root test (Matthess et al., 2023; Martínez-Alonso et al., 2023; Asad et al., 2023; Bersalli et al., 2020). Therefore, in this study, other tests were carried out without including unit root analysis.

Table 3. Determination of Unit and Time Effects

Tests		Unit	Time	Decision
FE	Stat.	921.79	1.07	Unit
	Prob.	(0.000)	(0.394)	
RE	Stat.	814.15	0.00	
	Prob.	(0.000)	(1.000)	

In panel data applications, there may be unobservable effects or unobservable heterogeneity that can come from both unit and time or both elements. These effects can be detected with FE (fixed effect) and RE (random effect) tests. The tests applied to the unit-ordered data are then reapplied to the time-ordered data. As a result, it is determined whether the effects are caused by unit or time. According to Table 3, it has been determined that there are unit effects in the applied panel.

Table 4. Hausman Test Results

Variables	Fixed	Random	Difference	Hausman
İnvestment	0.0068	0.0064	0.0003	4.58 (0.598) Random Effect
Employment	-0.0085	-0.0078	-0.0007	
Inflation	0.0013	0.0013	0.0000	
Trade	0.0021	0.0020	0.0001	
Intellectual Property Payments	0.2346	0.2342	0.0003	
Research and Development	0.2314	0.2346	0.0031	

After determining the unit and/or time effects, the Hausman test (1978) is applied to determine the correlation of these effects with the independent variables. If there is no correlation between the unit effect and the independent variables, the random effects model is valid. This is because in the fixed effects estimator, the unit effects are dropped from the model. On the other hand, if there is no correlation, the random effects estimator creates an endogeneity problem. This is because in the random effects model, since the unit effect is summarized in the error terms in the model, the correlation between the independent variable and the unit effect violates the exogeneity assumption. Therefore, if there is a correlation, the fixed effects are consistent (Tatoglu, 2020: 199-200). According to the results of Table 4, it has been determined that the random effects are effective according to the Hausman test result.

Table 5. Diagnostic Tests

	Tests		Stat. (Prob.)
Multicollinearity	Mean VİF		2.20
Normality	D'Agustino & Belanger	e:	1.85 (0.395)
	D'Agustino	u:	2.24 (0.325)
Heteroskedasticity	Brown ve Forsythe	W0	4.50 (0.000)
		W10	4.50 (0.000)
		W50	2.77 (0.006)
Autocorrelation	Modified Bhargava et al. Durbin–Watson		0.54
	Baltagi–Wu LBI		0.72
Cross-Sectional Dependence	Pesaran		4.47 (0.000)
	Friedman		34.9 (0.000)

According to the test results obtained, diagnostic tests should be applied to the model before running the estimator. In panel data analysis, robust estimators are applied in the presence of one or more diagnostic problems. The model is expected to have normal distribution characteristics. Therefore, the test proposed by D'Agostino, Belanger & D'Agostino (1986) was applied. The test tests the conformity of both the error terms and the errors due to unobserved units or times to the normal distribution. The basic hypothesis of the test is "normal distribution exists". According to the results presented in Table 5, the basic hypothesis could not be rejected. Accordingly, the unobserved errors resulting from random effects and the error terms of the model are normally distributed. The fact that the average of the applied Variance Inflation Factor (VIF) test is below 5 indicates the absence of a multicollinearity problem. According to Table 5, since the VIF value (2.20) is less than 5, it has been determined that there is no multicollinearity problem. For the heteroscedasticity problem, the Brown ve Forsythe (1974) test was applied. The basic hypothesis of the test is "there is no heteroscedasticity". According to Table 5, the basic

hypothesis was rejected at the 1% significance level. Thus, it can be seen that there is a heteroscedasticity problem. The Durbin-Watson & Baltagi-Wu tests proposed by Bhargava, Franzini & Narendranathan (1982) were used to determine autocorrelation. The decision point of the test is that if the test statistic is below the value of "2", it can be said that there is autocorrelation. Since the test results are below 2, it has been decided that there is autocorrelation. The Pesaran and Friedman tests were applied for the existence of cross-sectional dependence. The basic hypothesis of the tests is "there is no cross-sectional dependence". According to the test results, the basic hypothesis could be rejected, and it was determined that there is a cross-sectional dependence problem. Finally, there is a problem of autocorrelation, cross-sectional dependence, and heteroskedasticity in the model. These problems are corrected with the estimator that produces robust standard errors.

Table 6. Results of the Driscoll-Kray Estimators (Dependent Variable: Economic Growth)

Variables	**Coeff.**	**St. Dv**	**t stat.**	**Prob.**
İnvestment	0.0064	0.0037	1.74	0.101
Employment	-0.0078	0.0036	-2.15	0.046
Inflation	0.0013	0.0021	0.64	0.530
Trade	0.0020	0.0010	1.86	0.080
Intellectual Property Payments	0.2342	0.0239	9.76	0.000
Research and Development	0.2346	0.0142	16.50	0.000
Cons.	21.103	0.3180	66.34	0.000

Table 6 shows the results obtained using the Driscoll ve Kraay estimators of the final model. *Investment* and *Employment* variables are the basic components of EG. Therefore, in the economic literature, increases in both variables are expected to have a positive impact on EG. In the estimation results, it is seen that the *Investment* variable is not statistically significant despite its positive coefficient. In the literature, it is mostly seen that the gross capital formation variable positively affects economic growth. Some examples of this positive relationship are Kesar et al. (2023); Pasara & Garidzirai (2020); Jermsittiparsert et al. (2019) studies.

The *Employment* variable is statistically significant but the coefficient sign is negative, contrary to expectations. However, in recent years, some researchers have focused on the concept of "jobless growth". This concept refers to the fact that there may be situations where economically growing economies do not create employment. Butkus et. al. (2024); Mathy (2024); Haider et al. (2023); Alfaro et al. (2023); Onaran (2008) studies provide empirical evidence that jobless growth can occur. In the main literature of the study, Inekwe (2015) found that employment negatively affects growth in developing countries and middle-income countries.

When the instrumental variables used were examined, it was determined that the *Inflation* variable had a positive sign but was not statistically significant. The positive coefficient sign in inflation is consistent with economic expectations. It shows that increases in inflation cause increases in economic growth. Purnomo & Wibowo (2024). Ioan et al. (2020); Thanh (2015) studies have conducted research on different country groups. As a result of the studies, it has been determined that increases in inflation positively affect economic growth.

The *Trade* variable was positively signed and statistically significant. It can be interpreted that the increasing trade volume in industrialized countries supports economic growth. In economic expectations, the *trade* is expected to have a positive effect on economic growth, but it is also possible for this effect to be negative. Since foreign trade revenues will be positive at the point where exports exceed imports, the trade variable is also expected to have a positive effect on economic growth. Khezri et al. (2024); Audi et al. (2022); Banday et al. (2021); Iyoha & Okim (2017); Liu (2016); Brueckner & Lederman (2015); Kılavuz & Topcu (2012) are studies indicating a positive relationship between trade and EG. The findings of this study are consistent with the literature.

The IPP variable positively affects economic growth and is significant according to the 1% significance level. The increase in Intellectual property payments in the country group supports economic growth. The IPP variable is high in terms of coefficient. This shows that industrialized countries attach great importance to the issue of Intellectual property. IPP is not a frequently used variable in the literature. The IPR variable has been used more in the literature. The positive relationship between Intellectual property and economic growth found in the studies of Cheng (2024); Ambrammal (2023); Xu & Cao (2019); Liu (2016); Aricioglu & Ucan (2015); Schneider (2005) is consistent with the results of this study.

The R&D variable positively affects economic growth. The increase in the number of patents in industrialized countries supports economic growth. In fact, it is seen that the R&D variable is quite strong compared to other variables as a coefficient. This situation shows that research and development activities are of great importance in developed countries. The vast majority of studies in the literature have found a positive relationship between

R&D and economic growth. The results obtained in this study are also consistent with the literature and economic expectations. The positive relationship between R&D and economic growth found by Alam & Alvi (2024); Khezri et al. (2024); Ahmet & Zheng (2023); Wang et al. (2022); Olaoye et al. (2021); Nair et al. (2020); Liu (2016); Sokolov-Mladenović et al. (2016); Gumus & Celikay (2015) is consistent with the findings of this study.

5. CONCLUSION

This study examines the impact of *Intellectual Property Payment* and *Research and Development* activities on EG in highly industrialized countries. The article used annual data for the period 2004-2023 for 9 highly industrialized countries. The econometric method used was panel data analysis (fixed-random effects). The results show that *Intellectual Property Payment* and *Research and Development* variables have a positive impact on EG dynamics.

Increasing R&D activities enables the development of new technologies and products, which indirectly increases labor productivity. In this process, the competitive advantage provided by high-tech products is a critical element for EG. Particularly in knowledge-based economies, the innovations generated by R&D play an important role in transforming industry and increasing competitiveness in the global marketplace.

Since increasing R&D activities will cause both quantitative increases in investment and employment and productivity in macroeconomic terms, it acts as the locomotive of economic growth. In addition, exports of R&D products support both foreign trade and balance the balance of payments in countries. For this reason, the development steps taken by highly industrialized countries towards industrialization form the basis of long-term economic growth. It is recommended that R&D activities continue to be supported as a policy.

Effective protection of intellectual property rights and commercialization of innovations are essential for encouraging R&D investments. Intellectual property ensures the protection of the values created by researchers and entrepreneurs, reduces the risks in this process and encourages innovation. The study has shown that strengthening intellectual property systems creates a sustainable growth environment for economic actors both locally and internationally. For this reason, in order to establish R&D activities on solid foundations, protection of intellectual property rights at a level higher than the current situation should always be included in long-term policies.

As a result, the positive impact of R&D and intellectual property rights on EG is central to countries' long-term strategies. Policymakers can increase the sustainability of EG by developing regulations that encourage R&D investment and protect intellectual property rights. In this context, the creation of a strong innovation ecosystem will enhance not only national economic development but also global competitiveness. Future research can support the design of policies and strategies by examining these interactions in more detail.

This study conducted research on 9 highly industrialized countries. The data period is limited to 2004-2023. These features indicate the limitations of the study. Although studies have been conducted in the literature according to different income and development levels, panel data with longer data sets and a wider number of countries should be created in future studies. The development of database infrastructures may allow the subject to be reconsidered with longer data sets in the coming years. In addition, since the subject of the effects of intellectual property rights on economic growth together with R&D activities does not have sufficient depth in the literature, it should be addressed more comprehensively in future studies.

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The entire research is written by the author.

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Strategic Interaction Between Monetary and Fiscal Policy in Algeria: a Game Theory Approach

Cezayir'de Para ve Maliye Politikası Arasındaki Stratejik Etkileşim: Bir Oyun Teorisi Yaklaşımı

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ABSTRACT

Using a dynamic game theory framework, this study evaluates the interplay of fiscal and monetary policies under various demand and supply shock scenarios in the Algerian economy. Aligning fiscal and monetary policies is essential to mitigate potential conflicts that may arise from uncoordinated actions, such as increased inflation volatility or unsustainable public debt levels, which ultimately reduce societal welfare. In this context, the game theory-based approach utilized in this study to examine the effectiveness of different coordination methods (Nash equilibrium, Stackelberg leadership, and cooperative solution) between Algerian fiscal policy and monetary policy in a conventional macroeconomic optimization issue. Our computational analysis indicates that the cooperative Pareto equilibrium minimizes welfare loss by offering optimal responses to economic shocks, particularly in terms of output stabilization, debt sustainability, and inflation control. Although this study focuses on Algeria, the findings may provide insights for other developing economies with similar macroeconomic and institutional contexts. This study contributes to the literature by quantitatively assessing the effectiveness of policy coordination strategies through a game theory lens, filling a gap in the analysis of fiscal-monetary interplay in developing economies.

Anahtar Kelimeler:
Para Politikası,
Maliye Politikası,
Pareto Kooperatif Çözümü,
Stackelberg Dengesi,
Nash Dengesi

Jel Kodları:
E61, E63, C72

ÖZET

Bu çalışma, dinamik oyun teorisi çerçevesini kullanarak Cezayir ekonomisinde çeşitli talep ve arz şoku senaryoları altında maliye ve para politikalarının etkileşimini değerlendirmektedir. Maliye ve para politikalarının uyumlu bir şekilde yürütülmesi, koordinasyonsuz eylemlerden kaynaklanabilecek potansiyel çatışmaları hafifletmek için gereklidir. Bu çatışmalar arasında artan enflasyon dalgalanmaları veya sürdürülemez kamu borcu seviyeleri yer almakta olup, bunlar nihayetinde toplumsal refahı azaltmaktadır. Bu bağlamda, bu çalışma, geleneksel bir makroekonomik optimizasyon sorunu çerçevesinde Cezayir'in maliye ve para politikaları arasındaki farklı koordinasyon yöntemlerinin (Nash dengesi, Stackelberg liderliği ve iş birliği çözümü) etkinliğini incelemek için oyun teorisi temelli bir yaklaşım kullanmaktadır. Yapılan analiz sonucunda, iş birliğine dayalı Pareto dengesinin refah kaybını minimize ederek ekonomik şoklara, özellikle de üretim istikrarı, borç sürdürülebilirliği ve enflasyon kontrolü açısından optimal tepkiler sunduğunu göstermektedir. Bu çalışma her ne kadar Cezayir'e odaklansa da, bulgular benzer makroekonomik ve kurumsal bağlamlara sahip diğer gelişmekte olan ekonomilere yönelik de içgörüler sağlayabilir. Çalışma, maliye-para politikası etkileşiminin oyun teorisi perspektifinden koordinasyon stratejilerinin etkinliğini nicel olarak değerlendirerek, gelişmekte olan ekonomilerde maliye-para ilişkisine yönelik analizlerdeki önemli bir boşluğu doldurmak suretiyle literatüre katkı sağlamaktadır.

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1. INTRODUCTION

The main instruments for controlling the economy at a large scale are fiscal and monetary policies. They aim to maintain a high level of jobs, stable prices and overall economic growth. Macroeconomists are wondering about how the relationship between fiscal and monetary policies affects the economy's performance in achieving its objectives and targets. These different objectives are the reason why the monetary and the fiscal authorities have difficulty aligning their actions, or why they do not cooperate at all. Yet, there is the capability that the decision makers are trapped in an interplay that results in high deficits and stringent money, which is a common imbalance of the fiscal-monetary mix. There are many reasons for this imbalance, but one of them is the variations in incentives of the monetary and fiscal officials. Governments are elected and do not want to initiate a policy that will worsen the economic situation before elections, even if it has some long-term benefits. Monetary decision makers frequently have a longer-term standpoint; however, they are also cautious and occasionally slow. Thus, in an economy that exhibits a large deficit equilibrium, a policy to reduce the deficit may cause a short-term but (for the elected) economically disastrous political decline, if the monetary authorities do not react quickly enough. Politicians who care about their own interests may prefer to keep the high-deficit equilibrium. This situation is called the monetary-fiscal game, because it shows that monetary and fiscal policies are largely separate and have opposite goals in several countries with large economic performance.

Policy makers and economists think that their countries have fiscal shortfalls as well as real interest rates that are too high to support enough long-term expansion of potential output and private investment, in almost all countries that have separate fiscal and monetary policies. This unfavorable fiscal-monetary mix syndrome has been present in the macroeconomic landscape for many years. Regarding Algeria, both the fiscal and external balances have worsened greatly because of the COVID-19 pandemic impact. The general government's overall balance showed a significant increase from -5.6% in 2019 to -13.6% in 2020 (see Figure A1 in the appendix), public debt also increased from 46.19% in 2019 to 60.96% in 2020 and to 65.83% in 2021(see Figure A2 in the appendix). Meanwhile, despite efforts to curb imports and sluggish domestic demand, the trade deficit widened to 18.2% of GDP due to a sharp decline in export revenues (-51%), and the current account deficit rose to 18.8% of GDP in 2020.

The government revealed a national socio-economic recovery plan to face the COVID-19 pandemic's effects on both individuals and the economy. A supplemental finance law (SFL) has measures worth 70 billion dinars to lessen the negative effects of the COVID-19 pandemic on the economy and public health. Furthermore, between March 15, 2020, and February 15, 2021, notably, the Bank of Algeria has reduced the ratio of needed reserves. 10% to 8%, then to 6%, then to 3%, and to 2%. It additionally decreases the primary policy rate to 3.25% from 3% after a difference of 25 basis points. Additionally, haircut rates for government securities utilized in refinancing operations were reduced. It stated that it was relaxing banks' reliability, liquidity, and NPLs ratios. Banks can postpone repayments on certain loans unless the need of setting aside funds for them. Within October 2017 banking law, the value of the provided loans for public treasury by the Bank of Algeria reached to 6556 billion dinars by the end of January 2019 (about 23 percent of GDP) (see Figure A3 in the appendix). This legislation permits the Bank of Algeria to directly finance activities such as the National Investment Fund, public sector debt buy-back, and budget deficit until 2022. Furthermore, given the increasing overall public funding requirements and the continued refusal of the authorities to make worldwide financial markets resources worthwhile, the financial system in Algeria may be forced to cover the bulk of Algeria's high level of public funding in the coming years. In a context where external threats continue to pose a challenge, the implementation of this new strategy could potentially worsen existing macroeconomic imbalances by fueling inflationary pressures.

Meanwhile, if we compare the interest rate on Algeria's public sector debt and economic growth (see Figure A4 in the Appendix), it becomes clear that the earlier is not particularly adequate to repay for the liability's nominal rate of interest. Since then, Algeria's fiscal space has declined because growth-adjusted interest costs are less than the pace of public sector debt increase. Algerian government bonds will experience an increase in the sovereign risk premium because of this situation and international markets will be informed about potential defaults.

In 2022, the Algerian economy experienced a boost in hydrocarbon prices, which contributed to its recovery from the pandemic-induced shock. However, the country is facing challenges such as rising inflation (which reached 9.3% in 2022) and the potential for a global economic slowdown, which could hinder its growth. The price level has increased to its highest point in a quarter of a century due to a rise in international commodity prices and a combination of global and local factors, such as the 2021 drought, loose monetary policy stance, wage hikes in 2022 and stricter import rules. The prospect of a global slowdown creates policy dilemmas in the short term, as

reducing inflation and maintaining fiscal soundness will need to be balanced against boosting growth and purchasing power. The risk of changes in hydrocarbon prices is still high.

Under these conditions, the central bank's capacity to restore stability to the economy following adverse shocks is hampered by the prevailing low rate of interest situation. Meanwhile, the historically high debt level may limit the effectiveness of fiscal measures by causing people to expect future fiscal adjustments to address solvency concerns. Coordination of these two policy areas is therefore essential, as decisions by one institution can have devastating effects on the other, leading to a loss of social welfare. The lack of coordination between fiscal and monetary policies can lead to economic imbalances and societal welfare losses. In the Algerian context, determining effective methods of policy coordination is a pressing issue for both policymakers and scholars. On the other hand, transparency in the interaction between fiscal and monetary policies is critical for fostering economic stability and public trust. Clear communication and coordination between these policy domains ensure that objectives. Transparency reduces uncertainty for investors, businesses, and households, helping them make informed decisions. Moreover, it enhances accountability, allowing policymakers to be evaluated on their effectiveness and adherence to long-term economic goals. This openness is particularly crucial during crises when confidence in economic governance can significantly influence recovery outcomes.

Against this background, many important key macroeconomic questions are addressed, and need to be investigated: How do the supremacies of Algeria's monetary and fiscal policies relate to their strategic choices? How do coordination and independence in macroeconomic policy affect the economy positively and negatively? How does the autonomy in policymaking that is deeply established in the Algerian polity impact the economy? Does a lack of political independence lead to ineffective monetary and fiscal policy coordination? When and under what conditions does choosing monetary and fiscal policy strategies independently lead to economically effective decisions, and when does coordination of decisions become necessary?

In this context, this paper aims to contribute to improving policy-making in the Algerian economy. In particular, it helps to design a more flexible fiscal policy that does not interfere with monetary policy based on different policy objectives. In order to avoid "fights" between authorities, it is important to know the leadership structure. This is because the strength of such conflicts and their impact on well-being depends on the authorities' ability to play a leading role in the policy game. To this end, the primary aim of this study is to analyze the interaction between fiscal and monetary policies in the Algerian economy and evaluate the effectiveness of various coordination mechanisms (Nash, Stackelberg, and Pareto solutions). By employing a game theory approach, the study seeks to understand the impact of policy coordination on responses to economic shocks. Effective coordination between fiscal and monetary policies is critical for economic stability and sustainable growth. This study addresses a gap in the literature on policy coordination in developing economies and provides insights that may inform policymakers in Algeria and beyond. The limitations of this study stem from the assumptions inherent in the game theory model and the focus on data specific to the Algerian economy. Moreover, the shocks analyzed are limited within the model's scope and may not fully represent real-world complexities.

The remaining portions of this study are structured as follows. Theoretical underpinnings of the interplay between fiscal and monetary policy are discussed in Section 2 using a game-theoretic approach. Section 3 includes detailed empirical evidence. Section 4 emphasizes the primary findings and the approach employed. The last section offers some conclusions and suggestions for leaders.

2. THEORETICAL BACKGROUNDS

According to the conventional macroeconomics literature, the actions of policymakers shape macroeconomic policies. The fiscal and monetary policymakers, who have different and sometimes conflicting objectives, carry out these policies with strong impacts. To affect the economy's framework and achieve their objectives, they select and put into practice the optimal policy regulation. The policy formation process is affected by the interdependence of the optimal policy rules, which stem from the diverse and conflicting goals of the policymakers. Therefore, it is essential to use game theory to model this process and capture the interaction of policymakers better. In models of game theory regarding macroeconomic strategy, those in charge are considered as individual entities with specific goals and choices, attempting to reduce their losses and enhance their advantages, similar to economic agents like households and firms. These models consider the joint strategic interaction of policymakers in their policies. Thus, in a game theoretical framework, policymakers are seen as individuals (players) with unique objectives, anticipations, and inclinations. Political and economic behavior was merged into a field of study by the new economy approach in the 1980s, which gave rise to game theoretical policy models. The new political economy approach used methods such as econometrics and game theory, which

permitted a more in-depth and thorough examination of the interconnectedness between political as well as economic initiatives of economic organizations, surpassing previous capabilities.

Presented now is a basic fiscal-monetary game designed as an introductory tool to elucidate the key issues and outcomes of this paper, drawing inspiration from the classic 'prisoner's dilemma' model. Table 1 illustrates the key suppositions and outcomes of this particular game, where we examine the possible central bank reactions and government when confronted with an adverse shock that increases inflation (interest rates) and decreases employment (output or debt).

Table 1. Monetary and Fiscal Game

		Central Bank	
		Tight Monetary	**Loose Monetary**
Fiscal Authority	Tight Fiscal	7 Low Inflation 4 Low Employment	6 Medium Inflation 6 Medium Employment
	Loose Fiscal	6 Medium Inflation 6 Medium Employment	4 High Inflation 7 High Employment

Source: Bennett & Loayza, 2002: 301.

Maximizing an asymmetric utility function is the goal of the policymaker. Both monetary and fiscal policy makers are wary of production drops and inflation increases, but they are tolerant of output increases or inflation decreases. Each fiscal and monetary authority has two alternatives: They have the option of choosing a loose or restrictive policy. In scenarios where both implement tight policies, resulting inflation remains low, yet employment levels also drop. Conversely, when both enforce loose policies, inflation and employment levels rise simultaneously. Finally, when a single authority enforces a rigid policy, it typically leads to modest levels of employment and inflation.

The payoff schedules depicted in Table 2 demonstrate the disparities in priorities between fiscal and monetary authorities when it comes to inflation and employment, which is an intriguing aspect of this fiscal/monetary interaction. Reducing inflation is more important to the monetary authority than increasing employment, while the fiscal authority places greater importance on achieving high employment than on low inflation.

Table 2. Monetary and Fiscal Game: Payoff Schedules

Inflation	Low	Medium	High
Central Bank	6	4	1
Fiscal Authority	3	2	1
Employment	Low	Medium	High
Central Bank	1	2	3
Fiscal Authority	1	4	6

Source: Bennett & Loayza, 2002: 301.

The outcome we want to emphasize is achieved by deliberately setting the differences in preferences between both authorities to be significant. The sole Nash equilibrium[1] within this game comprises a fluid fiscal policy and a stringent monetary strategy. The remaining three choices offer chances for one player to gain an advantage by separately changing from the initial phase play. Central banks' conservatism and fiscal authorities' liberalism are revealed through the game's equilibrium. The ideal reaction for both parties is highlighted because of the differences in preferences between them. If so, the monetary authority decided to implement an ambiguous policy, thereby agreeing to the government's commitment to stricter restraint, the government would likely find it advantageous to go back on its promise and engage in a loose policy. Similarly, if the government were to implement a rigid policy while the central bank is pursuing a loose policy, the monetary authority would find it advantageous to diverge from its current stance by implementing a tight policy. It should be noted that the Nash equilibrium corresponds with a strategy that combines loose monetary and tight fiscal policies when it comes to the payoffs to both players. (Bennett & Loayza, 2002, p. 301)

[1] When each authority achieves maximum utility by its self policy tool under the assumption that the other policy tool is gived, the Nash solution is achieved.

Using the *Active* and *Passive* dichotomy (according to Leeper's (1991) terminology), the strategic component of policy interactions can be evaluated through the of a 2 × 2 game. The payoff matrix in Table 3 outlines the overall game scenario with {*a, b, c, d, v, w, y, z*} representing the payoffs of policymakers across the four potential policy regimes. The payoffs are clearly dependent on the fundamental factors of the macroeconomic framework and policy choices. In the regimes categorized as non-Ricardian and Ricardian [as identified by Woodford (1994)] The F and M policies, in turn, address the F gap, leading to a consistent real debt burden. However, under the (AM, AF) regime, neither strategy addresses the issue, which results in a situation where the actual debt is increasing at a concerning rate. Ultimately, under the (PM, PF) regime, each policy tackles the issue separately, leading to a notable reduction in the actual debt.

Table 3. The Payoff Matrix

	Fiscal Authority		
		Passive Fiscal	**Active Fiscal**
Central Bank	Active Monetary	Ricardian (*a, v*)	Explosive (*b, w*)
	Passive Monetary	Mis-coordination (*c, y*)	Non-Ricardian (unpleasant arithmetic) (*d, z*)

Also, several scenarios are possible depending on the policy weights:

- The scenario of *Symbiosis*, as described by Dixit & Lambertini, where the (AM, PF) result represents the sole Nash equilibrium and is favorable for both participants. Consequently, there is an absence of *F* spillovers in this scenario.
- In scenarios of *Discipline*, what comes out of (AM, PF) remains the sole Nash equilibrium, leading to the prevention of *F* spillovers. However, the resultant outcome ceases to be *F*'s most favored choice.
- *The Tug-of-War* scenario where the (AM, AF) result emerges as the particular Nash equilibrium. Although Over time, spillovers are not anticipated, long-term sustainability of this arrangement cannot be achieved because of the government's unsatisfied budgetary constraints.
- Two clear Nash equilibrium, denoted by (AM, PF) and (PM, AF), are present in the Pure Coordination scenario, coupled with a combination of strategies Nash equilibrium that is Pareto lower to both absolute Nash equilibrium. The possibility of spillover effects from the F to M policy is low because both policymakers would favor the previous Nash equilibrium.
- *Two separate Nash equilibria are given as well in the Game of Chicken scenario.* (*AM, PF*) and (*PM, AF*) along with one equilibrium involving mixed strategies. However, there is a higher likelihood of spillover effects from F to M policy here, given that each decision-maker favors a different Nash equilibrium solution.
- In a *neglect scenario* where *(PM, AF)* represents the singular Nash equilibrium, spillovers surely occur. (Hallett et al., 2014 : 9)

We can calculate each authority's individual "happiness points" if the ideal levels of the fiscal deficit (D) and interest rate (r) were established, and if each authority had the power to set both instruments (under an independent economic maker). Figure 1 demonstrates the curves of: Fiscal Reaction Function (FRnFn) and Fiscal Cross Maximization (FCrMx), Monetary Reaction Function (MRnFn) and Monetary Cross Maximization (MCrMx). The fiscal authority's best position point is attained when the FRnFn and FCrMx intersect, yields the ideal pair (D^F; r^F). The best option point of the monetary authority, represented as (DM; rM) pair, is determined in a similar manner to that of the fiscal authority. The Nash equilibrium leads to a pair (D^N; r^N) wherein no one is able to reach a higher level of utility by independently deviating from it. The crossroad of MRnFn and FRnFn leads to the solution of Nash. Furthermore, the Nash equilibria illustrated in Figure 1 reflects the findings presented in Loewy (1988) and Nordhaus (1994): Contrasting as is said at the bliss point, in the Nash equilibrium, the real interest rate and the magnitude of the fiscal shortfall are larger. The Nash equilibrium (D^N; r^N) is Pareto inferior than a wide range of points, in particular the arc that connects both bliss points.

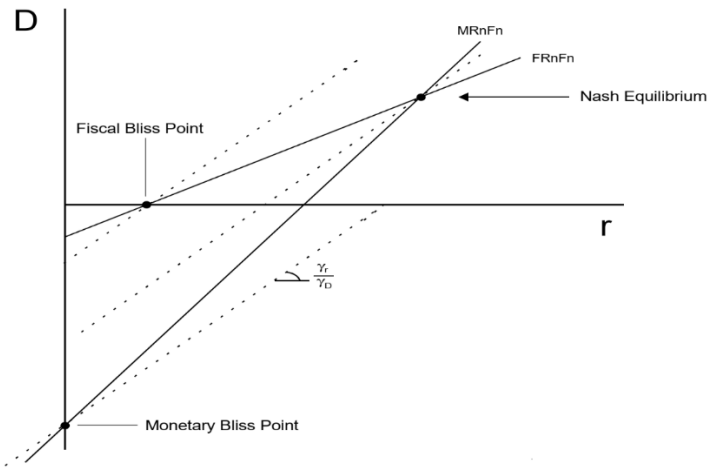

Figure 1. The Nash Equilibrium
Source: Bennett & Loayza, 2002: 312.

This game ignores the possibility of talks within monetary and fiscal authorities that might lead to coordinated efforts in policymaking (a procedure referred to be coordination is when two autonomous authorities engage in negotiations. to harmonize their approaches in an attempt to enhance outcomes for the two sides). The Stackelberg solution injects dynamic elements into the game by choosing one player as their leader, allowing the leading authority to initiate a reciprocal reaction from the follower. When the central bank takes over the leadership in the Stackelberg strategic interplay, the game is attained by optimizing *UM* with respect to *r*. Noteworthy is the fact that the central bank is now able to influence *D* in line with the fiscal authority's reaction function. Figure 2 illustrates the Stackelberg equilibrium point, where MAnFn (Stackelberg) intersects with FRnFn. In a similar manner for the Nash solution, a lack of cooperation between policies, which is portrayed as a Stackelberg strategy, leads to deeper fiscal deficits and high values of real interest rates compared to outcomes when either authority oversees the two strategy instruments. Reducing deficits and lowering interest rates is attainable by using the Stackelberg approach, just like the Nash solution. When the central bank takes the lead, in addition, it allows both authorities to attain a larger iso-utility curve than in the Nash equilibrium and denotes increased activity (and inflation). The Box in Figure 2 demonstrates a scenario in which the government takes on the leadership role. Results in this case are very similar, but the total demand level that results is less than that of the Nash solution.

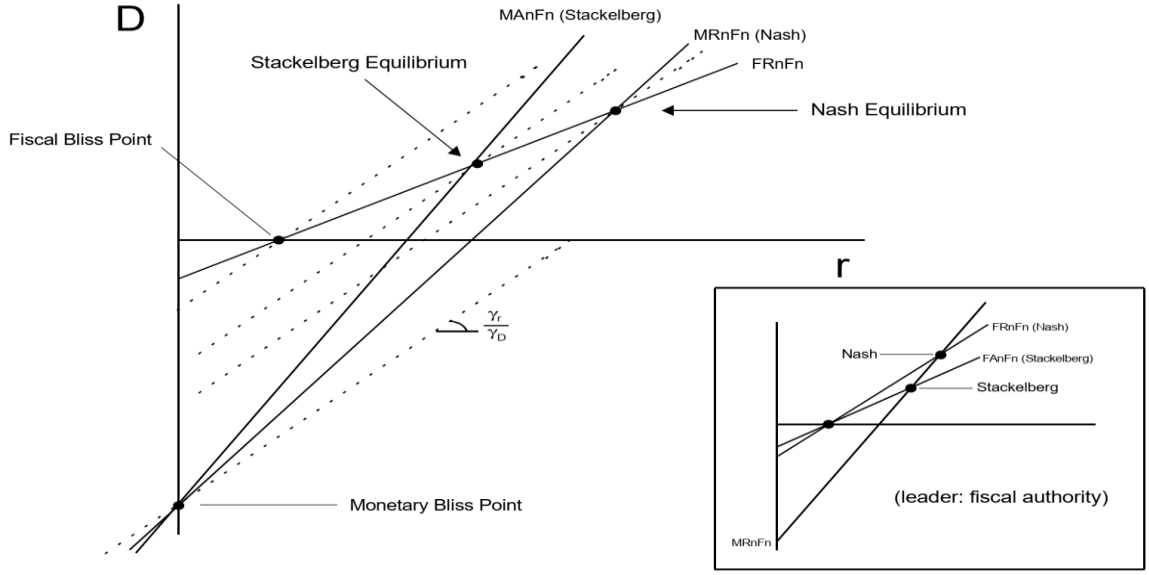

Figure 2. The Stackelberg Equilibrium (Leader: Central Bank)

Source: Bennett & Loayza, 2002: 316.

3. EMPIRICAL LITERATURE

Numerous thorough studies have explored the consequences of possible oppositions among monetary and fiscal strategies, along with the advantages of a coordinated scenario. Numerous research works rely on game theory frameworks, which assume a predetermined level of cooperation between the government and the central bank. These entities influence one another's behavior through their decisions[2]. In this regard, Blinder (1982) examined a straightforward fiscal-monetary game in which the players were the monetary and fiscal authorities, each of whom had a couple of monetary and a couple of fiscal options —the tight and loose ones. The researchers pointed out that the Nash equilibrium, that is not Pareto optimal, can arise from autonomous activities by authority. Comparable reasoning for coordinating the policies was presented, along with a comparable examination of the prisoner's dilemma situation.

Tabellini (1986) explores the problem of keeping public debt manageable as a dynamic game between monetary and fiscal authorities. The relationship among both of those authorities is modeled as a game with linear dynamics that demonstrate the debt progression in the event of external rates of interest, as well as the authorities' efforts to reduce a quadratic objective function. Among these primary results concerns the advantages of collaboration, which suggests that when two policymakers align their efforts, they are able to achieve a lower level of long-term debt. Moreover, this reduction is accomplished more quickly compared to situations where collaboration is absent. A further outcome is that when one player reduces the proportionate weight allotted to debt stabilization, the modification burden on the opposing player gets more.

In a seminal work, Nordhaus (1994) examined the intricate problem of reconciling the objectives of monetary policy and fiscal policy, which often pose a trade-off between independence and coordination moreover employing a fiscal-monetary strategic game. The game was developed using a straightforward theoretical macroeconomic model. This model incorporated utility functions representing both the government and central bank, which were influenced by their policy tools. The discussion included topics such as Nash equilibria, payoffs' Pareto optimality, potential disagreements of interest among authorities, and recommendations for coordinating policies. The Nordhaus game model served as an initial foundation for subsequent research.

Similarly, Bennett & Loayza (2002) analyze a group of 19 industrial countries from 1970-94, applying a model based on game theory to study how monetary and fiscal authorities work together to stabilize the economy. These authorities exhibit distinct preferences regarding output and inflation gaps, and they also wield varying policy instruments. Under conditions of policy coordination failure, the solution can be represented as either a Nash or a Stackelberg equilibrium, which suggests that a rise in the difference in inclinations between both fiscal and monetary authorities will occur and inevitably result in higher public deficits, ceteris paribus (the fiscal authority's policy instrument) as well as increased interest rates (the central bank's instrument).

Again, Pierre Faure (2003) analyzes the tactical confrontations between the fiscal and monetary authorities in the European Union and the broader global context, using a game-theoretic model and empirical data. The article shows that the absence of coordinated policy within and across currency areas leads to higher interest rates and public deficits, and that the European Central Bank’s angle for inflation stability may complicate international cooperation. The article suggests that institutional arrangements that allow for policy coordination can improve economic outcomes and reduce policy biases.

On the contrary, Dixit & Lambertini (2003) take into account the relationship between fiscal and monetary policies when the fiscal authority is more careful than the monetary authority. Under the two policies being discretionary, the Nash equilibrium results in lower output and increased pricing compared to the optimal points of both authorities; fiscal leadership is typically the superior option between the two leadership alternatives. When fiscal discretion is exercised; monetary commitment leads to identical outcomes as discretionary monetary leadership across all shock scenarios. However, fiscal commitment remains unaffected by monetary discretion in a similar manner. Achieving second-best results involves either both authorities committing jointly, setting identical targets leading to socially optimal outcomes and conservative price levels, or completely separating tasks.

[2] The interplay among fiscal and monetary policy is a topic of interest for many economists. To evaluate this topic empirically, there are four approaches: The first, which demonstrates that it might alter the circumstances of monetary policy's stability, is undoubtedly connected to the fiscal theory of the price level-FTPL- (central bank vs government supremacy). The second method looks at the idea of accommodating and counteractive time-varying regime changes as well as the nature of the relationships—that is, whether they are complementary or substitutes—among fiscal and monetary policies. The third approach investigates the interplay between monetary authority and fiscal authority using models of dynamic equilibrium, foundation of macroeconomic theory ever since the uprising of the real business cycle (RBC). The fourth method incorporates game-theoretic tools (advantageous interplay) and perceives fiscal authority and monetary authority as competing in a "game" opposing each other. A game-theoretic strategy necessitates coordination between both of them as actions made by one of them might have severe consequences for the other, resulting in a loss of social welfare.

Moreover, Neck (2003) explored the impact of discretionary versus rule-based policies, as well as non-cooperative versus cooperative policies in Europe. The study's goal was to evaluate their effectiveness using intertemporal objective functions. Findings indicate that the responses to these inquiries are heavily influenced by the type of shock that European and other economies experience. In addition, Neck & Behrens (2003) introduced a theory of dynamic game and the OPTGAME 2.0 algorithm to a fundamental macroeconomic model of fiscal policy and monetary policy in a monetary union. They found that optimal policies during a symmetric negative demand shock are counter-cyclical but not particularly active, with similar outcomes using different solution concepts. Considering cooperative economic policies are more effective or active than noncooperative ones, a different combination of policies is used to achieve significant stability benefits.

Moreover, Di Bartolomeo & Di Gioacchino (2008) analyze Stackelberg's concept of leadership in a debt-stabilization scenario. They contend that a Linked Equilibrium, which gives players the possibility to coordinate and correlate behavior, is a more effective solution concept for the starting point (where institutions, or the regulations for the next phase, are set up), rather than a Nash equilibrium, that limits action to be autonomous and individualistic.

Fragetta & Kirsanova (2010) delineated leadership patterns in the interplay between fiscal policy and monetary policy across three nations, precisely the US, the UK and Sweden. They construct a small-scale, open economy's structural model and simulate it using Bayesian techniques. They argue that the authorities may take a strategic part in a game of policy without cooperation, and analyze various types of leadership. They find that the fiscal leadership model is most suitable for Sweden and the UK, while the Nash or non-strategic regime is more common in the United States.

According to Merzlyakov (2012), the central bank's independence is not important in the export-driven Russian economy from 2001 to 2008. In a cooperative Stackelberg game scenario, where the government assumes a leadership role, fiscal and monetary policies can effectively complement each other through coordinated action. Under both types of interaction, minimal social loss occurs when expansionary fiscal and monetary strategies are in place for helping output reach its optimal degree. The efficient alignment of fiscal and monetary decisions is feasible whether there is coordination or political disagreements between the government and the central bank's decision-making committee. The independence of the central bank is not crucial in an economy dependent on resources with underdeveloped financial markets, as it is more of a political rather than economic concern.

In the context of Brazil, Saulo et al., (2013) assessed the most beneficial fiscal and monetary strategies under three different coordination plans: when organizations separately minimize welfare loss in a normal form game's Nash equilibrium, the Stackelberg solution where one institution acts first, and when institutions collaborating towards common objectives. Based on a numerical analysis, the smallest loss in social welfare is observed under a Stackelberg solution as the monetary authority takes the leadership while the fiscal authority plays the role of a subordinate. Evidence shows that under the best policy, Brazilian society strongly distastes inflation.

A new game-theory framework with asynchronous move timing is used by Hallett et al., (2014) to study strategic monetary-fiscal interactions. By adding a dynamic component to the commitment process, this framework expands on the classic Stackelberg leadership idea. This structure allows player movement at a predefined frequency, allowing policies to be strict or committed for different durations. They conclude that the inferior non-Ricardian regime (active fiscal, passive monetary) can arise in equilibrium and that, because of free-riding, a monetary union is a more likely place for this to occur. Unlike the situation portrayed in Sargent and Wallace's (1981) static commitment, this could still occur even if monetary policy takes the lead over fiscal policy for longer periods of time. Interestingly, in specific situations, a well-crafted institutional framework for monetary policy could assist the central bank in disciplining governments that engage in excessive spending, but also can assist it in fending off fiscal strain and avoiding the disagreeable monetarist arithmetic. By seeming like a reliable threat of an expensive tug-of-war policy, long-term monetary commitment (e.g. a legally mandated inflation target) could spur the economy to transition to a Ricardian (passive fiscal, active monetary) regime and diminish the median level of debt and the budget deficit. Generally, this paper shows how using a game-theoretic model with dynamic leadership can effectively choose a Pareto-efficient outcome in scenarios with multiple equilibria, where standard methods are not helpful.

Woroniecka-Leciejewicz (2015) discussed the outcomes of a policy-mix simulation analysis, carried out in a monetary and fiscal policies game, where the monetary and fiscal decision-makers have different objectives and instruments. She uses a modified logistic function to model the relationship between the policy instruments and the economic effects, taking into account the limited effectiveness of extreme policies and their impact on the business cycle. The findings illustrate the ways in which the function's parameters and the authorities' preferences

affect the Nash equilibrium situation, which is associated with the selection of a particular set of monetary and fiscal policies.

The Iranian economy's equilibrium model is examined by Mahmoudinia et al., (2016) applying Tabellini model (1986) in the Stackellberg case by feedback and open loop data. The main findings indicate that the open loop case exhibits a higher convergence speed than the feedback case, and the feedback case's debt equilibrium is less than the open loop state. Alternatively, the results show that the government and central bank show the capability to control debt levels in a Stackelberg game, even with significant oil revenues, by implementing policies to restrict central bank money creation.

Within the framework of a common currency union (monetary union), Chortareas & Mavrodimitrakis (2017) examine the strategic interactions that arise when a fiscal authority has a tactical edge over the adversary (monetary authority). Specifically, their approach differs from the traditional body of research on strategic interactions within monetary unions, by using an approach in which they solved a three-stage game where the two national fiscal authorities don't act at the same time. It is observed that when demand shocks occur, the leading fiscal authority is always motivated to engage in a game of three stages that makes the alternative fiscal authority more vulnerable. Compared to the usual scenario of limited coordination, choosing this option results in a more (less) unstable fiscal position across the union when faced with demand (supply) shocks. This instability is correlated with the asymmetries in demand shocks.

In a monetary union model of a two-country, Engwerda et al., (2019) examine the impact of Eurobonds introduction on debt-related factors. The analysis involves monetary and fiscal strategies in a debt stabilizing dynamic game, with government debt interest rates adjusting endogenously. Three distinct equilibria are examined: the fiscal coordination equilibrium, the fully cooperative solution and the non-cooperative Nash open-loop solution. It is demonstrated how the effects of Eurobonds are influenced by factors such as an equilibrium game theory framework, existing institutional arrangement, initial debt values, policymakers' debt stabilization goals, and financial market discipline strength.

Using a two-country monetary union dynamic game model, Blueschke et al., (2020) studied the results of sovereign debt relief for a member government or group of members following an exogenous decline in overall demand and the consequent increase in state debt. They perform numerical solution calculations for the dynamic game between the members' governments and monetary authority (ECB) depending on the use of OPT GAME 3 algorithm. The outcomes reveal that debt alleviation has no positive impact on either the "periphery" or the "core" of the monetary union, according to the study's model. They also say that after the first haircut, more debt relief will be needed, to the point where the union's continued existence is in trouble.

Tetik & Ceylan (2021) assess the strategic interaction between policymakers using the DSGE model in an economy that is small yet open to the world. The performance of an optimal strategy, derived through game theory, is evaluated through dynamic simulations within a counterfactual experiment framework. The model's parameters are measured for the Turkish economy. Based on how the impulse response works, social loss analysis. Furthermore, the dynamic simulation of the models. The main findings show that the best possible policy mix for the Turkish economy is one in which the monetary authority leads and the fiscal authority follows.

4. METHODOLOGY AND RESULTS

In this work, we stand on the MUMOD1 model and the Blueschke's et al., (2013) OPTGAME3 algorithm, developed and presented in Neck & Blueschke (2014). This model exhibits some Keynesian features in both the financial and goods markets, and it is expressed regarding deviations from a long-term growth trajectory. The short-term equilibrium between income and spending represents the goods market, known as the IS curve. Aiming to reach the effect on the ecoonomy's goods markets, monetary authority determines the prime rate.
Real output (a distinction between output in the short run and growth trajectory over the long run) is set up through the reduced form demand-side equilibrium equation:

$$y_t = \delta(\pi_{jt} - \pi_t) - \gamma(r_t - \theta) + \rho y_{jt} - \beta\pi_{it} + k y_{(t-1)} - \eta g_t + z d_t \quad (1)$$

π_t: represents inflation rate. r_t : represents the real rate of interest. g_t : real fiscal deficit or surplus, calculated as a percentage of real GDP, it is considered a control variable or tool for fiscal policy. Both the real inherent interest rate and the typical rate of growth in real output, $\theta \in [0,1]$, are taken to be equal. $\delta, \theta, \beta, k, \eta, \gamma, \rho$ are parameters assumed to be positive.

zd_t: represents external shocks in the goods market via the demand side and is an uncontrollable exogenous variable.

For t = 1,…, T, the current real interest rate is given by:

$$r_t = I_t - \pi_t^e \quad (2)$$

Where: π_t^e: is the inflation rate (expected values). I_t: is the nominal interest rate, that is given by:

$$I_t = R_{Et} - \lambda g_t + \chi D_t + zhp_t \quad (3)$$

Where: R_{Et}: represents the nominal interest rate that is determined by the monetary authority, it is assumed to be a monetary policy instrument or control variable. D_t: represents the real public debt calculated in relation to GDP.

λ: denotes the risk premium of fiscal deficit (assumed to be positive). i.e., the country i's nominal rate of interest increases by λ_i percentage points for each percentage point of the real fiscal deficit-to-GDP ratio.

χ: is a risk premium for debt level (assumed to be positive). i.e., for every percentage point increase in the real debt-to-GDP ratio, the nominal interest rate of country i rises by χ_i percentage points.

zhp_t: is an exogenous variable that simulates the "haircut penalty," or extra risk premium that financial markets impose following a haircut.

The inflation rates for t = 1,…, T are set based on an expectations-augmented Phillips curve, i.e., the current inflation rate is influenced by both anticipated inflation rates and excess demand in the goods market (a demand-pull relation):

$$\pi_t = \pi_t^e + \xi y_t + zs_t \quad (4)$$

Where: ξ: is a positive parameter. zs_t: represents uncontrollable external factors and depicts external shocks on the supply side, like rising oil prices, which could result in cost-push inflation.

π_t^e: represents the expected inflation rate, it's formed at the end of time period *t*–1.

The expected values of inflation are shaped by adaptive expectations theory:

$$\pi_t^e = \varepsilon\pi_{(t-1)} + (1-\varepsilon)\pi_{(t-1)}^e \quad (5)$$

where: is a positive parameter that determines how quickly expected inflation adjusts to actual inflation, and $\varepsilon \in [0,1]$.

Neck & Blueschke (2014) showed also that the median values of output and inflation are determined by:

$$y_{Et} = \omega y_t. \quad \omega \in [0,1] \quad (6)$$

$$\pi_{Et} = \omega\pi_t. \quad \omega \in [0,1] \quad (7)$$

The following equation denotes the government budget constraint; it is expressed as an equation linked to government debt:

$$D_t = \left(1 + BI_{(t-1)} - \pi_{(t-1)}^e\right)D_{(t-1)} - g_t + zh_t \quad (8)$$

Where: D_0 given, and it is assumed that there are no seignorage effects on the debt of governments. zh_t: indicates an external haircut impact on public debt. $BI_{(t-1)} - \pi_{(t-1)}^e$: denotes the payments of interest for the prior level of public debt.

BI_t: represents the average government bond interest rate at time t. it's as indicated by the subsequent equation:

$$BI_t = \frac{1}{6}\sum_{\tau=t-5}^{t} I_\tau \quad (9)$$

As determined by Krause & Moyen (2013, p. 4), it is assumed that government bonds have a six years maturity average.

Neck & Blueschke (2014) posit that decision makers (players) in the field of macroeconomic policy theory aim to minimize quadratic loss functions. Therefore, the central bank and the government have their own objective functions given by:

$$J = \frac{1}{2}\sum_{t=1}^{T}\left(\left(\frac{1}{1+\tau}\right)^{t-1}\left(\alpha_y(y_t-\tilde{y}_t)^2+\alpha_\pi(\pi_t-\tilde{\pi}_t)^2+\alpha_{iD}\left(D_t-\tilde{D}_t\right)^2\right)\right.$$
$$\left.+\frac{1}{2}\sum_{t=1}^{T}\left(\left(\frac{1}{1+\tau}\right)^{t-1}(\alpha_g(g_t-\tilde{g}_t)^2)\right)\right. \quad (10)$$

And

$$J_E = \frac{1}{2}\sum_{t=1}^{T}\left(\left(\frac{1}{1+\tau}\right)^{t-1}\left(\alpha_{Ey}(y_{Et}-\tilde{y}_{Et})^2+\alpha_{E\pi}(\pi_{Et}-\tilde{\pi}_{Et})^2\right)+\frac{1}{2}\sum_{t=1}^{T}\left(\left(\frac{1}{1+\tau}\right)^{t-1}(\alpha_{ER}\left(R_{Et}-\tilde{R}_{Et}\right)^2\right) \quad (11)$$

When every weight has a positive value $\alpha \in [0,1]$ and $= \theta * 1e-2$. A tilde denotes the desired (‘‘ideal’’) values of the respective variable. The combined objective function to find the collaborative Pareto-optimal solution is determined by the weighted sum of the two objective functions[3]:

$$J_{pareto} = \mu J + \mu_E J_E \text{ ,}(\ \mu, \mu_E \geq 0, \mu + \ \mu_E = 1 \quad (12)$$

Equations (1) to (12) form a dynamic game involving two players, both of them possess a single control variable.The model consists of 14 endogenous variables, as well as 7 exogenous variables. Additionally, the model assumes that it is played out within a time frame that is limited. In the trajectories of the control variable and state deviations from their respective desired values, the objective functions are quadratic. The dynamic game that is produced is nonlinear-quadratic, making it impossible to solve analytically and requiring numerical methods. For this purpose, it is necessary to define the model's parameters. In this case, an effort has been made to adjust the model parameters. Algeria's average economic indicators are the data used for calibration from 2000 to 2022, which is extracted from the Central Bank of Algeria, the International Financial Statistic (IMF), and the Algerian Ministry of Finance. For the remaining model parameters in Table 4, we use values based on econometric studies and plausibility considerations [Mahmoudinia et al., (2016); Merzlyakov (2012); Saulo et al., (2013), Tetik & Ceylan (2021)].

Table 4. Parameter values

variables	θ	η ،δ ،ε	γ،ρ ،β ،k ،λ	ξ	ω	χ	μ, μ_E
value	3	0.5	0. 25	0.1	1	0.0125	0.5

Table 5 provides the weights for the variables in the objective functions (as in Eqs (10) and (11)). The output and fiscal surplus/deficit weights x_{iy} , x_{iy} are equal to 1. It is expected that the country gives slightly less significance to inflation, which has a weight equal to 0.5. Due to the elevated levels of variable D, the country places significant emphasis (weight) on achieving fiscal stability debt targets, so α_{1D} is set to 0.01. The central bank places much greater importance on inflation than on the output goal (α_{ER}= 2 and α_{Ey}= 0. 5), which will stand for the central bank's stance, with its primary goal being price stability as mandated.

Table 5. Weights of the variables in the objective function

variables	x_{iy} , x_{iy}	$\alpha_{E\pi}$	$\alpha_{i\pi}$	α_{Ey}	α_{1D}	α_{ER}
value	1	2	0.5	0.5	0.01	3

Table 6 presents the starting values for the macroeconomic variables, which serve as the state variables in the dynamic game model. (we consider the average trend of variables in the Algerian economy).

Table 6. Initial values

variables	y	π	π^e	I	D	g	R_e
value	2.7	9.3	9.3	3.75	52.4	-0.115	3

Table 7 provides the desired values for the objective variables of players. The country's debt is currently at 52.4% of GDP and is planned to be reduced steadily to 40% at the end of the planning period. (A debt-to-GDP ratio of 60% is commonly considered a prudent threshold for developed countries, whereas developing and emerging

[3] The general loss function in the case of coordination should be the loss function for a single agent.

economies are advised to aim for a debt-to-GDP ratio of no more than 40% in the long run[4]). Regarding economic growth and inflation rates, we adopted those targeted within Algerian financial laws.

Table 7. Target value for state variables

variables	$\overline{y_t}$	$\overline{y_{Et}}$	$\overline{\pi_t}$	$\overline{\pi_{Et}}$	$\overline{D_t}$	$\overline{g_t}$	$\overline{Re_t}$
value	4.2	4.2	4	4	40	0.1	3

The model is effective in simulating the effects of various shocks depicted in the exogenous, uncontrolled variables' pathways, as well as the responses of policies to these shocks. It is assumed that the policy makers (the government and the monetary authority considered to be homogeneous) strive to minimize their loss function subject to the constraints which are given by the model, and interacting following a specific solution concept in the dynamic game. For this purpose, we consider a combined shock that affects both demand $zd_t$and supply sid zs_t: as shown in Table 8.

Table 8. Negative shock on demand and supply side

t	1	2	3	4	5	6	……..	30
zd_t	-2	-4	-2	0	0	0	…….	0
zs_t	0	0	0	2	2	2	…….	0

In the first three periods, the country experiences a negative demand shock affecting its economy in the same way. This shock will reflect a financial or economic crisis similar to the ‘‘Great Recession’’ of 2007–2010, which impacting all countries in the world. We assume a decrease in demand of 2% in the first period, 4% in the second period, and 2% in the third period. The country responds to the financial and economic crisis by boosting public expenditures, whether through discretionary measures or automatic stabilizers, and it will face the challenging issue of escalating public debt. Starting with third period country also experiences adverse supply side shocks, which lead to increase inflation rate. These shocks last three periods and the country experience an increase in inflation of 2%.

Every experiment we conduct involves calculations of four solutions for the dynamic game after executing several operations in line with MATLAB software: a baseline solution that does not include any policy intervention and describe as a simple simulation of the dynamic system, two noncooperative equilibrium solution (Nash feedback and open-loop Stackelberg[5]) and a cooperative (Pareto) solution.[6]

The following Figures 3-10 show the trajectories and the time paths for the two control variables (fiscal surplus g_{it} and the central bank's prime rate R_{Et}) and the six most relevant endogenous variables (output y_{it}, the nominal interest rate I_{it}, the inflation rate p_{it}, the real interest rate r_{it}, public debt D_{it}, and the average interest rate for bonds BI_{it}).

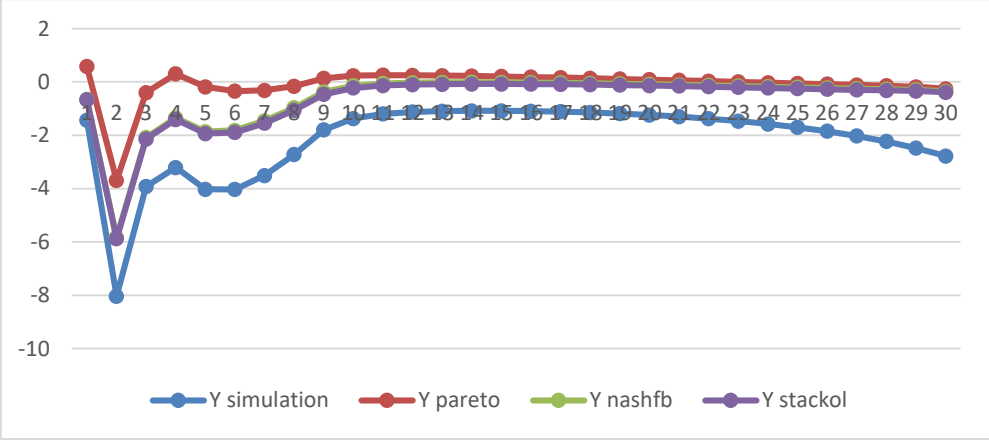

Figure 3. Country's Output

[4] Tran (2018) finds that optimal debt thresholds ranging between 40% and 55% for a group of 14 emerging economies, Reinhart & Rogoff (2010) was proposed a range of 41% to 60% as a benchmark to ensure sustained growth.

[5] This model is compatible with Algeria's situation, which is characterized by non-Ricardian regime or fiscal dominance [Chibi et al., (2021); Ikram & Si Mohammed (2023)]. In open-loop Stackelberg equilibrium, the leader (government) commits to a predetermined plan of actions that does not depend on the current state of the game or the follower's actions. The follower (central bank) then chooses an optimal response to the leader's plan, taking into account the game dynamics and the leader's information.

[6] For more details about techniques and functions you can see: Blueschke et al., (2013).

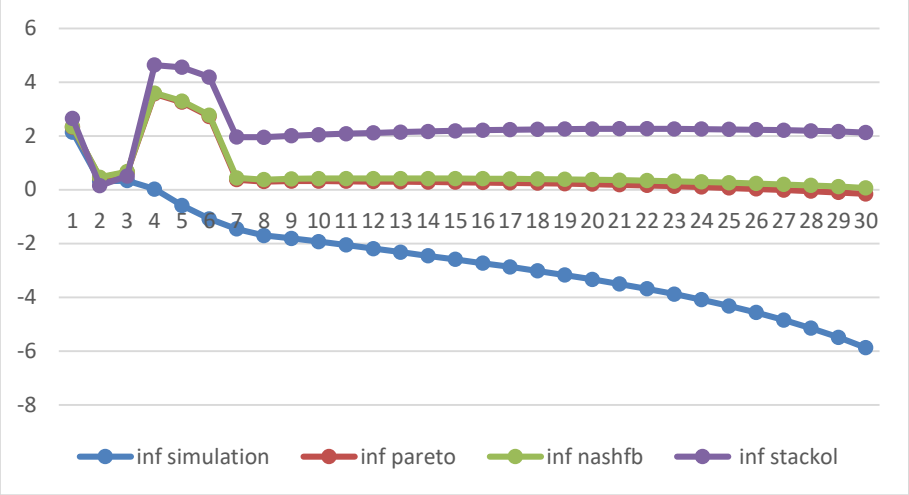

Figure 4. Country's Inflation Rate

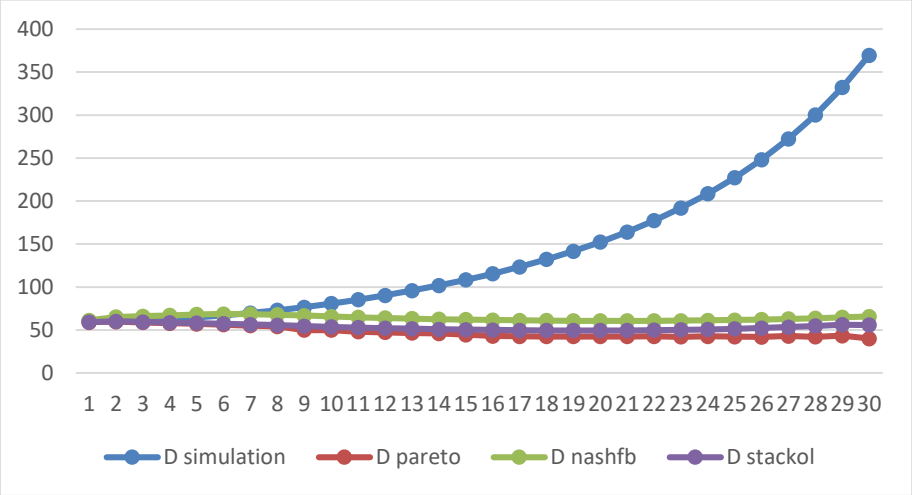

Figure 5. Country's Public Debt

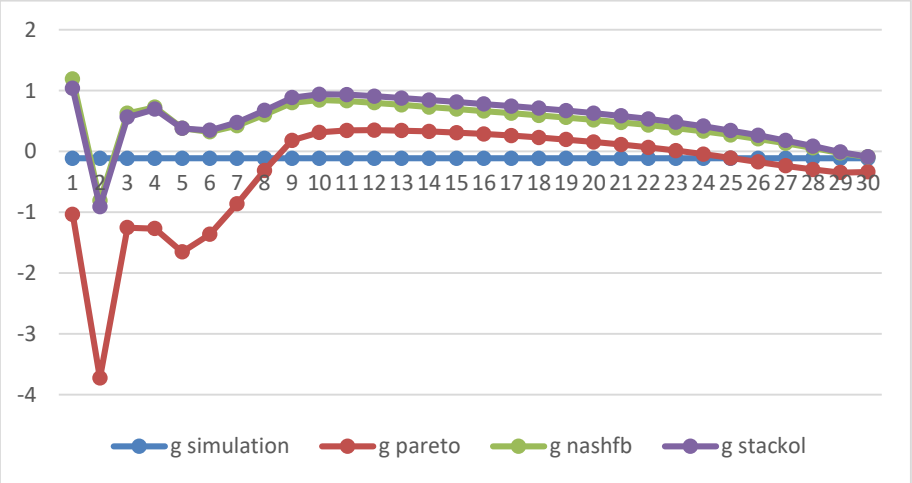

Figure 6. Country's Fiscal Surplus

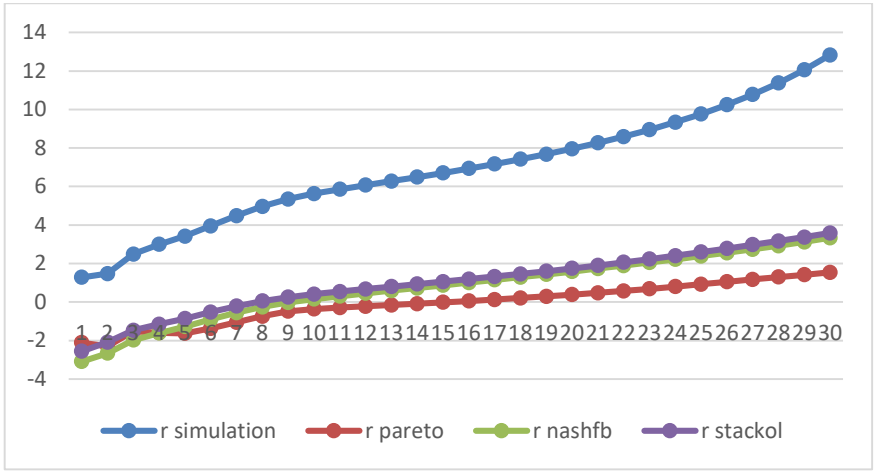

Figure 7. Country's Real Interest Rate

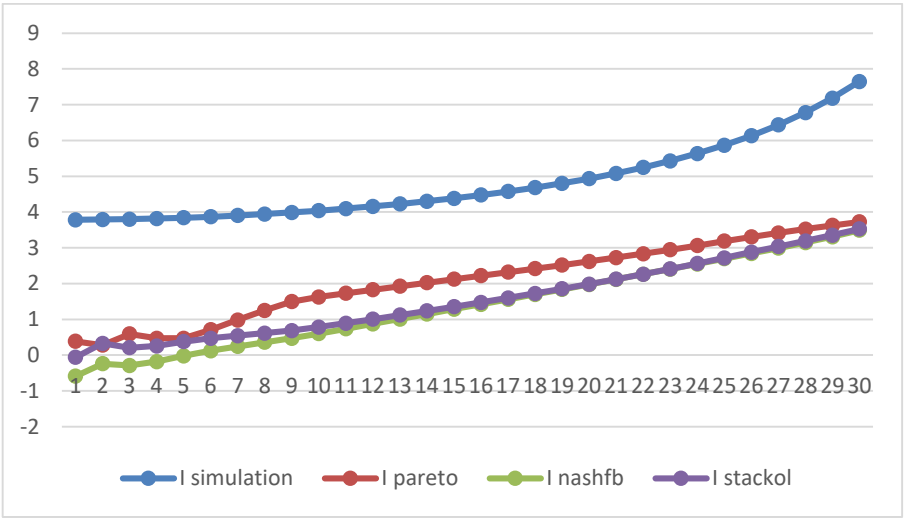

Figure 8. Country's Nominal Interest Rate

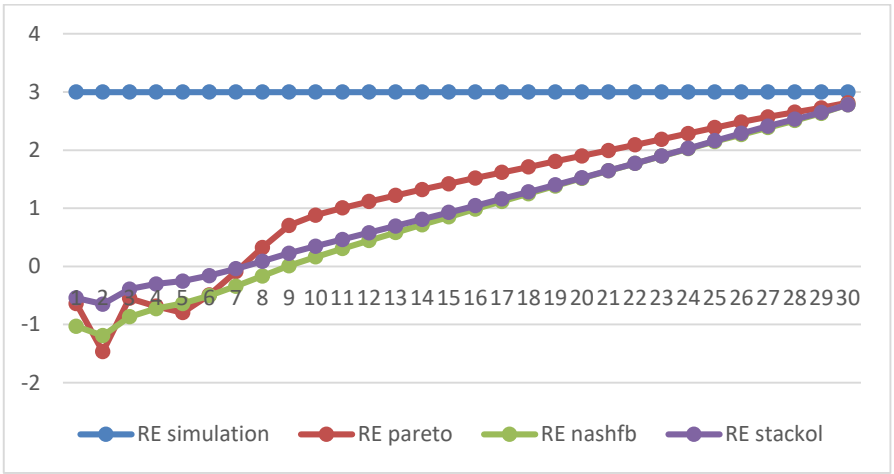

Figure 9. Country Central Bank's Prime Rate

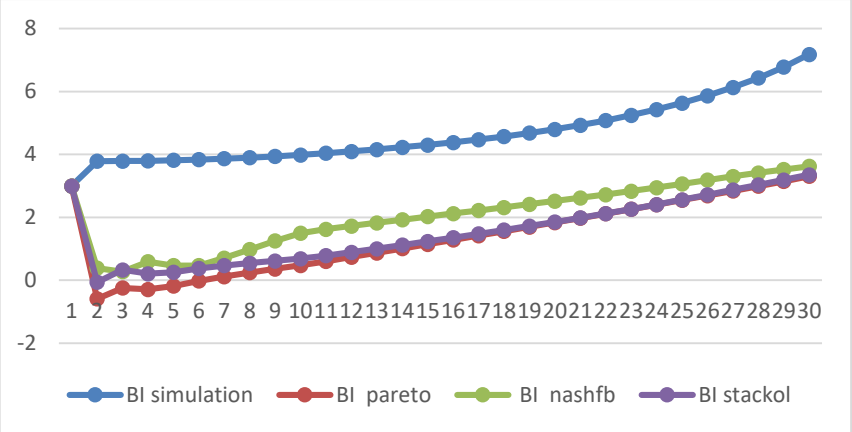

Figure 10: Country's Interest Rate for Bonds

In the absence of reactions from both fiscal and monetary authorities, (the baseline scenario denoted by simulation), the Algerian economy incurs the largest percentage of losses in terms of output decline, reaching 08%. Non-cooperative games within Nash and Stackelberg equilibrium offer solutions that are approximately 6% lower than this percentage. The optimal Pareto game equilibrium results in a decrease of only 4%, which suggests that the Algerian economy could perform better under the optimal Pareto scenario. This economic crise lowers inflation to value close to zero, but with the appearance of supply side shock inflation rate goes up especially in the Stackelberg government leader (the fiscal theory of price level), while this rate decreases in Nash and Pareto equilibrium. Even more striking is the development of public debt. Without policy intervention, it grows steadily throughout the whole planning horizon, reaching a level of 370% of GDP. That is shown a need for policy action (in all remaining scenarios) to stabilize the economy.

Overall, both monetary and fiscal policies respond to the negative demand shock in an expansionary and countercyclical way. In the Nash solution, the country incurs a fiscal deficit in the initial three periods and responds expansively in the first seven periods of the Pareto solution to mitigate the adverse effects of the demand shock. At the outset, the central bank implements an expansionary monetary policy by reducing its prime rate, gradually reverting back to the target value of 3 % by the end of the planning horizon. Such Keynesian policies assist in mitigating the impact of the adverse demand shock to a certain degree. Nevertheless, this policy has a cost in terms of its impact on the national debt and necessitates an austere fiscal policy post-crisis. Although the nation generates large budget surpluses, it also pursues a more restrained fiscal policy. Particular focus needs to be placed on the country's ability to maintain public debt at roughly a constant level of 50% of GDP under all scenarios. The solution concept has a major impact on the central bank's qualitative behavior. In the Nash equilibrium solution with non-cooperative feedback, the central bank exhibits almost no response. In the cooperative Pareto solution, after a crisis, the central bank raises the prime rate to first impose discipline on the government. Once the haircut shock has occurred, it then adopts an expansionary monetary policy to support the government. This approach can significantly reduce the negative impact of the haircut shock on output. The comparison between the Pareto solution and the feedback Nash and Stackelberg solution indicates that more active fiscal policy is needed during and immediately following a crisis with the Pareto solution, and less restrictive policies are required afterwards. Moreover, it requires a more proactive approach to monetary policy throughout the entire optimization timeframe.

The cooperative Pareto solution, overall, performs better than the feedback Nash and Stackelberg solution when it comes to its impact on output, inflation, and debt. This is evident when examining the minimum values of the loss functions calculated in Table 9 using equations (10) and (11).

Table 9. The Values Associated with the Objective Functions (loss functions, to be minimized) for Each Scenario

Strategy	JE	J	J+JE
Simulation	872,5331561	1518,251235	2390,78439
Pareto	254,83857	78,53194457	333,370515
Nash FB	474,1311267	57,03034548	531,161472
Stack OL	453,6347269	64,55909138	518,193818

5. CONCLUDING REMARKS

The fact that economic policy is not managed by a single policymaker, but rather involves more authorities making decisions on fiscal and monetary matters, raises questions about how they create a field for coordination of their actions to achieve common goals. Policymakers' work results in the outcome of the interaction between fiscal and monetary policies are determined by the rules of the game, which is the institutional regime in which they operate. In this context, we have used game theoretical methodology to examine the effectiveness of different coordination methods (Nash equilibrium, Stackelberg leadership, and cooperative solution) between Algerian fiscal and monetary policies in a traditional macroeconomic optimization issue. A numerical analysis shows that the lowest welfare loss happens under the cooperative Pareto equilibrium where the solution gives the best response to demand and supply-side shocks especially regarding output, inflation and public debt results. This result is consistent with the outcomes of Neck & Behrens (2003); Merzlyakov (2012); Woroniecka-Leciejewicz (2015); Blueschke et al., (2020)**.**

If the cooperative approach is seen as a financial arrangement that compromises all parties, it demonstrates the benefit of this institutional arrangement: it enables the country to depend on its efforts to decrease public debt. Therefore, the Algerian government could implement less strict fiscal policies due to the reduced prime rate set by the central bank of Algeria, which depends on the cooperation of the government. Specifically, coordination reduces the target-instruments problem by aligning fiscal deficits with monetary targets, ensuring smoother interest rate adjustments, and stabilizing inflation expectations.

Adequate institutional and operational arrangements are crucial for the effective coordination of monetary and fiscal policies in Algeria. Recent developments indicate a growing trend towards the division of monetary policy and public debt management at the institutional level, leading to increased independence for the agencies responsible for each. In such a context, central bank policies focus on maintaining price stability while public debt management agency aims to reduce the costs of financing fiscal deficits. Rule-based arrangements are also useful in enhancing transparency and in encouraging financial discipline, which are the key elements in providing an institutional framework that would bolster credibility and facilitate the success of stabilization policies.

Furthermore, formal channels and arrangements are needed for policy coordination, such as: independence of the central bank, limiting direct central bank credit to the government, balanced budget or deficit limitation clauses, currency board arrangements, the establishment of a separate debt management office, coordination committees, and the coordination at the day-to-day level (the management of the government cash balances, the level of central bank credit to the government, and the formulation of liquidity forecasts).

The findings from this study on Algeria provide a framework for understanding policy coordination in other developing economies with comparable institutional structures and economic conditions. Institutional and political barriers, including the central bank's independence and divergent fiscal priorities, often complicate policy coordination. The study's conclusions are contingent upon specific assumptions, such as linear policy responses and symmetric shocks. Future research could explore alternative models that incorporate nonlinear dynamics or asymmetrical shocks. It could investigate the implications of varying levels of commitment in fiscal and monetary policies, such as comparing rule-based versus discretionary frameworks.

AUTHORS' DECLARATION:

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AUTHORS' CONTRIBUTIONS:

Conceptualization, writing-original draft, editing and data collection – **AC**, methodology and formal analysis – **YZ**, Final Approval and Accountability – **SMC**

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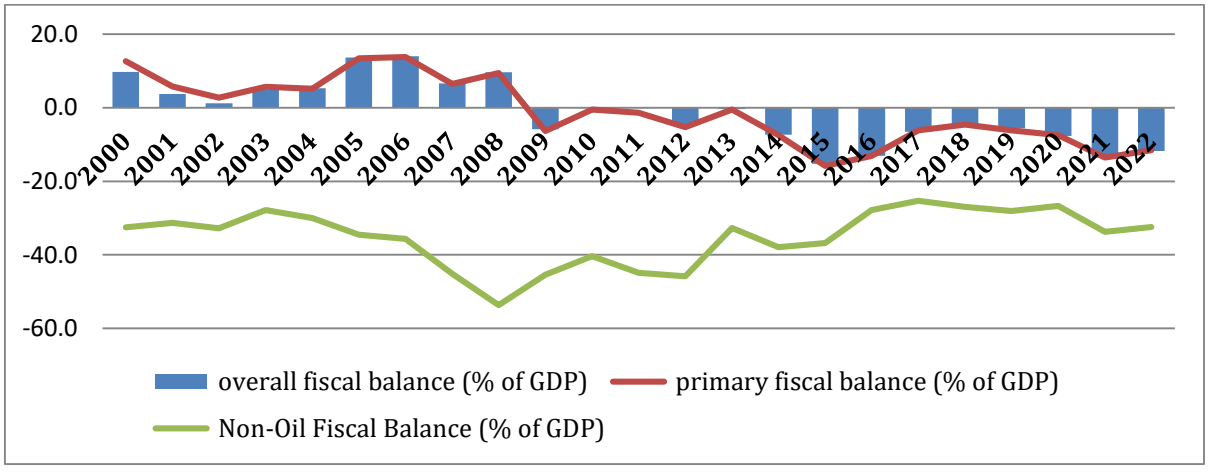
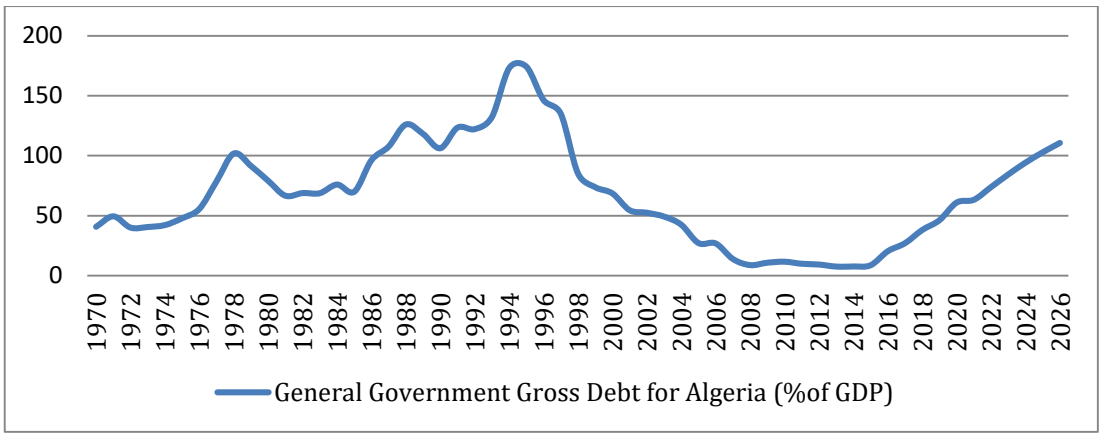
APPENDIX



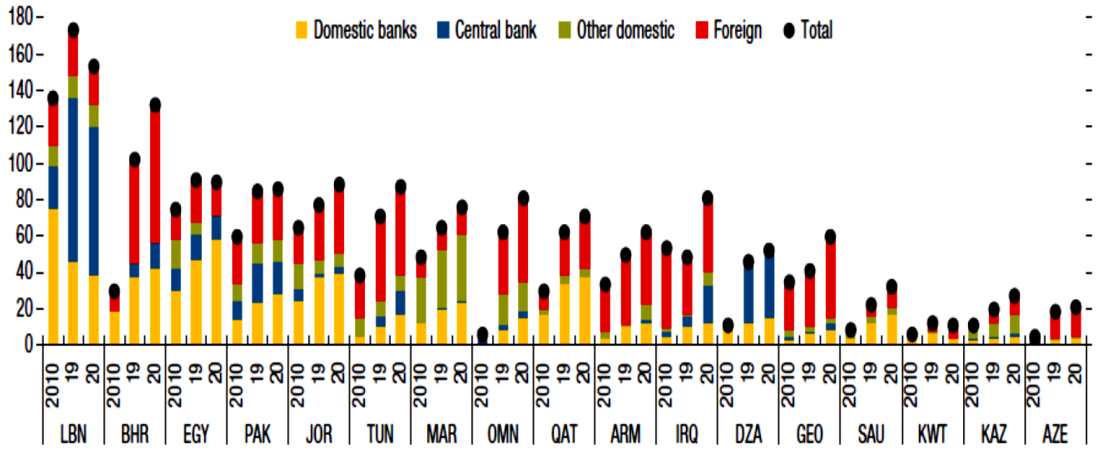
Appendix 1. Overall and primary fiscal balance for Algeria 2000-2022 (% of GDP)

Source: IMF: Regional Economic Outlook Database. April 2021 ,Fiscal Monitor Database. April 2021.



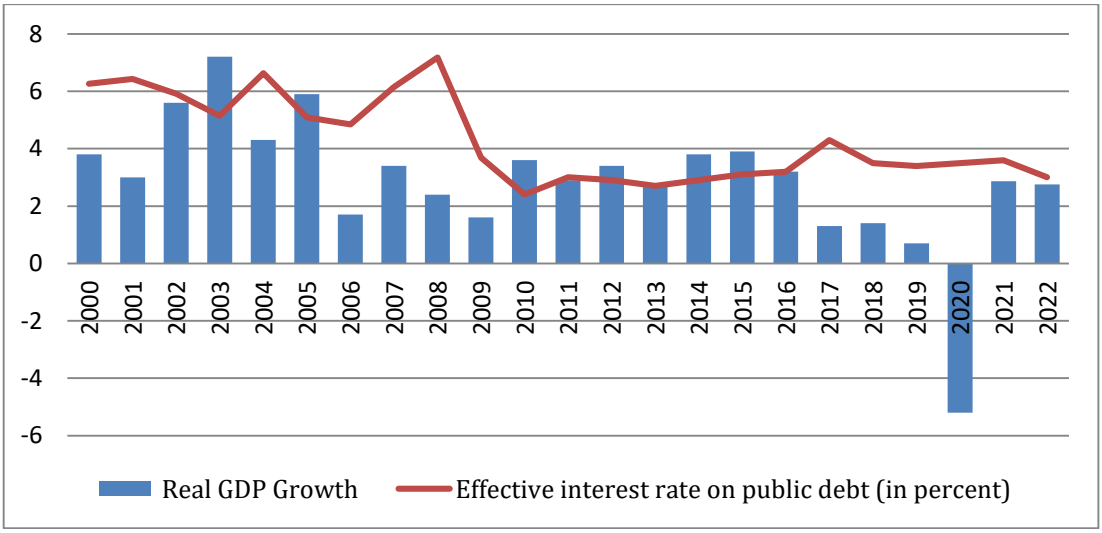
Appendix 2. General Government Gross Debt for Algeria 1970-2026 (% of GDP)

Source: IMF: Fiscal Monitor Database. April2021, World Bank: WDI.



Appendix 3. Government Debt Structure by Creditor (Percent of GDP)

Source: IMF: Regional Economic Outlook (MENA). April 2021. P: 17.



Appendix 4. Interest-rate-growth differentials for Algeria 2000-2022

Source: Authors' calculations, based on data from: Fiscal Monitor Database. April2021 and IMF Country Report No. 18/168.

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A Research on the Investigation of Turkish Consumers' Purchase Intentions in the Context of Omni-Channel Shops and Unified Theory of Acceptance and Use of Technology (Utaut-2)

Türk Tüketicilerinin Satın Alma Niyetlerinin, Omni-Kanallı Mağazalar ve Birleştirilmiş Teknolojinin Kabul ve Kullanımı Teorisi (Utaut-2) Bağlamında İncelenmesi Üzerine Bir Araştırma

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ABSTRACT

The particular aim of this paper is to examine the motivational factors underlying Turkish consumers' behavior during the process of their purchasing from omnichannel shops, with a deeper and broader perspective on the current role of technology. The Quantitative research method was used to achieve the adopted research objective. A total of 456 respondents shared their actions regarding their last purchase in the 12 months prior to data collection in Turkey. The hypothesis analysis part of this article suggests that the following elements have a favourable impact on purchasing behaviour: perceived trust, innovation, pricing value, and purchase intention. According to the study's findings, Turkish omni-channel shoppers value the ability to receive advertising messages through the technological devices they use, compare products and prices with these devices, and thus expect personalised campaigns to complete their purchases and track post-sale deliveries.

Anahtar Kelimeler:
Omni Kanal Pazarlama,
Tüketici Satınalma Davranışı,
Birleştirilmiş Teknolojnin Kabul ve Kullanımı Teorisi
Jel Kodları:
M30, M31

ÖZET

Bu makalenin amacı, Türk Tüketicilerinin omnikanal mağazalardan satın alma sürecindeki davranışlarının altında yatan motivasyon faktörlerini, teknolojinin mevcut rolüne ilişkin daha derin ve daha geniş bir bakış açısıyla incelemektir. Araştırmada nicel araştırma yöntemi kullanılmıştır. Türkiye'de yerleşik 456 kişi ankete katılarak, son 12 aylık dönem içinde, satın alma işlemlerine yönelik davranışlarını belirtmişlerdir. Araştırmadan elde edilen verilerin analizinde, Smart Pls ve IBM SPSS-25 istatistik yazılım paketlerinden yararlanılmıştır. Araştırmanın hipotez analizi kısmı, aşağıda belirtilen faktörlerin satın alma davranışı üzerinde olumlu etkiye sahip olduğunu ileri sürmektedir. Bu faktörler algılanan güven, yenilik, fiyatlandırma değeri ve satın alma niyetidir. Çalışmanın bulgularına göre, Omnikanaldan hizmet veya ürün satın alan Türk Tüketiciler kullandıkları teknolojik cihazlar aracılığıyla reklam mesajlarını alma, bu cihazlarla ürün ve fiyatları karşılaştırma olanağına sahiptirler. Bu nedenle, satın alma işlemlerini tamamlamak ve ayrıca satış sonrası teslimatlarını izlemek için kişiselleştirilmiş kampanyaları da takip etmektedirler.

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1. INTRODUCTION

With the advent of the twenty-first century, a new age of technological innovation and transfer began. Customer and company interactions alter as a result of technological advancements. Communication is evolving from traditional to digital. For example, new technology has revealed new ways to do business. By embracing these concepts, the internet began to serve as a catalyst for new business models. According to Ho Cheong & Park (2005: 126), the adoption of the internet over a wired network has transformed the distribution technique, making it more effective and convenient. However, wireless devices are supposed to offer clients with information and services at all times and from any location. As a result of the rise of the online channel and continuous digitalisation, retail has undergone tremendous transformation. As a result, the internet channel has grown extremely dominating, which can be regarded a disruptive trend.

The widespread use of the internet has enabled consumers to search for the products and services they want in a cost-effective, timely and reliable manner from various points of sale, thus causing distribution channels to change. In addition, consumers have also developed various options to access a product or service. In this situation, especially with the spread of e-commerce in the retail sector, consumers do not only want to buy or shop for designs, but also the channels where the purchase will take place play an important role in their decisions. Currently, consumers are looking for the best option for themselves in terms of both speed and cost.

The notion of omni-channel examines how to manage these channels in a harmonic and adaptable manner, as well as ensure channel synchronisation. Omni-channel is one of the most significant retail revolutions of recent years, affecting a wide range of industries including marketing, retail, communication, and information technology. Omni-channel strategy is a type of retailing that enables genuine engagement, allowing customers to shop anywhere, anytime across channels, hence removing barriers between online and physical channels. Mobile devices have become an essential part of modern consumer life. According to studies on the subject, consumers use mobile technologies for reasons such as personalization, accessing services without location restrictions, and providing a time/cost advantage.

The Unified Theory of Acceptance and Usage of Technology (UTAUT) models provide a useful framework for examining the adaptations to mobile applications, which are rapidly expanding globally and used by various consumer groups for shopping purposes. In addition, it aims to determine which mobile applications customers prefer on a general platform, both from offline and online retailers, and to find the factors that affect the tendency to use these applications. Therefore, this study aims to reveal the problems that hinder the usage of consumers on the factors and to offer reasonable solution suggestions. Thus, studies are carried out to reveal the attitudes of consumers towards mobile applications, which have become an inseparable part of their daily lives, and their future behaviors towards them. The secondary objectives of the study include predicting consumer behavior in the context of technology adaptation and determining the necessary elements for adaptation to applications.

Multi-channel research examines factors such as "performance expectancy", "effort expectancy", "social influence", "facilitating conditions", "hedonic motivations", "price values", "trust" and "innovation". Additionally, the relationship between online and offline "purchase intention" (behavioral intention) and "purchase behavior" (behavioral usage) is also under investigation. The functions assumed by demographic customer identifiers such as age, gender and spending are also investigated within the scope of these relationships.

2. LITERATURE REVIEW

The term "omnis" is derived from Latin, signifying 'all' or 'universal.' So, the concept of “omni-channel” denotes an amalgamation of all channels (Lazaris et al., 2014: 1). However, Neslin et al. (2006: 96) define a channel as a point of communication between the firm and the client. An omni-channel (O.C.) business model is a cross-channel business strategy used by firms to improve customer experience. O.C. business is described as "seamless and effortless, high-quality customer experiences that occur within and between contact channels. Thus "Multi-channel retailing” has been expanded into omni-channel retailing (Verhoef et al., 2015: 175).

The O.C. combines enhanced communication with user experience through a collaborative, well-coordinated cross-channel approach. O.C. substitutes multichannel platforms including e-commerce, social media, mobile applications, and physical sites with better customer values and a range of application channels in the healthcare, government, financial services, and telecommunications industries. Retailers use technology and communication strategies to select and provide products that satisfy their customers, and these strategies have a direct impact on consumer involvement, engagement, and competitive performance (Lazaris et al., 2014: 1).

More specifically, the retail environment has evolved and will continue to change as a result of the introduction of the mobile channel, tablets, and social media, as well as the integration of these new platforms into both online and offline purchasing. According to widely accepted studies, we are transitioning from an omni-channel retail model to a multi-channel retail framework. The interactive communication environment that mobile applications provide between the customer and the business leads to the creation of new products and services. The use of mobile applications promotes a system of open innovation. Consumer data collected via mobile applications aids in the expansion and diversification of products. Through the creation of online communities, mobile applications help to form consumer groups.

O.C. management is becoming more and more necessary as businesses and customers use more touchpoints to communicate more easily (Verhoef, et al., 2015: 176). When making a purchase decision, customers weigh the advantages and disadvantages of various channels and select the one that will minimize expenses like time, effort, money, and risk while maximizing benefits like better prices, safer purchases, and better deals (Gensler et al., 2017: 38; Pauwels & Neslin 2015: 184).

Venkatesh and his colleagues created the Unified Technology Acceptance and Use Theory, or UTAUT, paradigm in 2003 to forecast technology adoption in organizational settings (Chang, 2012:107). UTAUT is associated with the prediction of both behavioural intentions to use a technology and actual technology utilization, especially in organizational contexts.

UTAUT states that whilst behavioural intention and facilitating conditions dictate technology usage, performance expectancy, effort expectancy, and social influence were theorized and found to influence behavioural intention to use technology. Furthermore, different combinations of the four moderators were shown to moderate different UTAUT interactions according to theory (Zhang & Venkatesh, 2014: 715). UTAUT aims to model technology perception and disclose how individuals and the communities they form interact with it (Uyar, 2019: 687).

Numerous theoretical frameworks have been put out to explain users' acceptance behaviour. UTAUT moves forward by combining the structural elements of eight earlier models, ranging from computer science to human behaviour. It builds upon a number of earlier theories to provide a more thorough and all-encompassing model of human conduct.

After the acceptance of UTAUT, Vanktesh and his colleagues integrated three distinct constructs—namely, hedonic motivations, price value, and habit—into the UTAUT framework. Due to the UTAUT model's limited ability to comprehensively elucidate consumer expectations on its own, UTAUT-2 was developed by incorporating additional factors to enhance its explanatory power (Vankatesh et al., 2012: 150). The effects of these dimensions on behavioural intention and technology use are thought to be moderated by individual characteristics, including age, gender, and experience (Chang, 2012: 107).

3. HYPOTHESIS and RESEARCH METOD

Performance expectancy is defined by Venkatesh et al. (2003, 2012) and Chang (2012) as the degree to which using multiple channels and/or technology during the buying process will guarantee clients receive benefits while they are making purchases of goods and services. Performance expectancy has been shown again and time again to be the most significant predictor of behavioural intention, or buying intention (Ayensa et al., 2016: 4). In this regard, the following research hypothesis is proposed for this investigation:

H_1: Performance expectancy has a positive effect on Turkish Consumers' purchasing intentions from omnichannel shops.

Effort expectation is the degree of ease associated with consumers utilising a variety of touch points during the purchasing process. Present technology adoption models incorporate the notion of effort expectation as perceived ease of use. The effort expectancy construct is significant in both voluntary and mandatory age situations (Ayensa et al., 2016:4) and has been demonstrated to favourably boost purchase intention (Venkatesh and al., 2012:10) in prior research (Karahanna & Straub, 1999: 186). Consequently, the theory put forth below is suggested:

H_2: Effort expectancy has a positive effect on Turkish Consumers' purchasing intentions from omnichannel shops.

Customers may understand social influence in the way that various channels should be used depending on the demands of the people who are important to them, such as family, friends, role models, etc. The direct effect of social influence on behavioural intentions Social influence, subjective norm, and social norm constructs (Venkatesh et al., 2003:451), as well as the positive effects on purchase intention (Venkatesh et al., 2012; Ayensa

et al., 2016), all imply or explicitly state that people's behaviour is influenced by their perception of how others will perceive them as a result of using technology. In light of the literature, the study framework is expanded to include the following hypothesis:

H_3: Social influence has a positive effect on Turkish consumers' purchasing intentions from omnichannel shops.

Vankatesh added a direct relationship from favourable conditions to behavioural intent as the first modification to adapt UTAUT to the setting of consumer technology usage. Because they can help achieve full behavioural control and have a direct impact on behaviour in an organizational environment, enabling factors are expected to have a direct impact on technology use in UTAUT (Ajzen 1991:182 and Vankatesh et al, 2012: 164). This is due to the fact that a lot of the facilitating terms—like the training and support—can be offered by an organisation at no cost to customers and are essentially constant.

H_4: Facilating condition has a positive effect on Turkish Consumers' purchasing intentions from omnichannel shops.

Hedonic motives are associated with concepts such as enjoyable, pleasurable, and fun (Holbrook & Hirschman, 1982: 132 ; Kim & Forsythe, 2007: 503; Venkatesh et al., 2012: 156; Ayensa et al., 2016: 4). It has been shown to play a big role in influencing consumers' intentions to buy and their acceptance of new technology. According to Brown & Venkatesh (2005), it is defined as the delight or pleasure derived from using the mentioned technology. Numerous information and communication technology (ICT) articles have shown how hedonic motivation affects technology use and purchasing intention (Thong et al., 2006:802; Ayensa et al. 2016: 4). Consequently, the following theory is now included in the research structure.

H_5: Hedonic motivation has a positive effect on Turkish Consumers' purchasing intentions from omnichannel shops.

Price is defined as the perceived difference between the costs associated with employing technology and its benefits (Dodds et al., 1991: 308). The price and pricing scheme have a big influence on how customers use technology. In marketing research, the perceived worth of goods and services is generally ascertained by taking into account both the monetary cost and price in addition to the quality of the goods or services (Zeithaml, 1988: 17). When the advantages of adopting technology are thought to outweigh the financial costs, the price value is positive, and this price value positively influences behavioural intention (Vankatesh et al., 2012: 158). Therefore, the appropriate follow-up hypothesis now includes price value as an indicator of behavioural intention to utilise a technology.

H_6: Price value has a positive effect on Turkish Consumers' purchasing intentions from omnichannel shops.

Customers' perception of trust is defined as their belief that omni-channel businesses include information security concepts into their technology policies, such as encryption, authentication, and information protection and verification (Kim et al., 2008: 510). O.C.s will conclude that the retailer's goal is to ensure their information security during the purchasing process if they believe that online channels include security features (Chellappa & Pavlou, 2002: 363 and Ayensa et al., 2016: 5). Studies have indicated that the perceived trustworthiness of online channels has a beneficial impact on purchase intention (Salisbury et al., 2001: 171; Frasquet et al., 2015: 17). The research framework is broadened to incorporate the following hypothesis, which presupposes a connection between perceived trust and the inclination to buy, in light of the findings.

H_7: Perceived trust has a positive effect on Turkish Consumers' purchasing intentions from omnichannel shops.

Within the context of omnichannel marketing, innovation is characterised as an individual's inclination to experiment with novel items or channels and pursue novel experiences that necessitate more investigation (Midgley & Dowling, 1978:234). Numerous scholarly works have emphasised the significant impact that consumer innovation seeking has on information and communication technology (ICT) adoption and purchase intention (Agarwal & Prasad, 1998: 208; Citrin et al., 2000: 299; Salmones et al., 2008: 374). This is how the study hypothesis that follows is put forth:

H_8: Perceived Innovativeness has a positive effect on Turkish Consumers' purchasing intentions from omnichannel shops.

H_9: Purchase intention (BI) has a positive effect on Turkish Consumers' purchasing behavior (BU) from omnichannel shops.

In both online and offline settings, trust plays a significant role in purchasing decisions. However, in the online setting, trust is predominantly developed through person-to-website contact rather than person-to-person conversation mediated by technology (Winch & Joyce 2006: 549). Gounaris et al. claim that behavioural purpose determines usage behaviour. As described by (Fishbein & Ajzen, 1975; Fishbein & Ajzen, 2010; Davis & Cosenza, 1985), it is our ultimate goal and aim. It is the purpose of omni-channel shoppers to adopt and use the system.

According to Vanketesh et al. (2003), BI (behavioral intentions) will significantly improve BU (behavioral usage), just like making online and offline buying. As a result, the research structure now includes the following theory.

Sivakumar et al. (2002) state that there is generally more risk involved with online shopping than with in-store shopping. Consumer trust is seen to be impacted by product information and the online purchasing experience. Nonetheless, it appears that customer confidence is unaffected by security when shopping virtually. The elderly are the consumer demographic that is most susceptible to deception, so naturally, they prefer to shop from brands and establishments they are familiar with and can rely on. Elderly consumers are using credit cards at a higher rate due to changes in their lifestyles and buying patterns in recent years (Apostolova & Gehrt, 2000: 30). Because younger customers are seen as more technologically savvy because they were raised in the digital age, age is also proven to be important when it comes to technology adoption (Pieri & Diamantinir, 2010: 2410). Nonetheless, gender often plays a significant influence in how reliable customers view companies; for instance, Faqih (2015) discovered that women are less inclined than men to make purchases and to take more risks. Consequently, the following theories are now included in the research structure.

H_{10}: The relationship between perceived trust and purchase intention from ocs to use shopping behaviour in Turkey is moderated by age of consumers.

H_{11}: The relationship between perceived trust and purchase intention from ocs to use shopping behaviour in Turkey is moderated by the gender of consumers.

The impact of price value on behavioural intention is expected to be moderated by age, gender, and disposable income (Vankatesh et al., 2012:4). Theories pertaining to social roles, such as those advanced by Deaux & Lewis in 1984, have been employed to theorise regarding the relative importance of price value differences between genders and between younger and older individuals. It demonstrates how men and women adopt various social roles and display various role behaviours. Specifically, women are more interdependent, collaborative, and detail-oriented than men, who are typically free, competitive, and base their decisions on a limited amount of information and heuristics (Bakan 1966: 426; Deaux & Kite 1987: 97).

Consequently, women are more likely than males to be cost-conscious and to pay more attention to product and service prices in a consumer setting. Furthermore, compared to men, women tend to be more responsible, more involved in purchases, and more frugal with their money (Slama & Tashchian 1985: 74). The price males place on technology is probably higher than the price women place on it, because men are more likely than women to interact with different forms of technology. Moreover, the gender gap caused by social role expectations would increase with age because older women are more likely to engage in activities like taking care of their families (Deaux & Lewis 1984: 995). Because of their social roles and increased attention to family finances, older women will consequently be more price sensitive. This demonstrates that older women place a higher value on goods and services that have a monetary worth. As a result, the following H-12, H-13, and H-14 hypotheses are proposed:

H_{12}: The relationship between price value and purchase intention from ocs to use shopping behaviour in Turkey is moderated by the disposable income of consumers.

H_{13}: The relationship between price value and purchase intention from ocs to use shopping behavior in Turkey is moderated by the age of consumers so that the effect will be stronger among consumers who are elderly.

H_{14}: The relationship between price value and purchase intention from ocs to use shopping behaviour in Turkey is moderated by the gender of consumers so that the effect will be stronger among older women.

Grohmann et al. (2011: 195) examined the elements that affect mobile internet acceptance and whether there are gender disparities in this regard using the Unified Technology Acceptance Model and Technology Use Model. Their goal was to validate the role that gender plays in the adoption and implementation of new technologies. According to the findings, men but not women were found to be significantly impacted by performance expectations and computer self-efficacy with regard to the purpose of use. When the gender variable in the performance expectation component is examined, it is demonstrated that women are more prominent and superior to men. According to the literature, the following hypothesis has been proposed for this study:

H_{15}: The relationship between performance expectancy and purchase intention from ocs to use shopping behavior in Turkey is moderated by the gender of consumers so that the effect will be stronger among male consumers.

The influence of hedonic incentives on behavioural intention is expected to be lessened with age because of differences in customers' perceptions of innovation, novelty seeking, and novelty of the target technology (Vankatesh et al., 2012: 163). "The degree to which an individual is open to new ideas and makes innovative decisions independently" is what Midgley & Dowling (1978) defined as innovativeness. The inclination for a person to look for novel stimuli or information is known as novelty seeking (Hirschman 1980: 283). The hedonic incentive to use any product can also be influenced by such innovation and novelty seeking (Holbrook and Hirschman 1982: 93). Customers will become more aware of a technology's innovation and may even employ it for their own inventive purposes after they start using it (Holbrook & Hirschman 1982: 94).

Additionally, it has been discovered that the innovativeness of consumer technology is related to both age and gender (Lee & Leonas, 2018: 4). Young males exhibit a stronger propensity to seek innovation when utilising new technologies in their early phases (Chau & Hui 1998: 228). It is clear from this pattern that young men's early decisions about technology use will place a greater emphasis on hedonic incentive. All of this leads to the following theories, which are thus proposed as H-16 and H-17 (Vankatesh et al., 2012: 156).

H_{16}: The gender of the consumer moderates the association between innovativeness and the desire to purchase from ocs to utilise purchasing behaviour in Turkey, with a greater effect on male consumers.

H_{17}: The relationship between hedonic motivations and purchase intention from ocs to use shopping behaviour in Turkey is moderated by the age the of consumers.

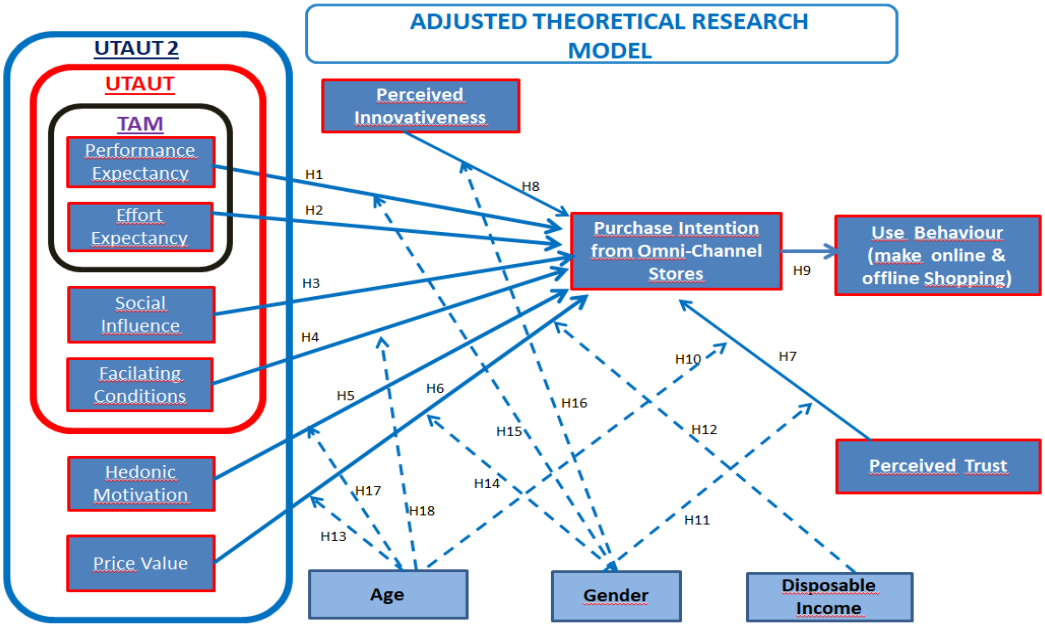

Figure 1. Research Model

Age is predicted to attenuate the impact of enabling settings on behavioural intention (Vankatesh et al, 2012: 157). The inability of older customers to assimilate new or complex information often hinders their ability to learn new technology (Menz et al. 2005: 1549; Plude & Hoyer 1986: 7). This challenge can be linked to the aging-related reduction in cognitive and memory functions (Posner, 1996: 1697). As a result, elder customers are more likely than younger consumers to emphasise the provision of sufficient support (Hall & Mansfield 1975: 204). Gender roles will become increasingly significant as people get older, especially as young people grow into adults.

As a result, senior ladies will give facilitating conditions greater weight. In fact, research indicates that as people age, gender disparities in the significance of facilitating conditions grow increasingly evident (Menz et al., 2005: 1549; Venkatesh et al., 2003: 454). In the early stages of using technology, older women depend more on enabling conditions because, as previously noted, they place more value on lowering the learning curve for new technology. Thus, our hypothesis is:

H_{18}: The relationship between facilitating conditions and purchase Intention from ocs to use shopping behaviour in Turkey is moderated by age of consumers.

4. DATA ANALYSIS and RESULT

4.1. Measurement Model

Quantitative research approaches were used to test the model and the previously mentioned hypotheses. Examining particular correlations between variables using quantitative data analysis is the main goal of quantitative research. The post-positivist perspective is adopted by quantitative research, which focuses on generating hypotheses, gathering data for analysis, and testing and validating theories. It can be used for phenomena that have a quantitative expression (Kothari, 2004: 39). An online survey targeting Turkish omnichannel retail customers provided the data for this study. In the summer of 2022, the survey was carried out. Omnichannel shoppers were defined as individuals who shop through at least two channels from the same merchant for the purposes of this poll. Regarding the conduct of this research, an "Ethics Permission Certificate" dated 27/10/2021 and numbered 14658 was obtained from the Ethics Committee of the Yaşar University.

Table 1. Respondents Features Characteristics. (N= 456)

Demographic Features	Frequency	Percent (%)
Gender of Respondents		
Male	265	58,1
Female	191	41,9
Total	456	100
Educational Level of Respondents		
Secondary School	5	1,1
High School	36	7,9
Associate Degree	38	8,3
Bachelors Degree	247	54,2
Postgraduate	130	28,5
Age level of Respondents		
18-24	16	3,5
25-30	58	12,7
31-35	44	9,6
36-40	69	15,1
41-50	157	34,4
51-60	106	23,3
61 years old and older	6	1,4
Income Level (TRY) of Respondents		
2825-3999	64	14,1
4000-5999	75	16,4
6000-8999	106	23,2
9000-11.999	62	13,6
12.000 – Over	149	32,7
Online Shopping Experience (Years)		
Less than one year	23	5
Between 1 or 2 years	48	10,5
Between 3-4 years	82	18,1
5 Years and over	303	66,4

The respondents were thoroughly examined to determine who might be considered an omnichannel shopper. In all, 456 respondents described how they had acted on their most recent purchase made in the 12 months before the data was gathered. The purpose of convenience sampling is to find responses or participants. Convenience sampling is a non-probabilistic sampling technique that aims to collect a sample of items that are easily accessible. The interviewer has the last say when it comes to choosing the sampling units. Often, respondents are selected just by coincidence—that is, by just so happening to be at the right location at the right moment. The sample units are cooperative and easily accessible (Malthora, 2004:30).

The survey's questions were developed after a careful analysis of pertinent literature and studies that highlight the relationship between omnichannel marketing's effects and the UTAUT-2 model's perspective on customer behaviour. The scales used in this study were taken from earlier research to guarantee that there would be enough items for the data analysis. A representative sample was given the questionnaire. Every participant in the online poll in Turkey was carefully chosen through the use of social media users (Facebook, WhatsApp, Linked-in groups, etc.).

There are two sections to this questionnaire: The first section collected demographic data from the respondents (e.g., gender, age, income, education level, etc.). The second section includes measurement scales that were adapted from relevant academic literature and scale items related to consumers' purchase intentions in omnichannel shopping that were taken from the UTAUT-2 model with 34 questionnaires. Questions at the nominal and ordinal levels are among the demographic variables. The participants in this study will be consumers in Turkey who have visited physical stores and online marketplaces and are over the age of 18.

In the context of the consumer behaviour perspective in omnichannel marketing, Vankatesh et al.'s (2003) study was utilised for the UTAUT-2 model's performance expectation (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), and price value scale items (PV).

While the questions on the behavioural intention (BI) scale were drawn from studies by Pantano & Viassone (2015) and Vankatesh et al. (2003), the items on the hedonistic motivation (HM) scale were generated by Kim et al. (2008), Coşkun & Marangoz (2017); Childers et al. (2001) investigations. Additionally, the innovation (IN) scale items were provided by Goldsmith & Hofacer (1991) and Lu et al. (2005), while the perceived trust (PT) scale items were provided by Cha (2011).

Based on a seven-point Likert scale, each item in the questionnaire is scored. The vocal statements "Strongly Disagree" and "Strongly Agree" are anchored at numerals 1 and 7, respectively (Malhotra & Birks, 2007: 29). The statistical packages IBM SPSS-25 and Smart Pls were used to analyse the data in this study.

4.1.1. Descriptive Analysis

It is clear from Table 1's data results on participant characteristics that 41.9 percent of the 456 respondents are women and 58.1 percent are men. The following represents the respondents' distribution based on educational attainment. There are five secondary school graduates, or 1.1 percent of the total, and thirty-six high school graduates, or 7.9 percent of the total. The number of associate degree education levels is 38, and the percentage is 8.3%. There are 247 bachelor's degree holders, or 54.2 percent of the total. Postgraduate education makes up the final educational level, with 130 participants, or 28.5 percent of the total.

Table 2. Descriptive Statistics of Respondents

		Gender	**Level of Education**	**Age of Respondents**	**Income Level**	**Online Shopping Experience**
N	Valid	456	456	456	456	456
Missing		0	0	0	0	0
Mean		0,58	4,01	3,39	2,34	2,46
Std. Error of Mean		0,23	0,041	0,069	0,067	0,041
Median		1,00	4,00	4,00	2,00	3,00
Mode		1	4	4	4	3
Std. Deviation		0,494	0,886	1,471	1,433	0,874
Variance		0,244	0,784	2,164	2,055	0,763
Skewness		-0,330	-1,089	-0,666	-0,238	-1,491
Std.Error of Skewness		0,114	0,114	0,114	0,114	0,114
Kurtosis		-1,899	1,191	-0,551	-1,274	1,137
Std. Error of Kurtosis		0,228	0,228	0,228	0,228	0,228
Range		1	4	6	4	3
Sum		265	1829	1547	1069	1121
Percentiles	25	0,00	4,00	2,00	1,00	2,00

	50	1,00	4,00	4,00	2,00	3,00
	75	1,00	5,00	4,00	4,00	3,00

Table 2 illustrates that there is no missing value in this survey. It is seen that all data (N=456) were used in this study. The age distribution of the respondents indicates that 16, or 3.5% of the total, are between the ages of 18 and 24. However, 58 individuals in this study—or 12,7% of the total—are between the ages of 25 and 30. As a percentage of all participants, 44 or 9,6% of them fall between the age range of 31 and 35. Thirty-six percent of the participants, or fifteen percent, are between the ages of thirty and forty. The age range of 41 to 50 is the largest group of respondents, comprising 34,4% of the sample. There were 106 responders, or 23,3% of the total, who were between the ages of 51 and 60. Finally, six participants, or 1.4% of the total, are 61 years of age or older. Looking at the respondents' income levels in Table 1, we find that the highest values in terms of numbers are 12.000 TL and above, with 149 respondents and a percentage of 32,7. The earning range from 9.000 to 11.900 TL is the lowest. There are 62 responders, and the percentage is 13.6 %.

Table 3. Tests of Normality

	Kolmogorof-Smirnov			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Age of Consumers	0,250	456	0,000	0,887	456	0,000
Learning how to use mobile internet is easy for me.	0,220	456	0,000	0,842	456	0,000
People who are important to me think that I should use mobile internet.	0,160	456	0,000	0,914	456	0,000

There is no normal distribution assumption in the normality test since not all data items are normally distributed ($p<0.00$ in the Kolmogorov-Smirnov test), which is also reflected in the table. As a result, in this study, we do not need to select the parametric test over the non-parametric test. The exogenous variables PE, EE, SI, FC, HM, PV, IN, and PT, in that sequence, comprise the independent variables of our research model. The variable BI is both endogenous and exogenous in this instance. By the way, BU is an endogenous variable.

Factor loadings and indicator reliability should both be statistically significant, ideally more than 0.708 (Hair et al., 2010; Chin & Marcoulides, 1998). Evaluating a suggested measurement theory's construct validity is one of CFA/SEM's main goals. According to Hair et al. (2019), construct validity refers to how well a set of tested items captures theoretical latent constructs that they are intended to measure.

First of all, to measure the validity and reliability of the research with the measurement model in the reflective variables; Internal "Consistency Reliability", "Convergent Validity and " Discriminant Validity analyzes were performed. In the internal reliability analysis of the measurement of the research, three different reliability coefficients were calculated. These are respectively "Cronbach Alpha", "Composite Reliability (CR)", and finally "rho_A" coefficients. Reliability coefficients are expected to be above 0.70. As Cronbach Alpha, rho_A, composite reliability (CR) values were above the critical value of 0.70, according to the below table indicating that all variables had sufficient reliability values. Construct provided composite reliability in this survey.

Table 4. Construct Reliability and Validity

	Cronbach's ά	**rho_A**	**CR >0,70**	**AVE >0,50**
BI	0,964	0,964	0,971	0,848
BU	1,000	1,000	1,000	1,000
EE	0,889	0,899	0,931	0,818
FC	0,873	0,902	0,915	0,732
HM	0,882	0,895	0,922	0,750
IN	0,890	0,895	0,925	0,757
PE	0,923	0,925	0,951	0,866
PT	0,899	0,915	0,937	0,833
PV	0,913	0,916	0,945	0,852
SI	0,906	0,906	0,941	0,841

The large shared variance of the latent variable's indicators indicates convergent validity (Hair et al., 2010). Two values are used to measure convergent validity. Factor loading is one, while the Explained Average Variance (AVE) is another. Above 0.50 is expected for the AVE value. Convergent validity is also shown in table 4 for this survey, as can be observed as the AVE values are more than 0.50. Discriminant validity demonstrates how the variable being decomposed is indeed distinct from other variables.

As a result, a high discriminant validity value suggests that the concept or event being measured by the focus variable differs from the concept or event being assessed by other variables. The discriminant validity is tested using three values. Cross-loading is one of them, the Fornell-Larcker criterion (Hair et al., 2014) is the second, and the Heseler et al., 2015 HTMT (Heterotrait-Monotrait Ratio) criterion is the third.

Table 5. Cross-Loading of the Survey

	BI	BU	EE	FC	HM	IN	PE	PT	PV	SI
BI1	0,896									
BI2	0,909									
BI3	0,940									
BI4	0,926									
BI5	0,909									
BI6	0,944									
BU1		1,000								
EE1			0,908							
EE2			0,912							
EE3			0,894							
FC1				0,931						
FC2				0,923						
FC3				0,873						
FC4				0,699						
HM1					0,934					
HM2					0,939					
HM3					0,889					
HM4					0,674					
IN1						0,917				
IN2						0,879				
IN3						0,748				
IN4						0,924				
PE1							0,907			
PE2							0,945			
PE3							0,940			
PT1								0,946		
PT2								0,952		
PT3								0,836		
PV1									0,891	
PV2									0,944	
PV3									0,934	
SI1										0,907
SI2										0,941
SI3										0,904

When evaluating discriminant validity, cross-loads are assessed first. When we control the factor loadings of the indicators in Table 5, it is expected that each indicator's factor loading will have the largest value under its own variable and that each variable's factor loading will differ from the factor in other variables by more than 0.01.

All factor loads, with the exception of the HM4 and FC4 indicators, are found to be above 0.70. The items with validity and reliability values between 0.60 and 0.70 ought to remain in the model. It doesn't hurt to keep the value in the model if it is at an acceptable level.

According to reports, factor loads in analysis techniques based on PLS-SEM are higher than 0.70 (Chin, 2010). It is generally acknowledged, nonetheless, that this value is higher than 0.60 according to recent research (Hair et al., 2014). The factor load in the variable that an indicator is connected with should be greater than the factor load in the other variables, according to the cross-loading criterion. The factor loadings that meet the cross-loading criterion's greatest values horizontally are displayed in Table 5.

Table 6. Farner-Lacker Values

	BI	BU	EE	FC	HM	IN	PT	PE	PV	SI
BI	**0,921**									
BU	0,872	**1,000**								
EE	0,739	0,701	**0,905**							
FC	0,687	0,646	0,826	**0,855**						
HM	0,701	0,656	0,679	0,658	**0,866**					
IN	0,756	0,758	0,681	0,675	0,636	**0,870**				
PT	0,720	0,707	0,623	0,557	0,595	0,673	**0,913**			
PE	0,742	0,714	0,866	0,828	0,674	0,675	0,573	**0,931**		
PV	0,750	0,765	0,662	0,641	0,683	0,701	0,627	0,644	**0,923**	
SI	0,554	0,522	0,626	0,571	0,640	0,538	0,446	0,632	0,531	**0,917**

According to the Cross-Loading criterion, the factor load in the variable associated with an indicator must be greater than the factor load in the other variables. The square root of each variable's explained mean-variance (AVE), as determined by the Fornell-Larcker criterion, must be higher than the variable's correlation with other variables. The geometric mean of the correlations between the indicators of the same variable, or monotrait-heteromethod correlations, and the heterotrait-heteromethod correlations, or mean correlations between the indicators of all the variables in the model, are expressed as a ratio by HTMT. Less than 0.90 should be the HTMT.

Table 7. HTMT Ratio Criterions

	Behavioral Int.	Behavior Use	Effort Exp.	Fac. Cond.	Hed. Mot.	Innovat.	Perc. Trs.	Per. Exp.	Price V.	Soc. Inf.
Behavioral Intention										
Behavior Use	0,883									
Effort Expectancy	0,674	0,623								
Facilating Condition	0,472	0,428	0,416							
Hedonic Motivation	0,708	0,638	0,637	0,552						
Innovativness	0,807	0,802	0,670	0,446	0,653					
Perceived Trust	0,768	0,740	0,564	0,396	0,618	0,747				
Performance Expectancy	0,780	0.743	0,769	0,524	0,708	0,744	0,622			
Price Value	0,802	0,800	0,598	0,467	0,674	0,777	0,690	0,723		
Social Influence	0,596	0,548	0,607	0,416	0,691	0,598	0,496	0,691	0,581	

Both the HTMT and Fornell-Larcker criteria from the survey were used, and the outcomes are displayed in Table 7. The HTMT ratio is guaranteed by each number. Research indicates that concepts that are conceptually distant should have an HTMT coefficient of less than 0.85, whereas concepts that have an HTMT value of 0.90 should theoretically be close to one another. Table 7 also includes this criterion. By giving the desired threshold values for the three criterias, the discriminant validity conditions of the model are supplied.

4.1.2. Stractural Model

Following the validity and reliability analyses, the model's connection analysis is carried out, and the linearity's VIF coefficients are determined. It should be established that there is no issue with collinearity between the variables prior to testing the hypothesis. Hair et al. (2017) state that the inner VIF value ought to be less than 5. Table 8 shows that the VIF coefficients had values less than 5. In light of this finding, it is inferred that there is no linearity between the research variables.

Table 8. Inner VIF Values

	BI	BU
BI		1,000
BU		
EE	2,686	
FC	1,523	
HM	2,933	
IN	3,787	
PE	4,065	
PT	2,490	
PV	3,138	
SI	2,301	

4.1.3. Quality Criteria

Once linearity has been established, we must look at R^2, which is a value that shows what proportion of exogenous variations account for the endogenous variant. R2 is regarded as weak when it is 0.25, medium when it is 0.50, and high when it is 0.75 (Hair et al. 2009, 2012). The endogenous variables of the research model, behavioural intention and behavioural usage, are explained at a rate of 75.4% and 76.1 %, respectively, based on the R2 value in the table. The strongest values are those. It is verified by the Quality Criteria that each exogenous variable's effect size (f2) coefficient has been computed. The f coefficient shows the percentages of exogenous influences in the endogenous variable disclosure rate. Effect size coefficients are classified as low, medium, or high if they are $f^2 > 0.02$. Cohen, (1988) states that a coefficient of less than 0.02 has no bearing. The quality standards, R^2. and f^2, are shown in the tables 9–10 below.

Table 9. R Square

	R Square	R Square Adjusted
BI	0,754	0,749
BU	0,761	0,760

Table 10. F Square

	BI	BU
BI		3,177
BU		
EE	0,007	
FC	0,001	
HM	0,022	
IN	0,063	
PE	0,037	
PT	0,096	
PV	0,068	
SI	0,001	

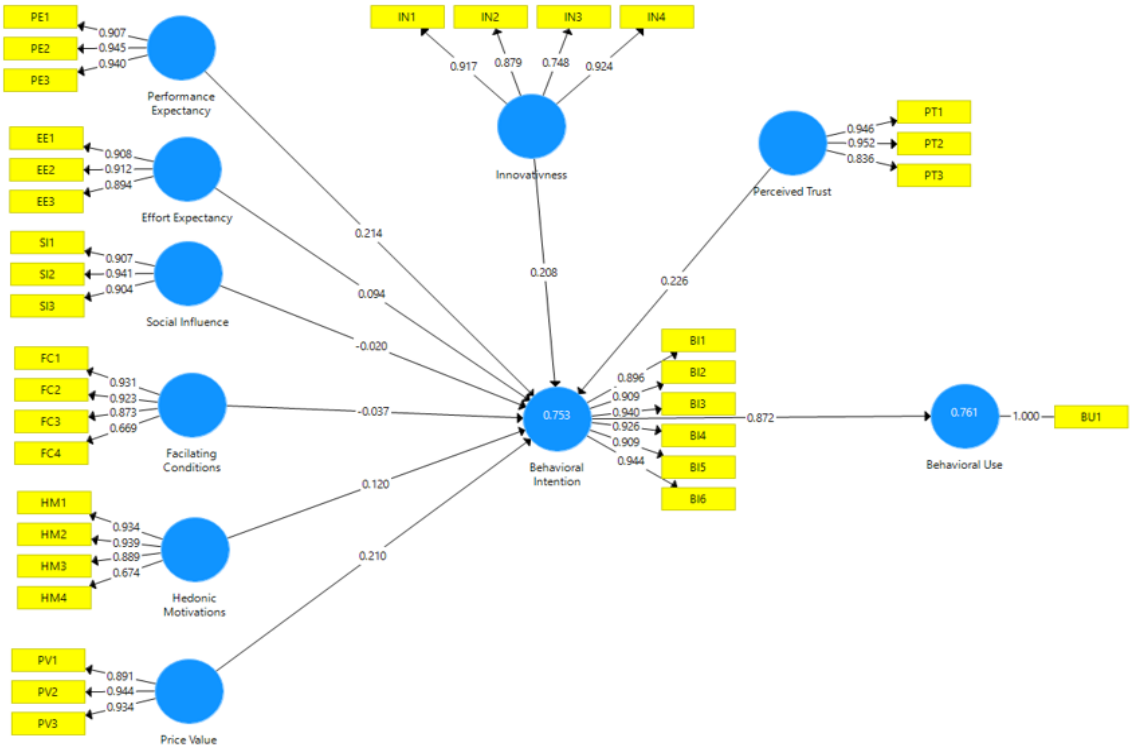

Figure 2. T Values of the Construct Model (Outer Loadings)

4.1.4. Hypotheses Results

The next table (Table-11) presents the findings of the hypothesis test for the sample mean bootstrapping-calculated standardised beta coefficients, T statistics, t values, and p, which presents p values, as well as the original sample standardised beta coefficients. To decide whether to accept or reject the hypotheses, one uses the P value. If the P value is less than 0.05, there is supporting evidence. As can be understood from the analysis and also as shown in Table 11, performance expectation (H_1), effort expectation (H_2), social influence (H_3), facilitating conditions (H_4) and hedonic motivation (H_5) are not supported. On the contrary, the other hypotheses such as price value (H_6), perceived trust (H_7), perceived innovation (H_8) have a positive effect on purchase intention and again, purchase intention has a positive effect on purchase behavior (H_9) are supported in the research analysis. When the moderator effects of the hypotheses are observed in the analysis, it was indicated in the table that the values of H_{14}, H_{15} and H_{16} are significant and supported.

Table 11. Hypotheses Test

HYPOTHESES		Original Sample (O) ß Coefficient	Sample Mean (M) Standart ß Coefficient	Standartd Deviation	T Statistics	P values	Support for Hypotheses
H_1	PE->BI	0,326	0,312	0,333	0,978	0,329	Not Supported
H_2	EE->BI	0,093	0,146	0,519	0,180	0,858	Not Supported
H_3	SI ->BI	-0,063	-0,066	0,062	0,969	0,333	Not Supported
H_4	FC->BI	-0,172	-0,205	0,249	0,718	0,473	Not Supported
H_5	HM>BI	0,135	0,132	0,074	1,836	0,067	Not Supported
H_6	PV->BI	0,206	0,205	0,078	2,633	0,009	Supported
H_7	PT->BI	0,223	0,215	0,105	2,124	0,034	Supported
H_8	INV>BI	0,246	0,255	0,093	2,642	0,008	Supported

H_9	BI->BU	0,888	0,889	0,023	44,353	0,000	Supported
MODERATING EFFECT OF HYPOTHESES							
H_{10}	AGE>PT>BI	-0,057	-0,018	0,072	0,791	0,433	Not Supported
H_{11}	GEN>PT>BI	-0,057	-0,025	0,069	0,819	0,413	Not Supported
H_{12}	INC.>PV>BI	0,044	0,011	0,054	0,855	0,414	Not Supported
H_{13}	AGE>PV>BI	0,018	-0,072	0,993	0,018	0,985	Not Supported
H_{14}	GEN>PV>BI	0,335	0,296	0,069	4,052	0,000	Supported
H_{15}	GEN>PE>BI	0,286	0,344	0,063	4,936	0,000	Supported
H_{16}	GEN>IN>BI	0,333	0,315	0,067	4,406	0,000	Supported
H_{17}	AGE>HM>BI	-0,051	-0,004	0,107	0,472	0,637	Not Supported
H_{18}	AGE>FC>BI	-0,033	-0,019	0,034	0,872	0,384	Not Supported

5. CONCLUSIONS

The research's confirmatory factor analysis, which used the unified technology acceptance model-2 to identify the factors impacting Turkish consumers' adoption of purchase intents, yielded ten dimensions. These include perceived trust, price value, hedonic motivation, social influence, performance expectation, effort expectancy, price value, innovation, behavioural intention, and use of behaviour. It is important to verify that the scale performs as intended in order to guarantee that measurement errors are kept to a minimal. Validity and reliability analysis is the method for doing this. The scale's validity determines whether or not it captures the intended data.

The scale's capacity to consistently produce the same result under the same circumstances is known as reliability. The internal consistency study of the research indicates that the CR and rho_A, cronbach alpha levels, and all values are above 0.70, which is deemed acceptable within the parameters of validity and reliability. Convergent validity is the high shared variance of the indicators of the latent variable (Hair et al., 2010). Two values are used to measure convergent validity. Factor loading is one, and the Explained Average Variance (AVE) is the other. The study's findings are 0.70 and above, however the literature expects the AVE value to be above 0.50. The purchasing behaviour (BU) scale, which measures using behaviour, has the highest value of 1.00.

For this research, discriminant validity is tested using three values. Cross-loading is one of them, the Fornell-Larcker criterion (Hair et al., 2014) is the second, and the Henseler et al. (2015) HTMT (Heterotrait-Monotrait Ratio) criterion is the third. When we look at tables 5, 6, and 7 in the study outcomes section, the cross-loading criterion makes sure that the factor load in the variable to which an indicator is connected should be higher than the other variables. It is necessary for each variable to meet the Fornell-Larcker criterion, nevertheless, if its square root of explained mean-variance (AVE) is greater than its correlation with other variables.

HTMT is used to express the mean correlations between the indicators of each variable in the model, known as heterotrait-heteromethod correlations, and the geometric mean of the correlations between the indicators of the same variable, known as monotrait-heteromethod correlations, as a ratio. The HTMT must be lower than 0.90. The study's conclusions can meet each of these three criteria.

Predictive power analysis, also known as blindfolding analysis, uses the data closure method to determine the model's predictive power. The approach, which is based on recycling the sample, is appropriate for models with only reflective variables. It is carried out by recalculating and closing all observations of the endogenous variable's indicators on a cyclical basis. To close all points, at least seven turns are needed. The difference between the closed real value, or true value, and the value obtained by closing the current data and recalculating it using different data, or predicted value, is known as the prediction error. The Q^2 value is determined by looking for estimating errors. The research model has the ability to forecast the endogenous variable in this study since the Q^2 value (0.631 and 0.734) calculated for the endogenous variable is greater than zero.

The percentage of the exogenous factors that explain the endogenous variables is shown by the value, or R^2. R2 is regarded as weak when it is 0.25, medium when it is 0.50, and strong when it is 0.75. Table 9 displays the

research findings, which indicate that the values for R^2 are 0.754 and 0.761, respectively. It has been found that 75.4 percent and 76.1 percent, respectively, of the endogenous variables—the purchase intention and the purchasing behavior—are highly explained.

The impact size f^2 for each external variable in this study is computed to indicate its proportion in explaining the endogenous variable. The effect size coefficients f2 in the model, which are based on the research findings, show that while purchase intention significantly influences buying behaviour, the influence of social influence, facilitating factors, and effort expectancy on purchase intention is not substantial.

Conversely, as table 11 illustrates that performance expectancy, effort expectancy, social influence, facilitating conditions and hedonic motivation have a negligible effect on Turkish customers' purchase intention (BI). Once again, the endogenous variable's R^2 value is 0.75, the exogenous factors' perceived trust f^2 value is 0.096, and the sum of the exogenous variables' explanations accounts for 75.4% of the endogenous variable. This is based on the rate of explaining the f^2 values.

This indicates that perceived trust adds 0.096 units to a 75.4 unit explanation on purchase intention. The perceived trust variable is the exogenous variable that makes the biggest contribution in this case. The following factors have positive effects on the purchase intention, according to the research's hypothesis analysis section (Table 11): perceived trust ($\beta = 0.215$; $p<0.05$); innovation ($\beta = 0.255$; $p<0.05$); and price value ($\beta = 0.205$; $p<0.005$).

The research's H_6, H_7, H_8, and H_9 assumptions are supported in this instance. The findings that follow indicate that the H_{14} ($\beta=0.296$; $p<0.05$), H_{15} ($\beta=0.344$; $p<0.05$), and H_{16} ($\beta=0.314$; $p<0.05$) hypotheses are supported by the moderator variables included in the hypothesis.

According to the research results, Turkish omni-channel shoppers perceive the benefits of accepting technological devices, especially to receive advertising messages with the technological devices they use, to compare products and their prices with these devices and thus, to expect personalised campaigns to complete their purchases and to track after-sales deliveries. In Turkey, which has demonstrated a notable rise in terms of the number of mobile subscribers and mobile internet usage, it is therefore evident that there is a considerable relationship between price value (PV) and purchase intention (BI). As explained in the hypothesis test, Turkish Consumers' use of technology is greatly affected by cost and pricing structures. In marketing research, monetary cost/price is often considered together with product or service quality to determine perceived value. As Zeithaml (1988: 18) also stated, we can use these concepts and assume that pricing value is the cognitive interaction between the benefits experienced by consumers and the cost of using them. When the perceived benefits of using technology exceed the monetary cost, the price value is positive and this price value can positively affect behavioral intention.

In the model developed in the study, it is confirmed that purchase intention and innovativeness, perceived trust and price value conceptual constructs are the factors affecting consumer purchase behavior in omni-channel framework using technology in Turkey. Income level, another categorical variable not included in earlier research in this area, was also included in the structure of the study to examine it.

In the age of mobile devices, when goods and services are dynamically tailored to each customer's unique requirements, it makes sense that customisation would influence how customers behave while making purchases via mobile apps. Customers will be more likely to display a positive attitude if the products and/or services they are interested in are identified through interactive communication with consumers through technology. Then, by personalising the product and service offers based on consumer behaviours in the past, such as income, gender, and age, the consumer can express a more positive attitude. As a result, customers who approach technology with positivity will gain more from tailored promotions.

As a result, buyers will be more inclined to divulge personal preferences to a seller they believe to be trustworthy. In this regard, it may be argued that it would be advantageous to eliminate and enhance any potential issues pertaining to interactive communication in the mobile technology space.

In this study, consumer attitudes towards perceived innovative product and service features were supported, and the positive effects of perceived innovativeness on purchasing intention as a result of social media users using their technological devices both in and outside the OCS and sharing about the selected product or service on social media were supported. In light of the data obtained from social media, it has been observed that consumers express their opinions about products containing innovative features on social media. It's no secret that consumers in the information era we presently live in try to make the best decision by doing as much research as they can about a good or service before deciding to buy it.

Reviews and comments left by users of a service, application, or product thus have a significant influence on potential purchasers. Thus, it is thought to be imperative to exercise caution while interacting with clients using mobile applications and to remove any negative feedback as soon as possible. Customers will thereby encourage the expansion of online and mobile shopping by providing positive reviews of their interactions with these platforms.

This study highlights that the consumers anticipate omni-channel retailers to provide them with electronic gadgets in the exhibition area, make it easier for them to use their own devices, and provide them with additional technical services (free-wife, etc.). In particular, in-store technology in women's apparel stores should provide information on product availability as well as assortment information. Furthermore, brands should make it easy for these customers to utilise their mobile devices in physical locations to achieve price-related benefits (such as comparing prices or receiving discount coupons). Shoppers should be able to browse a broader assortment of products and sizes at omni-channel retailers selling women's products thanks to in-store technology. It should also allow workers to provide shoppers guidance without having to leave the fitting room, making their lives easier (Mosquera et al., 2017: 252).

There are also certain restrictions with this study. The research sample is limited to Turkish citizens who use mobile applications to shop both inside and outside of stores. Another research restriction related to mobile is that Turkey has an emerging market rather than an established one. Among the study restrictions is the fact that certain structures, such as the platform on which mobile applications are produced and the technical elements of the programme, are not included in the research model. Apart from these, another research drawback is that omni-channel retail outlets are taken into consideration in general terms and cannot be examined on a sectoral basis.

Because of this, the model created within the research framework to explain the variables influencing consumers' acceptance of making purchases through technological mobile devices and applications, as well as their intention to make in-store and out-of-store purchases and their purchasing behaviour within the context of omni-channel shopping, is also structurally valid and reliable. The original model that is utilised in both domestic and foreign research will be replaced by the model that was developed with statistical significance. However, it is believed that the model created by the study will establish a new field of inquiry and influence both ongoing and upcoming research in this area.

AUTHORS' DECLARATION:

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AUTHORS' CONTRIBUTIONS:

Conceptualization, Writing-Original Draft, Data Collection, Editing - **ACD,** Methodology**,** Accountability, Final Approval - **İP** and Formal Analysis- **HOA**.

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APPENDIX

Appendix 1. List of Abbrevations

AVE	: Explained Variance Avarage
BI	: Behavioral Intention
BU	: Behavior Use
CR	: Composite Reliability
EE	: Effort Expectancy
FC	: Facilating Condition
HM	: Hedonic Motivation
HTMT	: Heterotrait-Monotrait Ratio
ICT	: Information and Communication Technology
IN	: Innovativness
PE	: Performance Expectancy
PV	: Price Value
PT	: Perceived Trust.
OC	: Omni-Channel
OCS	: Omni-Channel Shoppers
TAM	: Total Acceptance Model