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# The role of real exchange rate in the trade balance between Turkey and Libya: Evidence from nonlinear and wavelet-based approaches

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**ABSTRACT**

The time-invariable models would suffer to give a clearer description to the relationship between exchange rate and trade flows. Therefore, the growing strand of literature has failed to reach a consensus. This study aims to contribute to this discussion by employing not only nonlinear model to capture the asymmetric effect, but also to detect the time frequencies and explore the lead-lag relations between real exchange rate and trade balance between Libya and its major trade partner 'Turkey' by applying both NARDL and wavelet coherence approaches, using monthly data spanning January 2013 to December 2020, selected based on data availability. The findings disclose that trade balance responds to the real exchange rate asymmetrically. The asymmetric effect is skewed more in the negative direction, as the impact of negative change is significant and greater than the positive change in long run. While the oil price shocks positively impact trade balance, economic policy uncertainty negatively affects trade balance. The wavelet coherence analysis indicates that real exchange rate and economic policy uncertainty are lagging in trade balance, while oil price leads trade balance. Among various other policy suggestions, we recommend that stable exchange rate through the intervention in the foreign exchange market will promote the trade balance at the end.

## *I. Introduction*

Over decades, the exchange rate-trade nexus has been at the center of research interest. Since the closing of the gold standard by the United States in 1971, the academicians and policy makers started assessing the effect of exchange rate on the trade flows between countries (Bahmani-Oskooee & Arize, 2021). The unprecedented level of global economic integration accompanied by persistent trade imbalances and the resurgence of non-traditional trade restrictive measures have led to a renewed interest in the implications of exchange rates on international trade flows. The conventional theories of trade suggest that exchange rate may decrease the international trade flows, as the risk-averse exporters consider it as a sign of continuous profit uncertainty on international trade transactions (Santana-Gallego & Pérez-Rodríguez, 2019). Earlier argument documented that sharing a common currency act as a motivator to bilateral trade as it removes exchange rate uncertainty, decreases transaction costs between country pairs, and promoting the price transparency (Rose, 2000).

On the theoretical basis, some researchers have drawn an optimistic conclusion on the exchange rate uncertainty-trade flow nexus. For instance, (de Grauwe & Paulson, 2020) outlined that under some conditions the exchange rate uncertainty might benefit trade. When the exporters respond positively by increasing the exports when local currency depreciated, the higher variability in the exchange rate will increase the perceived profit. As a result, the risk-averse firms will again respond by increasing their exports. The risk neutral firms expect this positive dynamic causation to persist, given that the increase in firm's utility from increased average profits more than offsets the decline in utility from greater uncertainty of profits.

Since the pioneering work of (Magee et al., 1973), and within the framework of the J-curve hypothesis, myriad research papers have investigated the effect of exchange rate on trade balance. The hypothesis basically holds that due to adjustment lags and currency contracts, currency depreciation may not impact the trade balance immediately. In the short run, the country's trade balance may persistently deteriorate due to currency devaluation before leading to an improvement in the long term, depicting a J-curve pattern (Bahmani-Oskooee et al., 2021). Precisely, this mechanism is explained by the fact that due to currency depreciation the imported goods are expected to be more expensive than the exports in the short term. The trade balance deteriorates in short run as the volume of imports and exports will not adjust sharply. In the long term, however, the volume effect sets-in and reverses the initial worsening and improves the trade balance (Halicioglu, 2008).

In the literature, an extensive debate has been made on the J-curve proposition and abundant evidence have been pointed out under different conditions. For instance, some authors (Arndt & Dorrance, 1987) earlier claimed that the J-curve effect can occur only if the local currency prices of exports are sticky. Economic theory holds that the favorable results of currency depreciation depend on the Marshall-Lerner (ML) condition, which posits that the sums elasticities of both imports and exports is greater than unity (Tunaer Vural, 2016). However, the subsequent research in this area proved that there have been cases under which the Marshall-Lerner condition was satisfied yet the trade balance continued to deteriorate. The rebound effect of 1967 British and 1971 U.S. currency devaluation also still a debatable subject in the academic and policy making circles. To this end, one can claim that there is no consensus yet to be reached on the J-curve proposition,

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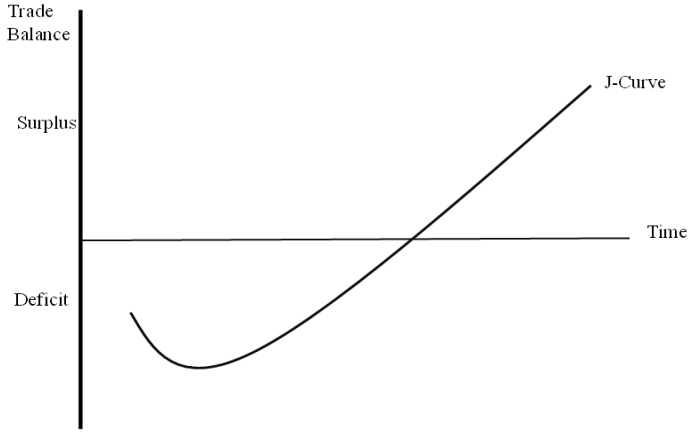
and the question of whether there still a room to improve the trade imbalance by manipulating the currency is an ongoing subject of discussion. This premise may call for a renewal research and fresh look into the topic again using the modern techniques and recently developed econometric models.

**Figure 1**. J-Curve pattern




Source: Author's own illustration

A glance through the literature, one can note two strands of research; the first strand of studies has relied substantially on tradition linear models to study the impact of exchange rate on trade balance. These studies have assumed that exchange rate affect trade flows symmetrically, which means that currency appreciation or depreciation have the same effect on trade balance in absolute terms (see for ex. (Bahmani-Oskooee & Gelan, 2018); (Dogru et al., 2019); (Kodongo & Ojah, 2013); (Tunaer Vural, 2016); (D. O. Olayungbo, 2019); (Sarlab & Seyed Ameri, 2021); (Serenis & Tsounis, 2014); (D. Olayungbo et al., 2011); (Senadza et al., 2018). This spectra literature has been much criticized as they ignore the factors that play a significant role in the dynamic of exchange rate-trade balance relation causing asymmetricity. Therefore, many authors have concluded that accepting the linearity assumption is equivalent to missing the asymmetric effect, which leads to partial understanding as the channels through which the volatility in exchange rate impact the trade balance is eliminated. The decision makers and other stakeholders, however, may need to understand the mechanism for the effect rather than the effect itself.

In the second strand, a growing body of literature have strived to overcome the previous limitation by modeling the exchange rate-trade balance nexus through relatively modern non-linear approaches, trying to address the link from more holistic prospective (see for instance; (Alessandria & Choi, 2021); (Baek & Jungho, 2020); (Bao & Le, 2021); (Wu et al., 2013); (Arize et al., 2017a); (Bahmani-Oskooee & Nouira, 2021); (Bahmani-Oskooee & Saha, 2019); (Xu et al., 2022); (Sambo et al., 2021); (Bahmani-Oskooee, Aftab, et al., 2017); (Shin et al., 2014). These studies have argued that exchange rate could asymmetrically affect trade balance as the traders' response to currency depreciation could be different than when it appreciated. Unlimited volume of research has been conducted focusing more on the mechanism or intuitively appealing methodological innovation to draw a clearer conclusion on the link between exchange rate and trade balance, and to solve the problems that the earlier conventional methodologies could not do so. Even though no consensus on the link has been reached. These inconclusive findings could be attributable to the econometric approaches being used or the differences in countries' characteristics. But most of the research that applied the nonlinear models have not also been far of criticism as they relied on the data between one country and its the rest of the world. This aggregation data bias has led to more concentration on the bilateral trade flows. But despite the growing numbers of studies on the subject, the actual effect of exchange rate on trade balance lacks the clarity and still an ongoing debate. Where does the current research on the subject stands? And what is missing?

Although the existing literature provided considerable outcomes which greatly contributed to policy making, these seminal works however, greatly relied on econometric models of estimation in which (a) parameter estimations are sticky and do not change over time and (b) the estimation of parameters detects at most two to three potential structural breaks of the time series. Therefore, this study, aims to contribute to this debate by introducing new methodologies not only to overcome the linearity problem but also to address the abovementioned literature shortcomings. This study utilizes Nonlinear Autoregressive Distributed Lag model (ARDL) for purposes of capturing asymmetric effect. In addition, the study employs a wavelet-based approach to address issue (a) and issue (b). This approach is expected to reveal (i) the effect of the leading variable (real exchange rate) on the lagged variable (trade balance) in the estimated model that might change over time, and/or (ii) the impact of leading variable (real exchange rate) on the lagged variables (trade balance) in the estimated model that might change from high frequency to low frequency. Since the economic theory suggests that for the real exchange rate to influence trade balance it must pass through adjustment lag. Therefore, it is believed that the wavelet-based offers unique properties to describe this dynamic effect. The wavelet technique allows us to decompose the interactive lead lag interactions in time frequency domain and to solve some practical difficulties inherent to the short sample period. This approach provides the policymakers with clearer view and more details about the possible effect and the interrelation pattern.

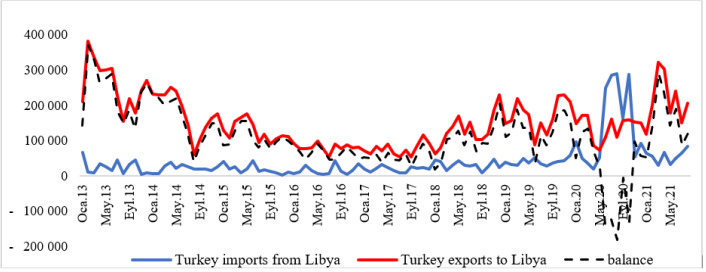
Therefore, following the J-curve proposition as the theoretical ground, this research basically aims to investigate what effect the real exchange rate possesses on the bilateral trade relations between Turkey and Libya. Turkey, which is among the twenty biggest economies in the world and 6th largest economy in Europe has experienced a dramatical exchange rate volatility, between 2020 and the first quarter of 2022, the Turkish lira depreciated by an amount never seen in its record. This dramatical currency depreciation and the anticipated impact on the country's current account and the exchange rate policy prescriptions raise academic interest in Turkish economy. Libya on the other hand, has experienced a tremendous political change since the emergence of the so-called Arab Spring over ten years ago, which later caused an endless political instability and civil war. Libya is one of the largest oil exporters and it depend heavily on oil revenues, nearly 95%. The political instability has affected the oil production (Yılmaz, 2020). Turkey is the second largest exporter to Libya after China, and the term of trade in the favor of Turkey (figure 2). The trade balance between Turkey and Libya with the average daily oil revenues of Libya demonstrate a significant cointegration. As can be seen in figure 3, both lines have almost the same trend in many periods, except between January and September 2014, and January to May 2019, which means that when the Libyan oil revenues are high, the Turkish exports to Libya getting higher and vice versa. Given all these information, Turkey-Libya trade balance offers just an interesting case of study. We believe that this research will provide considerable outcomes for policy guidance not only for Turkey and Libya policymakers but also to other policymakers in other countries with same characteristics.

The rest of the paper is structed as follows: part two reviews important literature on the topic, part three highlights the methodology, part four portrays the findings and discussion, and lastly, part five presents conclusion and policy recommendations.

## 2. Literature Review

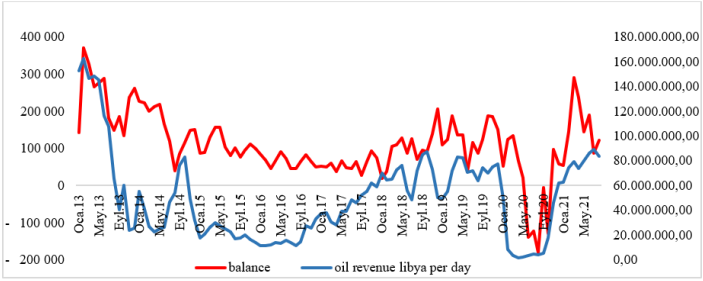
Predicting how traders behave, is a central debate on the exchange rate-trade nexus. One viewpoint asserts that the risk-averse traders react pessimistically to the unexpected change in exchange rate, consequently, the trade will decline. It is quietly argued that the risk -

Figure 2: Turkish imports and exports with Libya (Thousand dollars) Monthly




Source: Turkish Statistical Institute. https://data.tuik.gov.tr/Kategori/GetKategori?p=dis-ticaret-104&dil=2

Figure 3: Trade balance and Average daily oil revenues for Libya Monthly




Source: OAPEC Data Bank for Studies, Reports and Papers | OAPEC, (Date accessed: 20/12/2021).

averse firm operates in the environment of exchange-rate uncertainty under the floating exchange system. The subsequent literature then focused largely on incorporating uncertainty into the foreign exchange rate market, some authors have validated the proposition of negative of exchange-rate on international trade, but other researchers have documented inconclusive outcomes.

Contrarily, other view suggests that uncertainty may promote trade flows. The idea is that firm with a profit maximizing motive are expected to be more preserving and would increase their transactions to offset any decline in future revenue because of exchange rate volatility. Many researchers have reported findings in accordance with this view (Bahmani-Oskooee & Gelan, 2018). Recent debate in this area posits that the effect of exchange rate fluctuation on trade flows varies depending on whether countries are considered developed or developing. Precisely, some studies outlined that in developing countries with relatively low financial development, exchange rate volatility adversely impact the trade flows hence reduces growth. However, in developed nations with relatively high level of financial development the exchange rate volatility has no significant impact, although some empirical studies reported findings against this view (Arize et al., 2017b)

Table 1 summarized the most cited empirical studies on the possible impact of exchange rate volatility on trade balance, using different models (linear and nonlinear), and datasets. It so clear that from the prospective of emerging and developing countries, is less than a satisfactory number of empirical evidence merit conclusive inference on the nature of the link between trade flows and exchange rate fluctuation. Therefore, this literature silence necessitates fresh investigation with second generation econometric models. Therefore, in response to this literature shortcoming, this study considers the bilateral trade relation between Turkey and its major trade partner, Libya. By an in-depth search through the literature, a limited volume of research addressed the relationship between real exchange rate volatility and trade balance for Turkey. Libya on other hand, as well-known oil exporter country, depends heavily on oil revenues, and Turkey is its second largest trade partner. To our knowledge, countries with such characteristics has never been studies separately, we therefore expect this study to have a great contribution theoretically and empirically.

## 3. Methodology and Data

To analyze the nonlinear relationship between trade balance and real exchange rate we consider monthly data from January 2013 to December 2020. We added two control variables: economic policy uncertainty index and oil price. The full description and data sources are reported in table 2. Normally, the relationship between trade balance and exchange rate is investigated by standard time series techniques like causality, VECM, traditional ARDL and so on Tunaer Vural, (2016); Bahmani-Oskooee & Gelan, (2018). These conventional approaches are built on assumption that the relation between trade balance and real exchange rate is linear. Cointegration-based approaches can potentially examine the linear short run and long run relations; however, they are unable to examine the nonlinear relationships. Trade flows and exchange rate usually follow cycles revealing nonlinear behavior. Therefore, in this study we use the NARDL model which has been developed by (Shin et al., 2014). Unlike the standard ARDL, the NARDL bound testing cointegration approach decomposes the exchange rate into positive and negative changes to see whether the exchange rate have nonlinear effect on trade balance between Turkey and Libya within the sample period. The model allows us to detect the short run and long run asymmetric relationship between trade balance and exchange rate fluctuations.

Table 2. Definitions and the sources of the variables.

| Variable | Description | Source |
|---|---|---|
| Trade balance (**TB**) | TB is the Turkish imports from Libya divided by the Turkish exports to Libya | Turkish statistical institution: https://data.tuik.gov.tr/Bulten/Index?p=Dis-Ticaret-Istatistikleri-Ocak-2021-37413 |
| Real exchange rate (**REER**) | Real exchange rate between Turkish Lira and Libyan dinar | Yahoo Finance: https://finance.yahoo.com/quote/LYD%3DX/history?p=LYD%3DX |
| Oil price (**WTI**) | West Texas oil price index | Organization of Arab Petroleum Exporting Countries (OAPEC): https://oapecorg/Home/DataBank |
| Economic policy uncertainty index (**EPU**) | Economic Policy Uncertainty Index: | Economic Policy Uncertainty: https://www.policyuncertainty.com/global_monthly.html |

Our basic model can be specified as follows:

$$\ln TB_t = \mu + \alpha_1 \ln WTI_t + \alpha_2 \ln EPU_t + \alpha_3 \ln REER_t + \varepsilon_t \quad (1)$$

Where TB is the trade balance between Turkey and Libya; REER = Real exchange rate between Turkish Lira and Libyan dinar, and it is defined as REER = (PTUR(2003=100) ∗ NEX/ PLIB(2003=100), where NEX is the nominal exchange rate defined as number of units of Libya Dinar per Turkish Lira, PTUR is the price level in Turkey (measured by CPI(2003=100)]), and PLIB is the price level in Libya (also measured by CPI(2003=100)]). Thus, a decrease in REER reflects a real depreciation of Turkish Lira. Two other control variables have been incorporated, namely oil price (WTI is west Texas index), and economic policy uncertainty index (EPU). Since the seminal work of (Backus & Crucini, 2000) a relatively small but recently growing body of literature accentuates that studies in the previous groups rely usually on a conventional trade balance framework of (Rose & Yellen, 1989) in which the trade balance is specified as a function of exchange rates and economic sizes.

Since the price of crude oil may affect trade through macroeconomic channels, however, the exclusion of a relevant factor like oil prices by the relevant existing literature has raising questions about the validity of the results since oil prices explain a considerable variation in the balance of trade in Canada (Baek, 2020; Gnimassoun et al., 2017).

Another drawback in the attendant literature is that most, if not all, trade balance models have been predicated on the assumption that oil price changes symmetrically impact the balance of trade.

**Table 1**: Previous studies on the trade balance-exchange rate nexus

| Author(s) | Time | Nations | Variables | Model | Conclusion |
|---|---|---|---|---|---|
| Wang et al., (2012) | 2005-2009 | China | TB, YF, YD, REX | Panel ECM procedure | The results support an inverted J-curve hypnotises |
| (Demez & Ustaoğlu, 2012) | 1992 - 2010 | Turkey and 5 trade partners | DS, X | Unit root test | Export is not sensitive to the structural breaks and changes in currency rates |
| (Tarakçı et al., 2022) | 2002 - 2019 | Turkey and 9 trade partners | EX, Y, REX, VOL | ARDL & NARDL | exchange rate volatility plays important role for Turkey's export |
| (Santana-Gallego & Pérez-Rodríguez, 2019) | 1970-2016 | 191 countries | X, RTA, Crisis, ERR | Gravity model using PPML estimates | The exchange rate regimes, promote tared flows between countries |
| Bahmani-Oskooee & Gelan, (2018) | 1970-2015 | 12 African countries | X, W, R, δ | ECM | Exchange rate volatility impact on trade flows varies among countries in terms of periods of time between short run and long run |
| Bahmani-Oskooee & Karamelikli, (2018) | 1994-2017 | U.S.-Japan | TB, YF, YD, REX | ARDL & NARDL | Findings reveal an asymmetric effects of exchange rate changes on trade balance |
| Bahmani-Oskooee et al., (2021) | 2000-2020 | Mexico - Canada | TB, YF, YD, REX | ARDL & NARDL | Findings indicate symmetric J-curve in two industries, and asymmetric inverse J-curve in nine industries |
| Bahmani-Oskooee, Harvey, et al., (2017) | different periods | Japan and 12 trade partners | TB, YF, YD, REX | ARDL & NARDL | The outcomes conclude that nonlinear approach is more effective than linear one, and the asymmetric effect in most cases are confirmed |
| Bahmani-Oskooee, Bose, et al., (2018) | 2000 - 2015 | China and its 21 major trade partners | TB, YF, YD, REX | ARDL & NARDL | The short-run asymmetric effects of exchange rate in some cases and short-run adjustment asymmetry in other cases are proved with a significant long-run asymmetric effect cases of five partners. |
| Bahmani-Oskooee, Obaidur Rahman, et al., (2018) | 1985 - 2015 | Bangladesh and 11 trading partners | TB, YF, YD, REX | ARDL & NARDL | non-linear models supported short-run asymmetry adjustment as well as short-run asymmetry effects of exchange rate changes in most cases |
| Bahmani-Oskooee & Karamelikli, (2021b) | 2003-2018 | Turkey-US | TB, YF, YD, REX | ARDL & NARDL | The results disclose a short-run asymmetric effects in 28 out of 45 industries. |
| (Bahmani-Oskooee & Karamelikli, (2021a) | 1999-2019 | UK-Germany | TB, YF, YD, REX | ARDL & NARDL | The findings support the symmetric J-curve effect in 12 industries, and asymmetric J-curve effect in 21 industries |
| Bahmani-Oskooee & Kanitpong, (2021) | 1993-2019 | Thailand and its 12 largest partners | TB, YF, YD, REX | ARDL & NARDL | The Thailand currency devaluation increases its outpayments to eight trading partners and increases its in-payments from seven trading partners |
| (Bahmani-Oskooee & Baek, 2021) | 2000 - 2020 | Korea-US | TB, YF, YD, REX, PU | ARDL & NARDL | In the long run, nine U.S. exporting industries are negatively affected by the Korean uncertainty measure and only five industries are affected by the U.S. uncertainty measure. |
| Bahmani-Oskooee & Arize, (2021) | different periods | U.S. with each of the 20 partners from Africa | TB, YF, YD, REX, V | ARDL & NARDL | Significant long-run asymmetric effects were discovered in the case of U.S. exports to 15 countries and U.S. imports from 12 countries |
| Tunaer Vural, (2016) | 2002-2014 | Turkey - Germany | TB, YF, YD, RER | ECM model | The results support the existence of J-curve effect |
| Nicita, (2013) | 2000-2009 | 100 countries | X, xrate, TTRI, GDP, MR | gravity model | Study outcomes reveal that currency undervaluation promotes exports and restrict imports |
| Xu et al., (2022b) | 2000-2020 | China and 21 trade partners | TB, YF, YD, REX, V | ARDL & NARDL | Log-run significant asymmetric effects in 50% of the investigated models |
| (Dogru et al., 2019b) | January 1996–June 2017 | USA-Canada-Mexico-UK | TOB, EXC, I | ARDL & NARDL | supporting the postulations of the ML condition and contradicting the J-curve theory |
| Wu et al., (2013) | 1975-2010 | China and G7 countries | TB, rry, rer, rop, dw, rir | Panel smooth transition regression (PSTR) | Trade balance reacts significantly to the changes in relative real income, real oil prices and import-weighted distance |

**TB:** the trade balance; **YF:** the income of the trade partner; **YD:** the income of the country; **REX**: the real bilateral exchange rate; **X**: export volume; **W**: world income; **R:** real price rate, **δ** exchange rate volatility; **RTA**: regional trade agreement, Crisis country-specific episodes, **ERR:** bilateral exchange rate; **RER:** real effective exchange rate; **V** GARCH-based volatility of the real exchange rate; **PU:** economic policy uncertainty

This means that oil price hikes are thought of as having equally opposite effects as compared to oil price plunges. But nothing guarantees that such an assumption holds in reality. Given the effects of ups and downs in the price of crude oil on the trade balance could be different in both sign and magnitude, it would be more sensible to assume that oil price fluctuations have asymmetric impacts. Thus, to evaluate the macroeconomic impacts on the trade balance properly this study explicitly incorporates oil prices into the model. The economic policy uncertainty on the other hand captures almost all economic and political events that contribute to an uncertain situation. Since introduction of economic policy uncertainty index, researchers have assessed its impact on different macro variables, nonetheless the trade flows have been left out (Bahmani-Oskooee & Xu, 2022). In this vein, incorporating the uncertainty index to our model is of great importance and interest.

The linear ARDL models without asymmetric adjustment for the above models can be shown as follows:

$$\Delta lnTB_t = \mu + \alpha_1 lnTB_{t-1} + \alpha_2 lnWTI_{t-1} + \alpha_3 lnEPU_{t-1} + \alpha_3 lnREER_{t-1} + \sum_{i=1}^{p-1} \lambda_1 \Delta \ln TB_{t-i} + \sum_{i=0}^{q-1} \lambda_2 \Delta \ln WTI_{t-i} + \sum_{i=0}^{q-1} \lambda_3 \Delta \ln EPU_{t-i} + \sum_{i=0}^{q-1} \lambda_4 \Delta \ln REER_{t-i} + \varepsilon_t \quad (2)$$

The above equations show the symmetric cointegration relationship between the variables. Each variable was added to the model by taking its logarithmic transformations. Δ represents the first difference of the variables. $\lambda_j$ and $\alpha_j$ show the short- and long-term coefficients of the variables (j=1,2,3) respectively. The cointegration relationship is determined based on the *F*-statistics test of the null hypothesis established as "$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$) "there is no cointegration between the variables". If there is no linear relationship between the variables, the linear ARDL model would give spurious outcomes. To avoid this problem, we propose the following asymmetric model for the long run cointegration:

$$y_t = \beta^+ x_t + \beta^- x_t + u_t \quad (3)$$

$y_t$ represents the dependent variable at time t, $x_t$ refers to independent variables at time t, $\beta^+ \; and \; \beta^-$ represent the long-run parameters. $x_t$ constitutes the vector of estimators defined as $x_t = x_0 + x_t^+ + x_t^-$ . Here, $x_0$ represents the initial value *t*=0 and $x_t^+$ ve $x_t^-$ positive and negative shocks, respectively. The $x_t^+$ positive and $x_t^-$ negative partial sums of independent variables (real exchange rate, oil price and economic policy uncertainty) are obtained by decomposing with the following method:

$$x^+ = \sum_{i=1}^{t} \Delta x_i^+ = \sum_{i=1}^{t} \max(\Delta x_i, 0) \quad (4)$$

$$x^- = \sum_{i=1}^{t} \Delta x_i^- = \sum_{i=1}^{t} \min(\Delta x_i, 0) \quad (5)$$

When the positive and negative elements of the variables obtained in Equations 4 and 5 are added to the ARDL model, the NARDL model can be specified as follows.

$$\Delta lnTB_t = \mu_0 + \varphi lnTB_{t-1} + \alpha_1^+ lnWTI_{t-1}^+ + \alpha_1^- lnWTI_{t-1}^- + \alpha_2^+ lnEPU_{t-1}^+ + \alpha_2^- lnEPU_{t-1}^- + \alpha_3^+ lnREER_{t-1}^+ + \alpha_3^- lnREER_{t-1}^- + \sum_{i=1}^{p-1} \gamma \Delta lnTB_{t-i} + \sum_{i=0}^{q-1} \lambda_1^+ \Delta lnWTI_{t-i}^+ + \sum_{i=0}^{q-1} \lambda_1^- \Delta lnWTI_{t-i}^- + \sum_{i=0}^{q-1} \lambda_2^+ \Delta lnEPU_{t-i}^+ + \sum_{i=0}^{q-1} \lambda_2^- \Delta lnEPU_{t-i}^- \quad (6)$$

As in the linear model, the null hypothesis that there is no cointegration $(\varphi = \alpha_1^+ = \alpha_1^- = \alpha_2^+ = \alpha_2^- = \alpha_3^+ = \alpha_3^- = 0)$ is determined by applying the F-statistics test. Acceptance or rejection of the null hypothesis are decided by comparing the calculated F-statistic value with the critical values of the upper critical test results. If the F-statistics values are greater than the upper critical bound, thus, the null hypothesis of no asymmetric cointegration relationship between the variables is rejected. However, if the F-statistics values, are lower than the lower critical bound, the null hypothesis cannot be rejected and there is no asymmetric cointegration relationship between the variables. Then, the existence of short- and long-term asymmetries is investigated using the Wald test (Shin et al., 2014).

To detect the existence of long-term nonlinearity, the null hypothesis of $\beta^+ = \beta^-$ which is established as no long-term symmetry is tested. Here, $\beta^+ = -\alpha_j^+ / \varphi$ ve $\beta^- = -\alpha_j^- / \varphi$ , *j=1,2 and 3*. The presence of short-term asymmetry is $\sum_{i=0}^{q-1} \lambda_k^+ = \sum_{i=0}^{q-1} \lambda_k^-$, k=1,2 and 3. is evaluated by testing the null hypothesis established as k=1,2 and 3. Rejecting the null hypothesis means that there is no short-run asymmetry, and it is accepted that the relevant variable has short-run asymmetry.

The wavelet-based approach will also be used since the literature on the subject lacks the time frequency analysis. The time frequency analysis takes its importance from the co-movement and lead-lag properties it offers. Since the exchange rate change to influence trade balance, it must pass through an adjustment lag, the time frequency analysis is best approach to predict a clear movement through time. The wavelet approach combines the time frequency domain-based causality approaches which enables us to evaluate the degree of the co-movement concurrently at different frequencies over time. Time-frequency also deals with the change over time and shows how the relationship varies from one frequency to another. All these factors make the wavelet coherence approach the most preferable over the other causality approaches. Wavelet-based approach is relatively a new area of human knowledge, which is found to be useful for decomposing signals that have a cyclical behavior. Originally, this approach has been used in the study of a multitude of diverse physical phenomena from climate change analysis to financial issues. This study utilized Morlet wavelet function. (Adebayo, 2020) outlined that Morlet wavelet brings balance between phase and amplitude and can be specified as follows:

$$\varpi(n) = \pi^{-\frac{1}{4}} e^{-i\varpi n} e^{-\frac{1}{2}n^2} \quad (7)$$

$\varpi$ denotes the non-dimensional frequency, i refer to $\sqrt{-1\ p(\backslash)}$. By using the space and time \ = 0,1…N-1. Considering the wavelet continuous transformation of the time series, it takes following form:

$$\varpi_{k,f}(n) = \frac{1}{\sqrt{h}} \varpi \left(\frac{n-k}{f}\right), k, f \in \mathbb{R}, f \neq 0 \quad (8)$$

In equation 8, the $k$ and $f$ respectively indicate time and frequency. The continuous wavelet transformation (CWT) allows the cross-wavelet analysis to interrelate two variables and is defined in the following equation:

$$\mathfrak{w}_p(k,f) = \int_{-\infty}^{+\infty} p(n) \frac{1}{\sqrt{f}} \left(\frac{\overline{n-k}}{f}\right) dn, \quad (9)$$

In equation 10, the local variance is defined by wavelet power spectrum or shortly know as WPS. Although, there are many formulas in the literature specify the approach of wavelet coherence, but generally the specification of WTC can be given in equation 11. Where S indicates the time and scale smoothing operators with $0 \leq R^2(k,f) \leq 0$.

$$WPS_p(k,f) = \left|W_p(k,f)\right|^2 \quad (10)$$

$$R^2(k,f) = \frac{\left|S\left(f^{-1} W_{pj}(k,f)\right)\right|^2}{S\left(f^{-1}\left|W_p(k,f)\right|^2\right) S\left(f^{-1}\left|W_j(k,f)\right|^2\right)} \quad (11)$$

## 4. Empirical findings and discussion

In this part of the study, prior to conducting a stationarity test, cointegration and other subsequent estimations, we initially set off by introducing the summary of descriptive statistics properties through central tendencies and dispersion measures. Table 3 outlines some important descriptive statistics of our variables of interest including the trade balance, real exchange rate, oil price and economic policy uncertainty. Between January 2013 to December 2020 the trade balance varied between 0.020347 and 2.636127, with average and standard deviation of 0.307114 and 0.422581. oil shows a dramatical price movement from 16.81000 to 106.5500 with a mean and standard deviation of 61.89479 and 22.20954. Within the same sample period, real exchange rate also demonstrates a significant change ranging from 0.236772 to 0.950710, with average 0.535088 and standard deviation 0.229033. Economic policy uncertainty also demonstrates a considerable fluctuation within the sample period running from 88.56859 to 437.0496, with average and standard deviation 188.0079 and 80.28107. Overall, the economic policy uncertainty shows a highest

average followed by oil price, exchange rate and trade balance. The Kurtosis and Skewness results reveal that all the variables are normally distributed except the trade balance.

Although the unit root test is not a prerequisite for the nonlinear ARDL bound testing cointegration method, however, since most time series data are not stationary in nature, it is vital to investigate the stationarity properties to avoid the presence of second-order variables. Otherwise, the model yields often spurious findings. Simply, stationarity means that the time series has a constant average and finite variance, meaning that stationary time series tends to frequently return to the mean value. Table 4 reports the findings of Augmented Dickey-Fuller (ADF) and Zivot-Andrews (ZA) unit root tests with and without structural break. The unit root with structural break is generally employed to ascertain the stationarity properties when the structural break exists. As can be seen clearly, the variables are found to be integrated at different orders, at level and first-difference as well, but none of them is integrated at the second order. Figure 4 also confirms the unit root tests, and clearly indicates that our series tends to return to its mean values. In particular, the series are found to be nonstationary when the structural breaks took place in 2018:M03, 2014:M10, 2018:M09 and 2014:M10 for lnTB, lnWTI and lnEPU respectively.

Table 3: Descriptive statistics

| | Trade balance | Oil price | Real Ex. rate | EPU | |
|---|---|---|---|---|---|
| Mean | 0.307114 | 61.89479 | 0.535088 | 188.0079 | |
| Median | 0.205890 | 54.91500 | 0.463370 | 159.9744 | |
| Maximum | 2.636127 | 106.5500 | 0.950710 | 437.0496 | |
| Minimum | 0.020347 | 16.81000 | 0.236772 | 88.56859 | |
| Std. Dev. | 0.422581 | 22.20954 | 0.229033 | 80.28107 | |
| Skewness | 3.763870 | 0.685454 | 0.381403 | 0.916549 | |
| Kurtosis | 18.09324 | 2.385701 | 1.606274 | 2.979125 | |

Table 4: Unit root tests without and with a structural break

| Variables | ADF Intercept | ZA Intercept | Break Points | ADF Intercept and Trend | ZA Intercept and Trend | Break Points |
|---|---|---|---|---|---|---|
| | | | Level | | | |
| lnTB | -4.689 | -7.780 | 2018:M03 | -7.391*** | -8.175** | 2018:M09 |
| lnWTI | -2.605 | -3.692 | 2014:M10 | -3.032 | -3.649 | 2014:M10 |
| lnEPU | -2.179 | -5.599 | 2018:M09 | -5.111*** | -5.780*** | 2017:M03 |
| lnREER | -0.613 | -3.882*** | 2019:M06 | -2.457 | -4.042** | 2016:M12 |
| | | | 1st Diffidence | | | |
| ΔlnTB | -11.616*** | -7.287** | 2014:M09 | -11.538*** | -7.420*** | 2018:M08 |
| ΔlnWTI | -7.579*** | -7.912* | 2016:M03 | -7.549*** | -7.939* | 2016:M03 |
| ΔlnEPU | -12.977*** | -6.917* | 2017:M03 | 12.919*** | -6.905* | 2017:M03 |
| ΔlnREER | -9.785*** | -10.645*** | 2018:M10 | -9.729*** | -11.007*** | 2018:M10 |

Note: The natural logarithms of all variables are taken and Δ represents the first differences of the variables. ***, ** and * indicate 1%, 5% and 10% significance and rejected the null hypothesis at 1%, 5%, respectively. Structural break dates are those shown by Zivot–Andrews (ZA) tests

After identifying the stationarity properties, the study moves to explore the cointegration relationship among the study variables. The concept of cointegration was firstly introduced by Engle and Granger (1987) to investigate the relationship between a set of variables within a dynamic framework in long-term. (Nkoro & Uko, 2016) outline that cointegration illustrates the existence of a long run equilibrium among underlying economic time series that converges over time and provides a stronger statistical and economic foundation for empirical error correction model. Therefore, the cointegration test cannot be overlooked to confirm the long run meaningfulness of the model.

If no meaningful relationship is found, then the model is spurious and will give misleading outcomes. Table 5 summarizes both linear and nonlinear bounds testing approaches. The linear bound test's F-statistics value (4.169) exceeds the upper critical value (3.67) at 5% level of significance. The nonlinear bound test F-statistics value (15.560) is found to be greater than the upper critical value (3.99) at 1% level of significance. These findings clearly confirm the validity of applying both linear and nonlinear models. Once the long run relationship is confirmed, the analysis progresses to estimate the short run and long run linear and nonlinear models.

Figure 4: stationarity at first difference

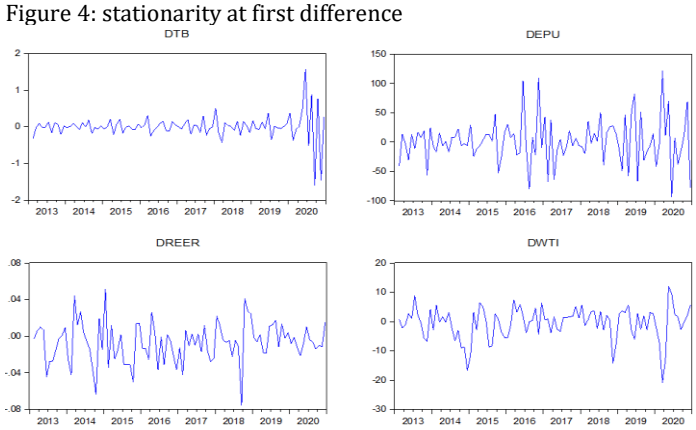



Table 6 presents the results of ARDL. The table clearly indicates that oil price (-0.589 (0.155)), economic policy uncertainty (0.690 (0.366)) and real exchange rate (-0.543 (0.316)) have no significant impacts on trade balance in the long run. This evidence may intuitively reveal that the reaction of trade balance to the leading variables in an asymmetric manner. Therefore, the asymmetric effect will be the focus of subsequent analysis.

Table 5: Cointegration Results of ARDL and NARDL testing approach

| ARDL Model (4,2,6,1): $F(lnTB_t/lnWTI_t,, lnEPU_t, lnREER_t)$ | | |
|---|---|---|
| Test Statistic | Value | k |
| F-statistic | 4.169** | 3 |
| Critical Value Bounds Significance | I(0) | I(I) |
| 1% | 3.65 | 4.66 |
| 5% | 2.79 | 3.67 |
| 10% | 2.37 | 3.2 |

| NARDL Model: $F(lnTB_t/lnWTI_t^+, lnWTI_t^-, lnEPU_t^+ lnEPU_t^-, lnRER_t^+, lnRER_t^-)$ | | |
|---|---|---|
| Test Statistic | Value | k |
| F-statistic | 15.560*** | 6 |
| Critical Value Bounds Significance | I(0) | I(I) |
| 1% | 2.88 | 3.99 |
| 5% | 2.27 | 2.28 |
| 10% | 2.88 | 3.99 |

Since the nonlinear bound test's F-statistics confirms the existence of cointegration in table 3, we employ nonlinear ARDL to disclose the short run and long run asymmetric relationship between our variables of interest. Table 7 portrays the short run and long run asymmetric results for our model. To confirm the nonlinear relationship between real exchange rate and trade balance, we decompose the real exchange rate, oil price and economic policy uncertainty into positive and negative shocks. To confirm the linearity, the impact of positive and negative shocks of the regressors on trade balance must be the same in absolute term. From table 7, the results indicate that in the long run positive shocks in exchange rate have no significant impact on trade balance 0.6052 (0.1098), while negative shocks in exchange rate significantly impact the trade balance. Precisely, a one-unit decrease in the real exchange rate will reduce the trade balance by 2.89%. This means that a negative shock in real exchange rate have a greater impact on bilateral trade between Turkey and Libya within the sample period. The model also confirms the presence of asymmetric relationship between oil price and economic policy uncertainty

We find that positive and negative shocks in oil price have significant positive coefficients in the long run, and the positive shocks have greater and long-lasting effect, a 1-unit increase in oil price brings about positive change of 0.6040 units in trade balance. Similarly, a 1-unit decrease in oil price brings a negative change of 0.2226 units in trade balance. On the other hand, we find that in the long run, positive and negative shocks in economic policy uncertainty index have significant negative coefficients. Particularly, a 1-unit increase in economic policy uncertainty index reduces trade balance by 0.2339 units in trade balance, while a 1-unit decrease in economic policy uncertainty index brings a positive change of 1.4414 units in trade balance. The adjustment coefficients of the short run dynamics show the speed of adjustments of the variables in response to a standard deviation from long run equilibrium.

Table 6: Results of ARDL

| Variables | Coefficient | Std. Error | t-statistic | p-value |
|---|---|---|---|---|
| Long-Run Association | | | | |
| C | -1.846724 | 2.420692 | -0.762891 | 0.4480 |
| $lnTB_{t-1}$ | -0.601380*** | 0.147006 | -4.090866 | 0.0001 |
| $lnWTI_{t-1}$ | -0.354446 | 0.241304 | -1.468879 | 0.1462 |
| $lnEPU_{t-1}$ | 0.415389 | 0.410516 | 1.011871 | 0.3149 |
| $lnREER_{t-1}$ | -0.327003 | 0.384978 | -0.849406 | 0.3984 |
| Short-Run Association | | | | |
| $\Delta lnTB_{t-1}$ | -0.053209 | 0.129942 | -0.409483 | 0.6834 |
| $\Delta lnTB_{t-2}$ | 0.006145 | 0.123560 | 0.049735 | 0.9605 |
| $\Delta lnTB_{t-3}$ | 0.231867** | 0.102745 | 2.256727 | 0.0270 |
| $\Delta lnWTI_t$ | 0.464260 | 0.520843 | 0.891363 | 0.3757 |
| $\Delta lnWTI_{t-1}$ | 1.186323** | 0.533461 | 2.223822 | 0.0293 |
| $\Delta lnEPU_t$ | -0.503092 | 0.391849 | -1.283891 | 0.2032 |
| $\Delta lnEPU_{t-1}$ | -0.433047 | 0.441713 | -0.980379 | 0.3301 |
| $\Delta lnEPU_{t-2}$ | 0.203577 | 0.435877 | 0.467053 | 0.6419 |
| $\Delta lnEPU_{t-3}$ | -0.169065 | 0.429189 | -0.393918 | 0.6948 |
| $\Delta lnEPU_{t-4}$ | -0.492315 | 0.420501 | -1.170784 | 0.2455 |
| $\Delta lnEPU_{t-5}$ | -1.221970*** | 0.383243 | -3.188500 | 0.0021 |
| $\Delta lnREER_t$ | 2.431717* | 1.255691 | 1.936557 | 0.0567 |
| $ECT_{t-1}$ | -0.601380*** | 0.128237 | -4.689599 | 0.0000 |
| Long-term coefficients | | | Statistics and diagnostics | |
| $lnWTI$ | -0.589 (0.155) | | $F_{PSS}$ | 4.169** |
| $lnEPU$ | 0.690 (0.366) | | $\chi^2_{SER}$ | 0.520 |
| $lnREER$ | -0.543 (0.316) | | $\chi^2_{HET}$ | 22.973 |
| C | -3.070 (0.438) | | $\chi^2_{NORM}$ | 0.3917 |
| | | | $\chi^2_{RAMSEY}$ | 2.403 |

The speed of adjustment is seen to facilitate long-run convergence among the parameters with a significant and negative sign (-2.9502), which signifies the capability of the model to witness a -2.9502% speed of adjustment to verify the tendency to equilibrium in the long-term. Table 7 also reports some important diagnostic tests outcomes such as serial correlation tests and stability test.

We use the wavelet coherence transformation (WTC) technique to figure out the co-movement and to identify the lead-lag relationship between trade balance, real exchange rate, oil price and economic policy uncertainty. Figures 5 to 10 present the WTC among the underlying variables between January 2013 and December 2020. The horizontal and vertical axis in each figure indicates the time and frequency respectively. The yellow and blue colors denote high and low dependence between the variables. The rightward and leftward arrows correspondingly show the in-phase and out-of-phase interrelations. Furthermore, the rightward-down or leftward-up indicates that the first is lagging. Whereas rightward-up (leftward-down) indicates the first series is leading. The curved lines drawn by using the Monte Carlo simulation with a 5% level of significance refers to the statistically significant region.

Figure 5 present the coherence between trade balance (TB) and real exchange rate (REER). The figure clearly indicates high correlations between two variables in the short and long term. At various frequencies, leftward-up and down arrows clearly reveal a negative relationship between trade balance and real exchange rate. The left down arrows until fourth period indicate that trade balance leads exchange rate fluctuations. This may be due to adjustment lag; the period trade flows need to response to the new exchange rate levels. But this relationship reverses in the long term after period 4, and the rightward up arrows still indicate that trade balance leads real exchange rate.

This means the real exchange rate is not the main determinant of trade balance between Turkey and Libya. Figure 6 shows the coherence between trade balance and economic policy uncertainty index. At different scales, the figure displays high correlation between two series in medium and long term. The rightward up arrows until fourth period reveal that economic policy uncertainty is lagging in trade balance. For some periods this relation takes opposite direction. For instance, until period eight, the right-down arrows indicate that economic policy uncertainty, but this relation returns and demonstrate negative correlation. Figure 7 also displays almost the same trend for some periods at given scales, until period four, the arrows show high correlation between oil price and trade balance with trade balance leading. However, until period eight, trade balance is lagging in oil price.

Table 7: Estimated long- and short-run coefficients of NARDL Results

| Variable | Coefficient | Std. error | t-statistic | p- value |
|---|---|---|---|---|
| C | -9.9478*** | 1.0537 | -9.4409 | 0.0000 |
| $lnTB_{t-1}$ | -2.9502*** | 0.3170 | -9.3072 | 0.0000 |
| $lnWTI^+_{t-1}$ | 1.7820*** | 0.4254 | 4.1892 | 0.0001 |
| $lnWTI^-_{t-1}$ | 0.6568** | 0.3134 | 2.0958 | 0.0413 |
| $lnEPU^+_{t-1}$ | -0.6903 | 0.4343 | -1.5897 | 0.1183 |
| $lnEPU^-_{t-1}$ | -4.2526*** | 0.5638 | -7.5429 | 0.0000 |
| $lnREER^+_{t-1}$ | 1.7857 | 1.0750 | 1.6612 | 0.1031 |
| $lnREER^-_{t-1}$ | 8.5263*** | 1.4085 | 6.0533 | 0.0000 |
| $\Delta lnTB_{t-1}$ | 1.7123*** | 0.2653 | 6.4553 | 0.0000 |
| $\Delta lnTB_{t-2}$ | 1.5143*** | 0.2483 | 6.0985 | 0.0000 |
| $\Delta lnTB_{t-3}$ | 1.2537*** | 0.2224 | 5.6369 | 0.0000 |
| $\Delta lnTB_{t-4}$ | 1.0932*** | 0.2155 | 5.0729 | 0.0000 |
| $\Delta lnTB_{t-5}$ | 1.0252*** | 0.1877 | 5.4623 | 0.0000 |
| $\Delta lnTB_{t-6}$ | 0.7302*** | 0.1703 | 4.2878 | 0.0001 |
| $\Delta lnTB_{t-7}$ | 0.5177*** | 0.1312 | 3.9465 | 0.0003 |
| $\Delta lnTB_{t-8}$ | 0.2466** | 0.0950 | 2.5954 | 0.0124 |
| $\Delta lnWTI^+_{t-3}$ | -2.4689** | 1.0413 | -2.3710 | 0.0217 |
| $\Delta lnWTI^+_{t-5}$ | 4.6752*** | 1.0205 | 4.5815 | 0.0000 |
| $\Delta lnWTI^-_{t-2}$ | -2.5098*** | 0.7053 | -3.5586 | 0.0008 |
| $\Delta lnWTI^-_{t-4}$ | -2.4591*** | 0.7212 | -3.4097 | 0.0013 |
| $\Delta lnWTI^-_{t-5}$ | -5.1279*** | 1.1179 | -4.5869 | 0.0000 |
| $\Delta lnWTI^-_{t-8}$ | -2.0094*** | 0.7398 | -2.7161 | 0.0091 |
| $\Delta lnEPU^+_t$ | -1.5971*** | 0.4605 | -3.4685 | 0.0011 |
| $\Delta lnEPU^-_{t-1}$ | 4.0843*** | 0.6460 | 6.3223 | 0.0000 |
| $\Delta lnEPU^-_{t-2}$ | 4.2926*** | 0.6094 | 7.0437 | 0.0000 |
| $\Delta lnEPU^-_{t-3}$ | 2.9102*** | 0.6089 | 4.7795 | 0.0000 |
| $\Delta lnEPU^-_{t-4}$ | 2.9859*** | 0.5637 | 5.2974 | 0.0000 |
| $\Delta lnREER^+_{t-2}$ | -9.3569*** | 3.4185 | -2.7371 | 0.0086 |
| $\Delta lnREER^+_{t-6}$ | 4.8142** | 2.3824 | 2.0207 | 0.0488 |
| $\Delta lnREER^+_{t-7}$ | 8.7291*** | 2.1921 | 3.9820 | 0.0002 |
| $\Delta lnREER^-_t$ | 4.2405*** | 1.3808 | 3.0711 | 0.0035 |
| $\Delta lnREER^-_{t-1}$ | -8.0817*** | 2.1267 | -3.8001 | 0.0004 |
| $\Delta lnREER^-_{t-2}$ | -7.6737*** | 1.9472 | -3.9410 | 0.0003 |
| $\Delta lnREER^-_{t-3}$ | -7.8812*** | 2.2658 | -3.4784 | 0.0011 |
| $\Delta lnREER^-_{t-4}$ | -6.4076*** | 1.8255 | -3.5101 | 0.0010 |
| $\Delta lnREER^-_{t-5}$ | -10.2434*** | 1.8965 | -5.4012 | 0.0000 |
| $\Delta lnREER^-_{t-6}$ | -3.3127* | 1.7568 | -1.8856 | 0.0653 |
| **Long-run asymmetric effects** | | | | |
| $lnWTI^+$ | 0.6040*** (0.000) | $lnWTI^-$ | 0.2226*(0.0458) | |
| $lnEPU^+$ | -0.2339*(0.099) | $lnEPU^-$ | -1.4414***(0.000) | |
| $lnREER^+$ | 0.6052 (0.1098) | $lnREER^-$ | 2.8900***(0.000) | |
| **Statistics and diagnostics** | | | | |
| $t_{BDM}$ | -9.307*** | $R^2$ | 0.852 | |
| $F_{PSS}$ | 15.560*** | $R^2_{Adj}$ | 0.737 | |
| $\chi^2_{SER}$ | 2.047 | $F_{ist}$ | 7.849*** | |
| $\chi^2_{HET}$ | 34.017 | $\chi^2_{RAMSEY}$ | 2.634 | |
| $\chi^2_{NORM}$ | 3.700 | Stability tests | Stable | |

Note: "+" and "– "are the positive and negative partial sums of the variables, $L^+$ and $L^-$ estimated long-run coefficients for the positive and negative shocks, respectively, $W_{LR}$ and $W_{SR}$ Wald test results is used to check the short-run and long-run symmetry, respectively. ***, ** and * indicate that null hypothesis is rejected at 1%, and 5% significance level. Δ, first difference operator $F_{PSS}$ shows the statistics from the Pesaran et al. (2001) bounds test. $T_{BDM}$ is the BDM t-statistic showing the statistics from Banerjee et al. (1998). $\chi^2_{SER}$,$\chi^2_{HET}$,$\chi^2_{NORM}$ and $\chi^2_{RAMSEY}$ indicate Breusch-Godfrey LM autocorrelation, Breusch-Pagan variable variance and normal distribution tests and regression specification error tests, respectively. CUSUM and CUSUMSQ present Cusum and Cusum square stability tests, respectively. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. The numbers in parentheses are p-probability values. GTOS (general-to-specific approach) method was used in the model estimation and the lag lengths of the dependent and independent variables were taken as maximum p=8 and max q=8, and insignificant variables are removed from the model and the most suitable model are obtained. The lower and upper bound critical value of the F-test for cointegration when k = 6 are 3.6-4.9 at the 1%, 2.87-4 at the 5%, and 2.53-3.59 at the1%, 5% and 10% level of significance.

We use the wavelet coherence transformation (WTC) technique to figure out the co-movement and to identify the lead-lag relationship between trade balance, real exchange rate, oil price and economic policy uncertainty. Figures 5 to 10 present the WTC among the underlying variables between January 2013 and December 2020. The horizontal and vertical axis in each figure indicates the time and frequency respectively. The yellow and blue colors denote high and low dependence between the variables. The rightward and leftward arrows correspondingly show the in-phase and out-of-phase interrelations. Furthermore, the rightward-down or leftward-up indicates that the first is lagging. Whereas rightward-up (leftward-down) indicates the first series is leading. The curved lines drawn by using the Monte Carlo simulation with a 5% level of significance refers to the statistically significant region. Figure 5 present the coherence between trade balance (TB) and real exchange rate (REER). The figure clearly indicates high correlations betweem two variables in the short and long term. At

various frequencies, leftward-up and down arrows clearly reveal a negative relationship between trade balance and real exchange rate. The left down arrows until fourth period indicate that trade balance leads exchange rate fluctuations. This may be due to adjustment lag; the period trade flows need to response to the new exchange rate levels. But this relationship reverses in the long term after period 4, and the rightward up arrows still indicate that trade balance leads real exchange rate. This means the real exchange rate is not the main determinant of trade balance between Turkey and Libya. Figure 6 shows the coherence between trade balance and economic policy uncertainty index. At different scales, the figure displays high correlation between two series in medium and long term. The rightward up arrows until fourth period reveal that economic policy uncertainty is lagging in trade balance. For some periods this relation takes opposite direction. For instance, until period eight, the right-down arrows indicate that economic policy uncertainty, but this relation returns and demonstrate negative correlation. Figure 7 also displays almost the same trend for some periods at given scales, until period four, the arrows show high correlation between oil price and trade balance with trade balance leading. However, until period eight, trade balance is lagging in oil price.

Figure 5. Trade balance and real exchange rate

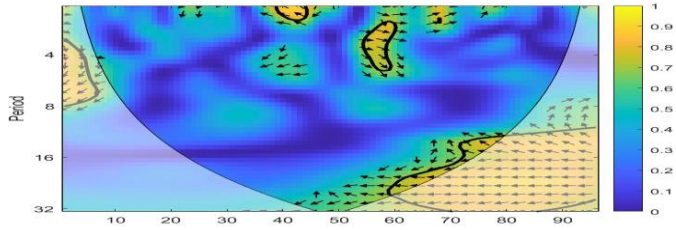



Figure 6. Trade balance and economic policy uncertainty

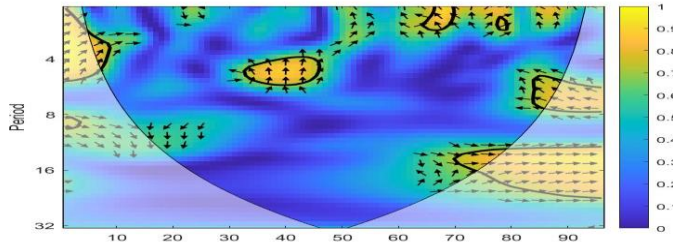



Figure 7. Trade balance and oil price

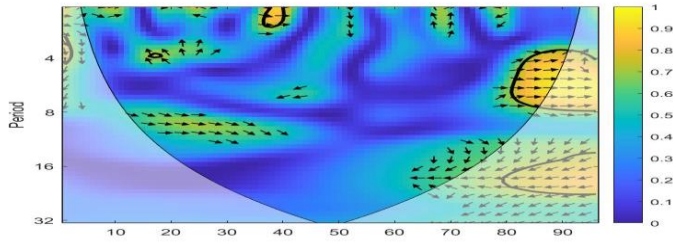



Figure 8. Economic policy uncertainty and real exchange rate

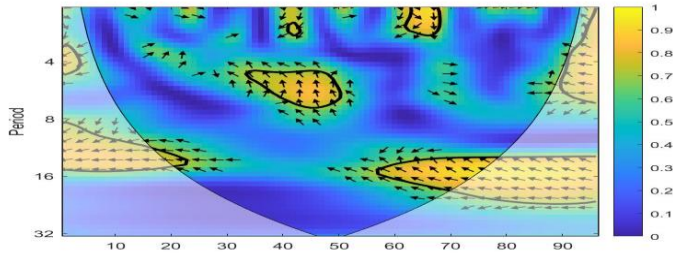



Figure 9: Real exchange rate and exports

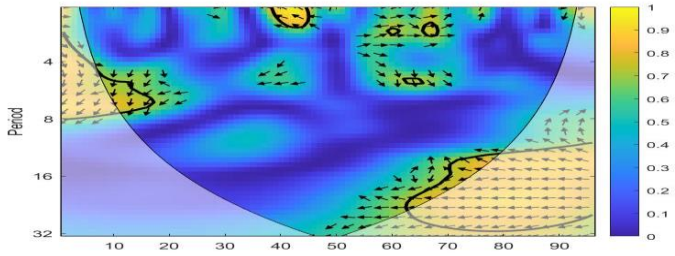
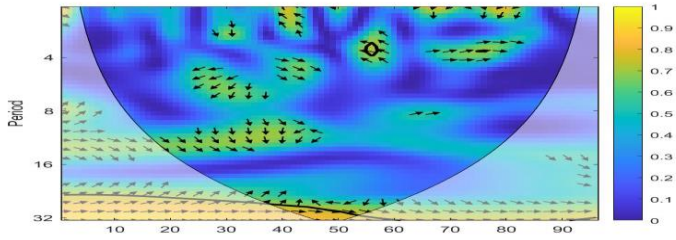



Figure 10: Real exchange rate and imports




To understand the asymmetric effect and lead-lag relationship between the trade balance and exchange rate this study uses two approaches: nonlinear ARDL and wavelet coherence. The finding of the first approach reveals the presence of a long run cointegration between trade balance, real exchange rate, oil price and economic policy and uncertainty. The nonlinear ARDL results also proved the asymmetric relationship between trade balance and real exchange rate. The asymmetric effect is skewed in the negative direction, as the impact of negative shocks in exchange rate on trade balance is significant and bigger than the positive shocks in which no significant effect was observed. This finding is consistent with results of many studies. For instance, (Bahmani-Oskooee & Gelan, 2018), studied the impact exchange rate volatility on trade balance for 12 African countries, and concluded that while exchange rate volatility affects trade flows of many of the countries in the short run, in the long-run however, the effects were restricted only on the exports of five countries and on the imports of only one country.

The possible explanation to this finding is attributed to the differences in import and export demand elasticities. (Bahmani-Oskooee, et al., 2018) also argued that the effect of exchange rate on trade balance is basically partner-specific. In case the largest partner, the trade flows may not respond to the exchange rate fluctuation instantaneously due to the adjustment lags. This view may better explain the Turkey-Libya situation, as Turkey is the second largest exporter to Libya after China. The NARDL results also confirm the asymmetric relationship between trade balance and oil price, with greater impact of positive socks in oil price. This finding is in line with those of (Commer et al., 2020; Ahad & Anwer, 2019; Baek & Jungho, 2020). Theoretically, in the oil - dependent countries the increase in oil price improves the term of trade, as the revenue will increase, this will promote the trade balance (Korhonen & Ledyaeva, 2010). This view is also explained indirectly by supply and demand effects. In supply effect, increase in oil price leads to downturn in those countries which import oil due to negative supply shock in the production process that reduce their imports that influence oil-producing countries' balance of trade. In demand effect, oil price increase creates inflation pressure on the global market that financially leads to high prices of imports in the case of both countries. This view also may provide a clear explanation to our finding as Libya is oil-dependent economy. The oil revenue constitutes more than 95% of its total revenue.

This also further proves the argument that nonlinear effect of the oil price on trade balance relationship depends on the source of the shock, for the oil exporter countries, expansion of oil supply is more important than supply disruptions, and the decrease in oil price only benefits oil

importer countries if they result from supply-side shocks (Jibril et al., 2020). Lastly, the NARDL result is consistent with literature findings regarding the negative effect of economic policy uncertainty on trade balance. For instance, (Bahmani-Oskooee & Baek, 2021) applied a firm-level study and concluded that in the long run, nine U.S. exporting industries are negatively affected by the Korean uncertainty measure and only five industries are affected by the U.S. uncertainty measure. Given the news-based uncertainty policy measures, the trade-policy uncertainty nexus has become an important area of research especially after the emergence of relatively more flexible exchange rates policies undertaken by global economic organization. Regarding the oil price shocks our result contradicts the result of (Lin & Bai, 2021) who found that, the negative response to the oil price shock is greater in oil-exporter countries than that of the oil-importing ones.

The wavelet coherence technique is employed for understanding the co-movement and lead-lag relationship between trade balance and real exchange rate first; and trade balance and other control variables as the second. The results of wavelet analysis indicate that trade balance exchange rate is lagging in trade balance in all periods although the co-movement reverse between periods with high negative correlation. Since the literature lacks the time frequency analysis to the subject of trade balance-exchange rate nexus, we find no evidence to support the obtained time frequency outcomes. To overcome the data aggregation bias, we estimated the co-movement between real exchange rate and the components of trade balance separately. Although both indicators demonstrate high correlations, but their lead-lag analyses reveal opposite directions. The finding indicates that exchange rate is lagging in exports, which supports the total trade balance. On the other hand, the finding also indicates that import is lagging in exchange rate. The wavelet results also provide evidence to understand the bilateral trade relations between Turkey. The leading exports may reveal which country has the power to influence the trade relation and benefit more.

## 5. Conclusion and policy recommendations:

Despite voluminous empirical and theoretical research addressing the nexus between real exchange rate and trade balance, the discussion still persistent. This study adds to the existing literature on the subject by providing new evidence form more holistic prospective, not only the asymmetric effect but also the co-movement and frequency overtime between exchange rate and trade balance. The study considers trade balance between Libya and its major trade partner, Turkey. By applying nonlinear autoregressive distributed lag model (NARDL), we find that in the long run, the impact of real exchange rate on the trade balance is skewed more to negative direction, as the negative shock in real exchange is significant and greater than positive shock, which means that the negative effect is long-lasting and positive changes is faded away by large negative shocks. The results of the NARDL model also reveal considerable outcomes regarding our other control variable namely oil price and economic policy uncertainty. Particularly, the findings indicate that trade balance respond to oil price and economic policy uncertainty asymmetrically.

This study applies a unique technique to find out the frequencies and co-movement between real exchange rate and trade balance over time. This technique has been neglected completely in this area of research although it is powerful technique in detecting the frequencies between two series. Since the time is a major element in the mechanism of exchange rate-trade nexus, conducting time-variable analysis would draw a clearer view on the adjustment lag. The wavelet coherence analysis provides important information about the lead-lag between trade balance and real exchange rate.

The result indicates that trade balance leads exchange rate in all periods. The most dominant periods are fourth and eighth periods. The lead-lag analysis also reveals that trade balance is lagging in oil price. However, the trend is opposite in case of economic policy and certainty and trade balance.

Our findings provide some significant economic interpretations; First, the presence of asymmetric effect and negative direction skewness of exchange rate fluctuations on trade balance answer the question of whether depreciation or appreciation of a currency has more and long-lasting effect on trade balance between countries. As the negative shock in exchange rate is greater than positive shock, it means that positive change may be faded away by large negative change. Second, the leading of oil price may explain the paradox of why some oil-dependent countries dominate the bilateral trade but still experiencing a trade deficit. This evidence may intuitively reveal the effectiveness diverse export-oriented policies at the expense of one sector-dependence.

The results of our analysis call for important policy implications. First, as the negative shocks in the real exchange rate have a significant long run effect which adversely affect trade balance, the study recommends that stable exchange rate through the intervention in the foreign exchange market will promote the trade balance, and economic growth at the end. Second, this study recommends that the policy makers of Libya should implement a diverse export-oriented policies to overcome the long-term detrimental effect of a one sector-based economy “energy dependent economy”. Third, it is suggested that an innovative public-private partnership in foreign trade sector can protect against the undesirable implications during uncertain times. Lastly, although the bilateral trade may to somewhat overcome the aggregation data bias but not completely since two countries engage in trading more than one commodity. Therefore, for the sake of more elucidation, more research on industry-level or commodity-base are required, which helps industries on how engage in foreign trade.

## Declarations

**Ethics approval**: this study follows all ethical practices during preparation.
**Competing interest**: the authors of this paper declare that there is no competing interest.
**Data availability statement**: the full dataset (EViews and MATLAB relevant work-files) is shared in public data repository with 10.6084/m9.figshare.19312364 *and can be reached through the link* https://figshare.com/s/0086701a0cc00d39891c

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# Lean manufacturing application in the frozen goods industry

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**ABSTRACT**

The long-standing producer's market, in which the selling price was the sum of costs and desired profit, has been transformed by globalization into a buyer's market, where profit is the difference between the realized selling price and the production costs. Therefore, every company must approach the reduction of operating costs and the optimal use of the resources at its disposal. Lean thinking can help companies in reducing business costs and increasing productivity. Lean companies can improve their processes and increase their competitiveness in the market. The paper aims to present lean thinking implementation in manufacturing companies to improve procedures and increase competitiveness. Based on proposed improvements to business processes, Frozen Ltd. saved time and costs, making it more competitive in the market and confirming the hypothesis that the lean methodology can help a company perform its business processes better. The company needs to continue with its efforts to use lean since this is not a single event but a journey.

## *I. Introduction*

Throughout history, companies tried to be competitive in the market using different strategies and business models. One of the essential characteristics of the worldwide economy is the extremely swift shifts imposed by the wealthiest countries, and the less developed countries follow them "in step". Changes in the global markets, advancements in technologies in all areas, new competitors, increased demand of buyers, and new requirements and limitations of target markets influence a new style of managing business systems, where management must find practical and quick solutions. Only companies that constantly enhance their businesses and stay ahead of the competition have an opportunity to maintain and improve their business and market position (Piškor & Kondić, 2010). The goal of every company is apparent: to live and succeed, which means producing what the market wants, with affordable-market prices and high quality, and required delivery times, while continuously satisfying the customer and other interested parties. One of the possible tools and/or approaches is lean thinking. Lee-Mortimer (2006) concluded that knowing the distinctions between traditional and lean manufacturing (thinking) is essential for companies before they decide to implement lean.

The paper aims to present lean thinking applications in manufacturing to improve a company's procedures and increase competitiveness. The first part of the paper presents the lean thinking approach to improving a company's operations. The second empirical part presents the application of the lean approach in a manufacturing company in Croatia. The third and final part of the paper provides conclusions and recommendations for further research.

## 2. Literature Review

Lean thinking-LT and lean manufacturing-LM represent an improved Toyota production system-TPS which was used in Japan in the 1950s. The TPS was founded on the desire for product organization in an uninterrupted flow and was not influenced by the long production flows to achieve efficiency (Melton, 2005). LT is a collection of different methods and philosophies for generating maximum user value through waits and waste reduction (Womack & Fitzpatrick, 1999; Womack & Jones, 2003). It pursues to change the company's values and philosophy fundamentally, ultimately changing its culture and behavior (Smith et al., 2012). LM is usually connected with big companies' projects to stay competitive in the market (Rajenthirakumar & Thyla, 2011), and as a result, companies that implement LT become increasingly competitive (Bhasin, 2011).

For LT implementation, the company needs to meet five principles of LT (value, flow, value flow, retreat, and perfection) (Womack & Jones, 2003) as follows: a) identify the value for the end-user; b) define value flow as a set of specific activities essential to carry a product through an internal value chain; c) flow denotes the value creation steps; d) withdrawal is planned; and e) perfection denotes constant efforts to advance the process. Those five principles can be presented graphically. (Figure 1)

Additionally, to use LT tools and methods, a change in work environments is needed, as a readiness to adjust approaches and mentalities and a forward-looking attitude to new technologies for waste reduction (Bittencourt et al., 2019).

Researchers (Vinodh et al., 2010; Marques et al., 2018) defined LM as a continuous improvement system for the integration of daily work in the production and delivery of products, services, and information with the main aim of waste identification that influences the production flow, quality, delivery times, and cost. Researchers (Santos et al., 2017; Carvalho et al., 2018) define LM as integrating socio-technical systems to remove waste by minimizing and reducing the variability of suppliers and customers. This definition states and confirms the research (Womack & Jones, 2003; Doiro et al., 2017) that wastes in production

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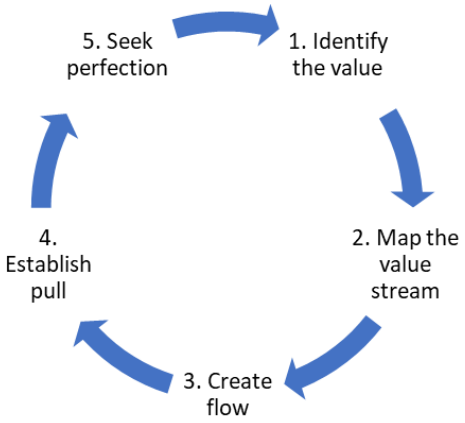
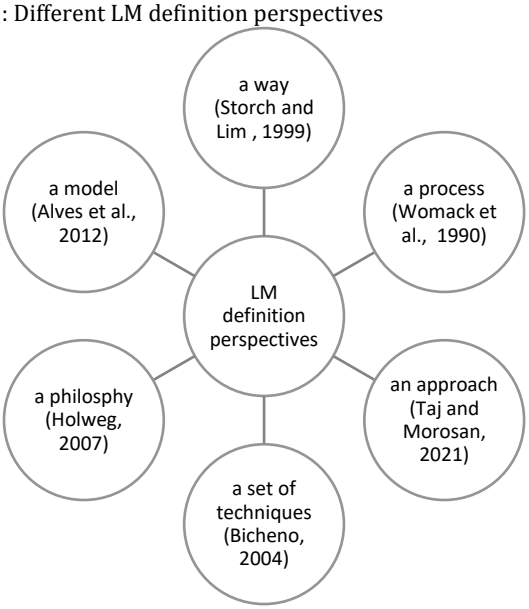
Figure 1: Five principles of lean thinking




Source: Karuppan et al., 2016: 201

include unnecessary transport, inventory, defects, waiting, over-production, movements, and overprocessing. In other words, the foundation of the LM is focused on designing actions that provide value to the buyer, methodical detection, waste removal, and continuous improvement of the production environment for productivity increase (Erceg & Dotlić, 2014). Due to the many studies, different researchers defined LM, which can be seen from different perspectives. (Figure 2)

Figure 2: Different LM definition perspectives



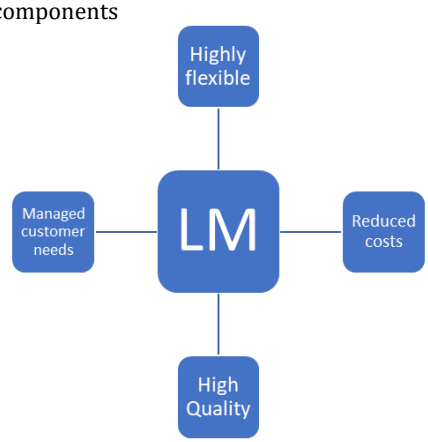

Source: author

Implementing LM enhances the production process and boosts the employee's job satisfaction (Sing et al., 2020). LM represents the company's methodology to reduce waste in its manufacturing processes (Kumar et al., 2022). The base is in minimalizing product costs in the production process, whether in the design or manufacturing phase (Womack & Fitzpatrick, 1999; Womack & Jones, 2003; Alavi, 2003). For LM implementation, companies must utilize a methodology with critical elements such as operations (Troncoso, 2018) and integrated management systems (Jimenez et al., 2018) dedicated to improving their performance. LM was initially developed for the auto industry. It is now widely used in different engineering and assembly industries, but there are not many studies about its implementation in the food industry (Jimenez et al., 2019).

Previous studies found successful LM implementation in among other banks (Hidayati et al., 2019), the building sector (Li et al., 2020), the health sector (Erceg et al., 2020), pharmaceuticals (Sieckmann, 2018), shipbuilding (Storch and Lim, 1999; Sharma and Gandhi, 2017), and in high education institutions (Balzer et al., 2016). LM can be used in all companies, no matter if they are public or private (Samuel et al., 2015), no matter their size (Hu et al., 2015), and in all aspects of their operations (Zhu et al., 2018). Companies implementing LM have become increasingly competitive (Bhasin, 2011). Research has shown that if a company implements LM, it has three times greater chances of becoming a leader in its industrial sector (Hertzler, 2013). In their discussion on LM, researchers (Slack et al., 2019) conclude that LM endeavors to meet immediate market demand with demanded quality and without waste. In other words, the product and service flow consistently deliver what the buyer wants (level of quality) when needed, in the required quantities, where it is needed, and with the lowest cost.

LM is a popular and valuable tool for most production and service companies to fight activities that do not bring value to the final customer (Nandakumar et al., 2020). The main reason for companies to implement LM is to gain and keep market competitiveness and improve product productivity and quality (Palange & Dhatrak, 2021). The main components of the LM are shown in Figure 3.

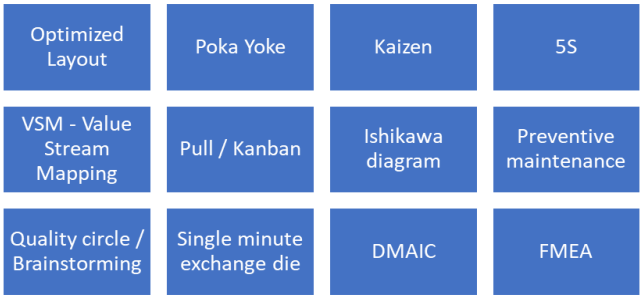
Figure 3: LM components




Source: adapted from Kumar et al., 2022

LM tools are valuable in every situation where there is a correct tool selection, genuine collected data, and employees with a positive attitude to draw out and recognize the necessary changes in their working culture and methods, which will result in an improved working environment (Kolla et al., 2019). Some of the LM tools are shown in Figure 4.

Figure 4: Various tools in LM




Source: adapted from Palange and Dhatrak, 2021

LM can be seen as a strategy for investing less in the production inputs and receiving increased productivity and product quality as outputs with better customer relationships and after-sales services (Bayou & Korvin, 2008). Researchers concluded that the techniques and tools used for LM have a goal of eliminating waste (Gamage et al., 2016; Nawanir et al., 2016) and all activities that do not add value to the process (production or service) in all stages of manufacturing companies (Yang et al., 2011; Jasti & Kodali, 2016) and the supply chain (Gamage et al., 2016; Pullan et al., 2013). LM aims to secure excellent value for customers through holistic process optimization in the whole organization and the organization's supply chain (Hu et al., 2015). Another study (Žvorc, 2013) points out that lean companies are focused on (i) the customer because goals and strategies are outlined based on his/her wishes; (ii) continuous changes and process improvements; (iii) towards spotting problems and solving them permanently (iv) innovation; (v) shaping the organizational structure determined during customer value; (vi) the standardization of work. Reaching LM is an ongoing journey, not just a single event with a destination (Womack and Jones, 2003; Bicheno, 2004). Therefore, the last step in reaching LM is constantly improving to achieve perfection. Companies must constantly evaluate the value they provide to their buyers and improve the processes to lower the time and effort involved, space used, cost level, and errors (Erceg et al., 2020).

## 3. Research methodology

Information and data for the research in this paper were collected and analyzed to propose process improvement based on LM tools. The primary LM tool used for the research was value stream mapping (VSM). In the research, a value stream is defined as a set of specific activities needed to take products through the business' three crucial management duties: problem solving, information management, and physical transformation (Sundar et al., 2014). VSM maps all material and information flow needed for activities coordination of all parties. VSM starts with mapping the status of the material flow and activities during the processes (Palange & Dhatrak, 2021). Its visual representation helps identify value-adding and non-value activities (Rother & Schock, 1999). Furthermore, the simulation model can evaluate the improved activities before implementation (Abdulmalek & Rajgopal, 2007). McDonald et al. (2002) state that a simulation tool in VSM is necessary to predict the level throughout.

Process flow mapping and time-value mapping (Melton, 2005) were used for research conducted to record results in this paper and to test the hypothesis that the lean methodology helps the company in becoming better at performing its business processes.

## 4. Results and discussions

Production company Frozen Ltd. produces, sells, and distributes frozen food and ice cream. It sells its products in the retail, wholesale, and HoReCa channels. The company has more than 800 employees and an annual turnover of more than 100 million EUR. The company sells its products by receiving customer orders through different trade channels. Orders are then commissioned within 48 hours and delivered with their transport to the points of sale. At sales points in the stores with a usable area of less than 200 $m^2$, in restaurants and coffee bars from the HoReCa channel, sales are made directly from company trucks according to the available assortment and quantities in the truck on that day. The trucks are driven by employees classified as driver-salesman who have an additional team member (assistant stacker) on the truck. The structure of their monthly earnings is a combination of a fixed part of the income with an incentive supplement in the form of a percentage of the sales revenue. In addition to sales tasks, the drivers salesmen are responsible for taking taking care of the inventory on the truck, replenishing the inventory, administration related to the delivery of delivery notes, delivery of cash payments from customers, and preparation of documentation for tomorrow's daily tour route. Their daily activities are shown in Table 1 as a percentage of working days.

Table 1. Working day activities of driver-salesman before LM implementation

| Warehouse | Administration | Distribution | Sales | Total |
|---|---|---|---|---|
| 25% | 10% | 30% | 35% | 100% |

Sales account for only 30% of daily activities, making it impossible for employees to be productive. This paper analyzes only part of the Frozen Ltd. sales process. It examines sales at the sales points in the store channel (stores with less than 200 $m^2$ usable areas) and the HoReCa channel (restaurants and coffee bars). The driver-salesman daily visit structure to the sales point is shown in Tables 2 and 3.

In previous tables, one can see that there are waste activities driver-salesman can, with an average duration of the sales process of 25 minutes, visit only 8 to 10 sales points per day to sell and deliver goods. After analyzing the previously presented process within the company, a process of reorganizing sales and distribution in the company started by applying the Kaizen principles:

1. Identification of the problems: Combining the functions of the driver, delivery person, storekeeper, and seller in one driver-salesman does not achieve the desired results in sales or distribution. There is not even an answer to the growing number of sales points in the growing range of products.
2. Analyzing current processes: Insufficient results were detected in sales, the number of daily deliveries, the physical load of drivers, and safety at work due to overload.
3. Creation of solutions: The need to separate the process of storing and loading goods from sales and distribution operations is determined. The working place driver-salesman is terminated, and three new positions are created: sales representative, driver-delivery man, and assistant warehouse worker (Table 4). Workers employed as the assistant stacker on a truck are reassigned to an assistant warehouse worker position. On the wave of computerization, the company invests in acquiring software solutions for sales support, warehouse inventory management, electronic delivery of orders, and transport management systems.
4. Testing of the solution: A pilot project was organized for a trial period of 60 days. Two working specifications covering two workplaces are defined: sales representative and delivery driver. The dynamics of the process are defined in such a way that the sales representative visits the customers according to a predefined schedule of visits, takes orders through a personal digital assistant (PDA), and sends them electronically. The total ordered quantities are cumulated and placed in the warehouse at the end of each working day. During the night shift, total quantities of products are ordered and loaded onto trucks. In the morning, the driver picks up a handheld device loaded with information about delivery locations and delivers according to the most economical tour schedule defined by the transportation management system. When delivering the goods, the driver prints the shipping slips in 3 copies on each truck's portable dot matrix printer.
5. Measurement and analysis of the results: After a 60-day trial period, an increase in daily orders from 12 to an average of 30 orders per day was determined, and the same number of deliveries to sales points.
6. Standardization of solutions: Solutions from the trial period are permanently adopted along with standardization of new processes, education, and familiarization of all organization members with new standards to avoid process delays.

**Table 2.** Structure of sales tour of the driver-salesman in minutes before LM implementation

| Step | Activity | Time | Activity type | Waste type |
|---|---|---|---|---|
| 1 | Getting orders | 3 min | Value | |
| 2 | Checking the customer's internal creditworthiness | 1 min | Value | |
| 3 | Agreement on terms of delivery and payment | 1 min | Waste | Waiting |
| 4 | Order preparation with an assistant stacker on the truck | 5 min | Value | |
| 5 | Order correction with the customer based on available stock | 1 min | Waste | Overprocessing |
| 6 | Manual printing of the delivery notes in three copies | 3 min | Value | |
| 7 | Unloading the order at the point of sale | 1 min | Value | |
| 8 | Control of conformity of ordered and delivered goods | 2 min | Value | |
| 9 | Verification of documentation | 1 min | Value | |
| 10 | Acceptance of the return of goods due to damage or expiration date | 2 min | Waste | Overprocessing |
| 11 | Printing of documentation for the return of goods in three copies | 3 min | Waste | Overprocessing |
| 12 | Storage of returns in truck | 1 min | Waste | Overprocessing |
| 13 | Preparing the cart for delivery | 1 min | Value | |
| 14 | Closing the storage area of the truck | 1 min | Value | |
| | **Total time** | **25 min** | | |

**Table 3.** Structure of daily activities of the driver-salesman in minutes before LM implementation

| Step | Activity | Time | Activity type | Waste type |
|---|---|---|---|---|
| 1 | Receiving a daily activity schedule from the transport officer | 5 min | Waste | Unnecessary movements |
| 2 | Visual inspection of the truck's condition | 2 min | Value | |
| 3 | Control of ordered goods to replenish truck stock | 30 min | Value | |
| 4 | Correction of documentation due to deficiencies in the preparation of ordered quantities | 8 min | Waste | Defects |
| 5 | Replenishment of the truck with the ordered quantities | 45 min | Value | |
| 6 | Driving along the agreed route - total time spent in active driving | 180 min | Value | |
| 7 | Ordering process - total daily time spent in the sales process | 210 min | Value | |
| 8 | Daily fuel tanking | 15 min | Waste | Overprocessing |
| 9 | Daily rest | 45 min | Value | |
| 10 | Handing over cash from cash sales to the cashier | 15 min | Value | |
| 11 | Submission of documentation to the administrator and deregistration of sold items | 15 min | Value | |
| 12 | Creation of a template of the required quantities to replenish the truck | 30 min | Value | |
| | **Total time** | **600 min** | | |

**Table 4.** LM workplaces optimization

| Old working place – termination | New working place - establishment |
|---|---|
| Driver – salesman | Sales representative<br>Delivery driver |
| Assistant stacker on truck | Assistant warehouse worker |

An analysis of the company's sales and logistics distribution processes was carried out, neuralgic points were defined, and steps were proposed that are believed to improve the process. The 5S tool was used to analyze each procedure within an individual process, eliminating waste in the process. In the distributive part of the process, the method of stacking goods is standardized. This was done with the presence of Kanban elements that refer to the markings of storage slots inside the truck and the marking of the assortment and storage space with colors (frozen vegetables are green, fish are blue, family ice cream is orange, impulse ice cream is yellow, dough is brown). The company invested in acquiring programs for sales support, warehouse inventory management, electronic delivery of orders, and transport management systems. Actions related to the daily organization of drivers' and sales representatives' activities are avoided by automated processing and preparation by sales managers and dispatchers. Since the credit checks and payment terms are predefined by the sales support tool, there is no need to conduct these activities. Correction of the order with the customer by the driver based on the available stock is no longer necessary since the sales representative has information about the availability of the goods in the PDA and the goods assembled and ordered the day before being delivered. The time needed to print orders in 3 copies is reduced to the time needed to print delivery notes. It does not represent a waste of time because the ordered goods are prepared simultaneously according to the order. The return policy for damaged or expired goods is changed so that Frozen Ltd. no longer physically accepts the return but approves a 50% reduction in the deadline, with the possibility of a complete write-off of the goods in case they are not sold by the legal deadline. Drivers are no longer required to fill up with fuel daily, and the transport management system controls potential fraud in the consumer segment. After the changes, the new, improved value stream is shown in Tables 5 and 6.

In the sales channel, separating the sales process through the new position of sales representative resulted in increased productivity in the form of an increase in the share of working time spent in sales activities from 35% to 63% of daily work activities. The number of daily orders of the sales representative grew from 12 to 35, which is 150%. In the distribution channel, the exemption of drivers from obligations related to sales activities significantly increases productivity in the distribution process. The share of distribution activities in the daily working activities has increased from 35% to 50%. The number of daily deliveries increased from 12 to 30, which is an increase of 150%. Although the different working place was established, there are still savings in the time needed for one visit (from 25 to 11 minutes per salesman and a total of 11 minutes for delivery).

As a result of LM implementation, the company Frozen Ltd. improved the sales-distribution process through productivity growth. The observed changes represent an opportunity to improve the selection process during employment since the separation of competencies enables selection according to the narrower specialization and skills required by each of the separated workplaces. Additionally, these changes help companies increase their market reputation by improving corporate culture (Esenyel, 2020) since the LM influences the company culture and the worker's approach toward it (Erceg & Dotlić, 2014). Changes resulting from the LM implementation in Frozen Ltd. and the investments in IT positively impact the growth of the company's business operations. These investments in IT (i.e., sales support, warehouse management) impact sales increase as seen in previous research (Işık, 2013), and their impact is higher when combined with LM implementation, as was the case in Frozen Ltd.

**Table 5.** Structure of activities of the sales representative in minutes after LM implementation

| Step | Activity | Time | Activity type | Waste type |
|---|---|---|---|---|
| 1 | Visual control of the point of sale, stacking, and replenishment | 5 min | Value | |
| 2 | Receiving the order | 5 min | Value | |
| 3 | Creation of an order for the approval of damaged/goods before the deadline | 1 min | Value | |
| | **Total time** | **11 min** | | |

**Table 6.** Structure of sales representatives' daily activities

| nistration | riving | Sales | Total |
|---|---|---|---|
| 2% | 35% | 63% | 100% |

Drivers spend 50% of their daily working time in the delivery process, 35% in active driving, 5% of their working time in mandatory rest, and 10% in administrative work. The number of deliveries to sales points increased from 12 to an average of 30 deliveries per day (a 150% increase). After the implemented changes, the new, improved value stream is shown in Tables 7 and 8.

**Table 7.** Structure of activities of the driver in minutes after LM implementation

| Step | Activity | Time | Activity type | Waste type |
|---|---|---|---|---|
| 1 | Preparation of goods for delivery to the point of sale | 5 min | Value | |
| 2 | Control of delivered goods with the customer | 3 min | Value | |
| 3 | Printing of delivery notes | 1 min | Value | |
| 4 | Preparing the cart for delivery | 1 min | Value | |
| 5 | Closing the storage area of the truck | 1 min | Value | |
| | **Total time** | **11 min** | | |

**Table 8.** Structure of drivers' daily activities

| Administration | Driving | Distribution | Obligatory rest | Total |
|---|---|---|---|---|
| 10% | 35% | 50% | 5% | 100% |

## 5. Conclusion

The significance of the LT and LM has been shown and proved in different academic and professional studies worldwide. This has been the case in both production and the service sector, whether private or public. LM can be applied in all processes in all industries. The main challenge is whether the company implementing LM knows its processes, what buyers perceive as a value, how the company operates, and what needs improvement. Companies have several different LM tools that can be used during this process. The tool they will use mainly answers their needs and potential knowledge regarding using it. Reaching LM is an ongoing journey, not just a single event with a destination; thus, companies need to keep working toward improving their processes.

The application of LM was presented in a Croatian frozen goods manufacturing company. For the implementation of the LM, the company applied LM tools and analyzed every process within the sales and distribution department in detail. By applying LM principles, redundant processes are eliminated, and because of the LM implementation, the company decided to separate the driver and sales representative functions. The LM application showed significant improvement and gave company savings and better workforce utilization, resulting in better sales results. These results showed that LM could help the company adapt to market changes, gaining and/or increasing competitiveness in the market. Therefore, the company should continue with its efforts in implementing LM in other business processes based on the results of improved sales and distribution processes. Research results confirm previous studies (i.e., Alves et al., 2012; Hidayati et al., 2019; Palange & Dhatrak, 2021) conclusion that LM can significantly improve business processes and increase competitiveness in the market in increasingly challenging environments.

Further research on LM in Croatia is more than needed not only in manufacturing companies but also in the service sector. Additionally, conducting another research on the company in five years is recommended to review its improvements, check if the company has used LM in other parts (i.e., production), and see if there are additional benefits of LM.

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# Is the performance of the companies operating in the participation index in the Turkish economy affected by the macroeconomic perspective?

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**ABSTRACT**

This study aims to examine whether the participation index performance in the Turkish economy is going well in terms of macroeconomic factors over the period of January 2018March 2021. In this study, the cointegration between the variables is checked with the ARDL bound test and the Johansen cointegration method. The long-term coefficients are estimated through the ARDL model. Finally, the causal linkage among the participation index performance and traditional stock market index, short-term interest rate, money supply, and the inflation rate is tested with the Toda-Yamamoto causality method. The main empirical findings are shown as in the following: 1) there is cointegration between the Participation index performance and traditional stock market index, short-term interest rate, money supply, and inflation rate under the structural break, 2) the traditional stock market index and money supply improve the Participation index performance in Turkish economy while short-term interest rates hamper it, and 3) there is a two-way causality between the participation index performance and the traditional stock market index and inflation rate, and a one-way causality relationship running from money supply and interest rates to Participation index performance. These evidences provide important suggestions to investors in terms of portfolio diversification and to policymakers in the light of risk allocation and market policies.

## *I. Introduction*

The Islamic financial market is expressed as a market driven by Islamic law (sharia) principles that prohibit interest (riba), extreme risk (garar), and betting (may) and promote risk sharing, support profit sharing, asset-based financial operation, and ethical capital (Shamsuddin, 2014). In addition, Sukuk (Islamic bonds) from Islamic financial services are based on financial regulations such as profit-loss sharing or leasing principles to avoid interest (Nasr et al., 2016; Akhtar et al., 2017). The DMI150 (Dar al-Mal al-Islami) index was created through two banks to observe the productivity of 150 globally publicly traded firms in the world in 1998 indicating that an Islamic index entered the financial market for the first time (Al Khamlichi et al., 2014). In Turkey, the first participation index was established with Sukuk stock in 2012 (Yılmaz & Bağış, 2020). Participation index traded in Borsa Istanbul in Turkey; There are three indices: Participation 50 Index (KAT50), Participation 30 Index (KATLM30), and Participation Model Portfolio Index (KATMP).

In recent years, the world Islamic finance market has attracted international capital flows from both Muslim and non-Muslim investors, and with the continuous growth of the trading volume of the Islamic capital market, the issue of whether the Islamic finance market is affected differently by economic variables has emerged as an ongoing debate by academics and experts (Bahloul et al., 2017). In studies in the literature, the performance of Islamic financial services (Shamsuddin, 2014), which grew by 10-15% annually, was based on the traditional stock market returns of the Islamic capital market (Majdoub et al., 2016; Bahloul et al., 2017; Sakarya et al., 2018; Star, 2020; Adekoya et al., 2021), money supply (Usa. Majid & Mohd. Yusof, 2006), inflation rate (Naifar, 2016), short term interest rate (Bahloul et al., 2017), industrial production index, an exchange rate (Prima Sakti & Harun, 2013; Aziz et al., 2020), oil prices (Abdulkarim et al., 2020) and energy prices (Zaighum et al., 2021) are affected by economic and financial variables. In addition, according to the study of Işık (2013), information technologies influence Turkish economy using the ARDL model estimator in the short and long run. On the other hand, the study conducted by Ali et al. (2018) found that Islamic markets in Brazil, the USA, Japan, China, the UK, India, Malaysia, South Africa, Russia, Turkey, and Pakistan were more effective than traditional markets throughout 2007-2010. At the same time, comparing Islamic and traditional markets, the Islamic markets are less subjected to any shocks originating from the inside while more subjected to those from outside the region (Dewandaru et al., 2014).

Therefore, focusing on the evaluations above, this study aims to examine whether the participation index performance in the Turkish economy is going well in terms of macroeconomic factors in the period January 2018 to March 2021. Macroeconomic variables such as traditional stock market yield and money supply, short-term interest rate, and inflation rate are included as independent variables in the model in the study and the data are examined by time series analysis. In addition, we have important sources of motivation to focus on the independent variables we have mentioned in this study. First, empirical studies in the literature have examined the effect of different variables such as traditional stock market indices (Jawadi et al., 2014), traditional stock market (Ajmi et al., 2014), interest rate on treasury bills, economic uncertainty, and oil prices, traditional stock market indices (Naifar, 2016), and market uncertainty index, oil prices, interest rate and inflation rate (Bahloul et al., 2017).

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Therefore, these studies are an important element in creating our model. Second, the money supply, which is treated as the macroeconomic variable in the working model, is a fundamental factor in the economic cycle phase, and the change in the money supply affects share prices (Ghazali & Yakob, 1998). Changes in the money supply cause investors to adjust the factors that determine stock prices (risk-free return, earnings expectations, and risk premium) and are expected to create an oversupply of money balances and, accordingly, excess demand for stocks (Homa & Jafee, 1971). Thus, it is seen that the money supply has a direct relationship with the stock prices in the Islamic capital market (Ajmi et al., 2014; Naifar (2016). When the relationship between the other macroeconomic variable interest rate included in the model and stock market index prices are mentioned, an increase in interest rates increases the opportunity cost of holding money and consequently increases the substitution between stocks and interest-bearing securities, that is, the decrease in stock prices. In theory, the relationship between interest rates and stock prices is negative. One of the reasons for this is that increased interest rates reduce firms' profitability, reducing their cash flows (Nishat & Sìiaheen, 2004; Panda, 2008). The last macroeconomic variable inflation rate to be included in the model is, according to Fisher (1930)'s hypothesis, "*the expected return of stocks is equal to the sum of the expected inflation and the expected real rate of return*". In other words, there is a positive relationship between the stock return index and inflation. The inflationary environment in the 1970s led researchers to examine the relationship between inflation and stock return, and empirical studies conducted in these years found that there was a negative relationship between inflation and the return of the stock market index (Fama & Schwert, 1977). In the 1980s, a negative relationship was observed between stock yield and inflation as there was a negative relationship between inflation and production and a positive relationship between production and stock yield (Fama, 1981). Studies in the literature show that there is a positive relationship between inflation and the stock return index in some and a negative relationship in others (Bahloul et al., 2017; Erdogan et al., 2019). In line with these evaluations, macroeconomic variables such as money supply, interest rate, and inflation rate in the study push the question of whether Islamic capital affects index performance. Our last source of motivation is that several countries are discussed in the first studies in the literature (Usa. Majid & Yusof, 2009; Wahyudi & Sani, 2014; Abdulkarim et al., 2020; Adekoya et al., 2021). However, studies that focus on the Turkish economy are rare. As a result, in this study, traditional stock market return index and macroeconomic factors such as money supply, interest rate, and inflation rate are analyzed by including them as independent variables in the model of determinants of Islamic capital market index performance.

The study, first, examines whether the variables are stationary with the Augmented Dickey-Fuller (ADF), Ng-Perron & Vogelsang Perron unit root tests. Secondly, the long-term relationship between participation index performance and the traditional stock market and macroeconomic factors is analyzed by ARDL bound test and Johansen cointegration technique. Thirdly, the long-term coefficients of variables are estimated according to the ARDL model estimator. Finally, the causality relationship between variables is investigated with the Toda-Yamamoto Granger causality method.

The study makes significant contributions to the literature. First, within a coherent econometric framework, the impact of traditional stock market yield, money supply, inflation rate, and short-term interest rate on Islamic index yields is explained. Secondly, with a particular focus on the Turkish economy, the long-term determinants of Islamic capital market index performance are identified in the period from January 2018 to March 2021. Finally, with the ARDL limit test based on the fractured period, it is ensured that it is known whether there is a cointegration relationship between the traditional stock market return index and macroeconomic factors such as money supply, interest rate, and inflation rate in the sample of the Turkish economy.

The rest of the study is planned as follows: In the second section, studies conducted in the literature are mentioned. The third section mentions the data and model in this study. The fourth section explains the methodology used in the study. In the fifth section, the findings of the analysis are interpreted and discussed with the findings of the previous study. In the last section, the result of the study is summarized.

## 2. Literature review

There are several studies that examine the influence of traditional stock market and macroeconomic variables on Islamic stock market performance together or separately with panel or time series analysis methods, and these studies shed light on this study. First of all, the studies carried out with the time series analysis method by focusing on the Turkish economy are summarized. Sakarya et al. (2018) examine the risk and return linkage among the Corporate Governance Index and Borsa İstanbul 50 index and the Participation 30 index in the period January 10, 2011-December 22, 2016. According to the Sharpe ratio, Treynor Index, Jensen Alfa, and Beta criteria, the participation 30 index in Turkey has a lower risk than other indices and has more days of return. Erdogan et al. (2019) use the ARDL model estimator to investigate whether macroeconomic factors had an impact on the Participation 30 index from 2011-2019. According to the estimator results, the industrial production index positively affects the Participation 30 index in the long term while the inflation rate negatively affects it. Bayram and Othman (2019) investigate the performance of the Islamic Participation 50 index and the traditional BIST100 index by using the t-test. The researchers determined that there exists no difference in the performance and returns of the Participation 50 index and the traditional BIST100 index in Turkey during the period of 15 May 2015-31 December 2016. Yıldız (2020) investigates the risks and returns between participation indices and traditional stock market indices by using the TOPSİS method in 2015, 2016, and 2017. According to the findings, it is determined that there are not any differences between the returns of indices in Turkey, but in terms of risk, participation indices have a lower risk. At the same time, these findings are similar to the findings of Strong (2019), who finds that the Participation 30 index has a lower systematic risk than the traditional BIST100 index. Therefore, in the literature, the effect of macroeconomic factors on the Participation 30 index by focusing on the Turkish economy (Erdoğan et al., 2019), risks and returns between participation indices and traditional stock market indices (Sakarya et al., 2018; Yıldız, 2020) and the performance of Participation 50 index and traditional BIST100 index (Bayram & Othman, 2019) are examined. However, there is no study examining the relationship between the Participation index and the traditional stock market index and macroeconomic factors in Turkey. At the same time, other studies include the time series analysis method as in the following: Abd. Majid and Yusof (2009) examine the link between Malaysia's macroeconomic series and Islamic stock market return by using the ARDL cointegration approach for May 1999-February 2006 after the 1997 financial crisis. The findings reveal the cointegration among the Islamic stock market and macroeconomic series such as money supply, treasury bond ratio, industrial production index, real effective exchange rate, and reserve ratios. Hussin et al. (2012) reveal that the link between Islamic stock market development and macroeconomic variables through the VAR method in Malaysia for April 1999-October 2007 is analyzed. According to the findings of the VAR method, it is obtained that there is cointegration between the variables, and the industrial production index, and consumer price index have a statistically positive effect on Islamic stock market prices while the money supply and exchange rate negatively affect them. In addition, it is seen that there is an insignificant negative correlation between the interest rate & Islamic stock markets.

Similarly, Sakti and Harun (2013) examine the relationship between the Jakarta Islamic stock market index and macroeconomic variables such as exchange rate, industrial production index, inflation rate, and money supply from January 2000-December 2010. According to the Johansen-Juselius method, there is a long-term linkage among the series. Granger causality results also indicate a two-way causality relationship between the exchange rate and the Islamic stock market index and unidirectional causality running from the inflation rate and the industrial production index to the Islamic stock market index. Erdoğan et al. (2019) investigate whether macroeconomic factors have an impact on the Participation 30 index by focusing on the Turkish economy by using the ARDL model estimator. According to the long-term results, the industrial production index positively affects the Participation 30 index while the inflation rate negatively influences it.

Jawadi et al. (2014) examine the financial performance of Islamic and traditional indices in three regions such as Europe, the US, and the world between 2000 and 2011. Taking the 2008-2009 global financial crisis into account, CAPM-GARCH model results indicate that traditional funds perform better than Islamic investments before and during the recession but fail during the crisis. In Islamic markets, the impact of the global financial crisis appears to be less important than in traditional markets. These results are similar to those obtained by Ho et al. (2014), which examined the performances of Islamic and traditional indices in eight countries. It also coincides with the findings of Majdoub et al. (2016), who found that there is a strong relationship between the Islamic and traditional stock market prices in France, Indonesia, the UK, and the US from September 8, 2008, to September 6, 2013.

Wahyudi and Sani (2014) analyze the causal linkage between the Islamic financial market and macroeconomic series by using the Toda-Yamamoto test in Indonesia from 2002-2011. The study findings show that there is an interaction among macroeconomic series, financial markets, and macroeconomic series, and between the Islamic capital and money market. In addition, Habib and Islam (2017), which tested the influence of macroeconomic series on Islamic stock market performance through regression for India between February 2007 and June 2016, found that the interest rate and exchange rate damaged Islamic stock market performance. Shahzad et al. (2017) examine returns and volatility among financial and macroeconomic series such as the global Islamic stock market, national stock markets for the US, UK, and Japan, capital market uncertainty index in the US, U.S. 10-year bond prices, and oil prices. Generalized VAR approach results obtained from July 1996-June 2016 period data show that there exists a significant and robust interaction between variables. Abdulkarim et al. (2020) study the impact of oil price changes on certain African Islamic indices (Tunisia, Morocco, Egypt, South Africa, and Nigeria) using daily data for the period May 4, 2011-January 25, 2018. MODWT, CWT, and multivariate GARCH-DCC model results also demonstrate a long-term relationship between the variables and the low volatility between the Tunisian stock market index, which is one of the Islamic stock markets, and the oil index.

At the same time, there are also some panel data studies conducted by many using panel data techniques. Bahloul et al. (2017), for example, examine the volatility impact of various macroeconomic factors and traditional stock market returns on Islamic stock market returns for 20 developed and developing countries from the period 2002-2014. According to the results of the Linear and Markov switching regression, while traditional stock market returns and money supply increase the Islamic stock market return in developing countries, short-term interest rate and inflation rate decrease it.

Akhtar et al. (2017) investigate the influence of unexpected interest on Islamic and traditional stock and bond yields in 11 countries at different periods. According to the panel regression results, the announced interest rate positively affects the returns of Islamic stocks in 2003, while it negatively affects 2011. In general, it is seen that the unexpected interest rate affects the Islamic stock yield more strongly and also has a more stable effect on the Islamic bond yield. Focusing on the US, China, Saudi Arabia, and Nigeria, Adekoya et al. (2021) analyze the relationship between traditional financial markets and Islamic financial markets by using the TVP-VAR method during the Covid-19 pandemic. According to the researchers, the findings suggest a strong relationship between traditional financial markets and Islamic financial markets between January 1 and November 30, 2020. Karyatun et al. (2021) obtain that inflation, the rupiah exchange rate, and the BI rate have not affect Indonesian Syariah Stock Index (ISSI). Ma et al. (2022) find that the economic growth, unemployment and exchange rate influence the stock market performance over the period of January 1980-December 2020 and Lopez et al. (2022) conclude that the uncertainty of oil prices and the exchange rate have an impact on the US stock returns between May 10, 2007 and December 31, 2017.

Hence, as a result of many studies carried out in the literature, especially focusing on the Turkish economy (Erdoğan et al., 2019; Sakarya et al., 2018; Yıldız, 2020; Bayram & Othman, 2019), as well as many studies in other countries, it is determined that there are not any studies that examines the combined effect of the traditional stock market index and macroeconomic factors on Islamic stock market performance in Turkey, and this is a motivating factor in determining the purpose of the study at hand. At the same time, unlike other studies (Jawadi et al., 2014; Akhtar et al., 2017; Shahzad et al., 2017; Yıldız, 2020; Adekoya et al., 2021), in this study, both the ARDL model forecaster for long-term estimation and the Toda-Yamamoto Granger causality to determine the causality relationship test were applied.

## 3. Model and data set

The study aims to examine whether the participation index performance in the Turkish economy from January 2018-March 2021 is going well in terms of macroeconomic factors. Money supply, interest rate, and inflation rate as macroeconomic factors and traditional market performance index are integrated into the model of participation index performance. In the models of empirical studies, the effect of different variables was examined such as traditional stock market indices (Jawadi et al., 2014), traditional stock market (Ajmi et al., 2014), interest rate on treasury bills, economic uncertainty, and oil prices, traditional stock market indices (Naifar, 2016), and market uncertainty index, oil prices, interest rate and inflation rate (Bahloul et al., 2017). In this study, a traditional capital index, traditional capital index variance, inflation rate, short-term interest rate, yield curve, and money supply variables are also included in the model. Therefore, by developing the models of these studies, the following model is obtained for the Turkish economy and tested by time series analysis.

$$lnPIP_t = \delta_0 + \delta_1 lnBIST_t + \delta_2 lnMS_t + \delta_3 lnIR_t + \delta_4 lnINF_t + \mu_t \quad (1)$$

Here, *PIP* presents the Participation 30 index as an indicator of participation index performance (Jawadi et al., 2014; Rizvi et al., 2014; Kenourgios et al., 2016), and *BIST* shows Borsa İstanbul 100 index expressed the traditional stock market performance (Nippani & Washer, 2004; Sharif et al., 2020). *MS* is a money supply consisting of cash, term deposits, checks, savings, and short-term deposits (M2) (Wahyudi & Sani, 2014; Gherbi & Alsedrah, 2021), *IR* demonstrates a quarterly short-term interest rate (Bahloul et al., 2017; Avcı, 2020) *INF* shows inflation rate as consumer price index (Wahyudi & Sani, 2014). *"t"* is January 2018- March 2021, $\delta_0$ refers to the constant coefficient and μ presents the error term. $\delta_1$, $\delta_2$, $\delta_3$, and $\delta_4$ show the long term elasticity of the traditional stock market, money-supply, long term elasticity of the traditional stock market, money supply, interest,

and inflation rate, respectively. Logarithmic values of each variable are included in the analysis to achieve more reliable and effective empirical results (Shahbaz et al., 2013). Another reason for using the logarithmic values of the series in the study is to be able to reveal the effect of variables in the context of elasticity. In the study, a time series data set is used as monthly data covering the period January 2018-March 2021. There are many reasons why the sample in this study started in January 2018. First of all, in 2018, the trade war between the US and China and the FED's decision to raise interest rates has caused an increase in exports to Turkey, which leads to foreign exchange inflows. In this case, the uncertainty of global policy reduces the risk in Turkey and accelerates the growth of the country. In addition, macro measures taken in Turkey accelerate the development of financial markets by enabling financial assets to grow more than financial obligations. Therefore, the positive developments in the financial and real markets in Turkey in 2018 were motivating the start of the sample period of the study from January 2018 (Central Bank of Turkey Annual Report, 2018; Bloomberg, 2021). Turkey Participation index, traditional stock market, inflation, money supply, and short-term interest are collected from the Investing TR (2021) website and the Central Bank of Turkey Electronic Data Distribution System-EVDS (2021) database.

Table 1 summarizes the correlation matrix and descriptive statistics of each variable. According to Table 1, the average value of the Participation 30 index in Turkey is 7.123 and the standard deviation is 0.303. This indicates that the Participation 30 index in Turkey does not have a high disparity from the period of January 2018-March 2021. The minimum and maximum values of the Participation 30 indexes are 6.772 and 7.774. The average value of the BIST100 index in Turkey is 6.978. There is no high discrepancy between the standard deviation value of 0.136 and the BIST100 index in Turkey. The minimum and maximum values of this index are 6.798 and 7.297, respectively. The average values of Turkey's money supply, interest rate, and inflation rate for the period of January 2018-March 2021 are 21.581, 2.968, and 2.651, respectively, and their standard deviations are 0.240, 0.349, and 0.276. At the same time, when looking at Table 1, it can be said that there is a positive correlation between Participation index performance and traditional stock market index and money supply, and a negative correlation between Participation index performance and interest rate and inflation rate. In addition, the trend of each series in the January 2018-March 2021 period is shown in Graph 1.

## 4. Methodology

The methodology section of the study consists of four stages. In the first stage, the variables are stationary with the Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1981), Ng-Perron (Ng & Perron, 2001), and Vogelsang Perron (Vogelsang & Perron, 1998) unit root tests. In the second stage, the long-term relationship between Participation index performance and traditional stock market index and macroeconomic factors is analyzed through the ARDL bound test (Pesaran et al., 2001) and the Johansen cointegration technique (Johansen, 1988). In the third stage, long-term coefficients of variables are estimated by the ARDL model (Pesaran et al., 2001). In the final stage, the Toda-Yamamoto causality (Toda & Yamamoto, 1995) analysis is applied to check the causality relationship between variables.

In the first part of the methodology, ADF and Ng-Perron tests as classical unit root tests and Vogelsang Perron unit root tests under one structural break are used to test whether the variables contain unit roots. The ADF and Ng-Perron tests do not provide reliable results because they are not based on structural breaks. In addition, in the existence of structural breaks, it is seen that these unit root tests are not suitable (Shahbaz et al., 2013).

Therefore, the stationary features of the series are also investigated with the Vogelsang Perron unit root test, which considers structural breakage. The Vogelsang-Perron unit root test offers two different models. These are the Additive Outlier Value-AO model in which break is abrupt and the Innovation Outlier Value-IO model, where the breakage occurs slowly, and unit root tests are made with these two models (Vogelsang & Perron, 1998). In this study, the stationary variables are analyzed with the AO model of the Vogelsang-Perron unit root test.

In the second part of the methodology, the long-term link between the Participation index performance and the traditional stock market and macroeconomic series like money supply, interest, and the inflation rate is determined by the ARDL bound test approach and the Johansen cointegration test. ARDL bound test developed by Pesaran et al. (2001) is also applied when variables are a mixture of I(0) or I(1) or both, and this test is more suitable for small samples. Short and long-term analysis can be performed by a dynamic unrestricted error correction model (UECM) derived from the ARDL bound test (Pesaran et al., 2001). The equation of the ARDL bound test is formulated as follows:

$$InPIP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i}\, \Delta InPIP_{t-i} + \sum_{i=0}^{q} \alpha_{2i}\, \Delta lnBIST_{t-i} + \sum_{i=0}^{q} \alpha_{3i}\, \Delta lnMS_{t-i} + \sum_{i=0}^{q} \alpha_{4i}\, \Delta lnIR_{t-i} + \sum_{i=0}^{q} \alpha_{5i}\, \Delta lnINF_{t-i} + \beta_1 InPIP_{t-1} + \beta_2 lnBIST_{t-1} + \beta_3 lnMS_{t-1} + \beta_4 lnIR_{t-1} + \beta_5 lnINF_{t-1} + \beta_6 D_{2019M10} + u_t \quad (2)$$

Where $\alpha_0$ refers to the constant term, Δ is the first difference operator of variables, $_{it}$ is the error term, and D presents the structural break as a dummy variable. The Schwarz Information Criteria (SIC) is used to determine the optimal lag length for the model. Null hypothesis of cointegration is $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ and alternative hypothesis is $H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$'. *F*-test is proposed by Pesaran et al. (2001) and the calculated *F*-statistics value is compared with the upper and lower limit critical values to decide the cointegration between the variables. If the *F*-statistics value exceeds the upper limit value, it indicates that there is cointegration between the variables. If the *F*-statistics value is below the lower limit value, it is stated that there is not a long-term relationship between the series by rejecting the null hypothesis of cointegration. Furthermore, if the *F*-statistics value is between the lower and upper limit values, there is no interpretation of the existence of cointegration (Pesaran et al., 2001). In addition, an alternative way for the existence of cointegration between variables in the model is the error correction term $ECT_{(t-1)}$ and the coefficient of this term is significant. If $ECT_{-1}$ is negative at a significance level of 5%, this points out that there is cointegration among the series by rejecting the null hypothesis (Saboori & Sulaiman, 2013). In addition, the existence of the long-term linkage among dependent and independent variables is checked by the Johansen cointegration procedure proposed by Johansen (1988).

After examining the presence of cointegration between variables, long-term coefficients are estimated with the ARDL model estimator in the third part of the methodology. At the same time, diagnostic and stability tests are applied to ensure the suitability of the ARDL model. Diagnostic tests include normality, autocorrelation, heteroskedasticity, and suitability for modeling. In addition, the CUSUM and $CUSUM^2$ tests detect the stability of the long and short-term elasticity estimates (Sebri & Ben-Salha, 2014).

In the last part of the methodology, the causality relationship between Participation index performance and traditional stock market index and macroeconomic variables is analyzed by the Toda-Yamamoto Granger causality test. This test was recommended by Toda and Yamamoto (1995) who examined the causality relationship between variables based on their level values, regardless of which variables were cointegrated in $I(0)$, $I(1)$, or $I(2)$.

**Table 1:** Descriptive statistic and correlation matrix

| Statistics/Variables | $lnPIP_t$ | $lnBIST_t$ | $lnMS_t$ | $lnIR_t$ | $lnINF_t$ |
|---|---|---|---|---|---|
| Average | 7.123 | 6.978 | 21.581 | 2.968 | 2.651 |
| Median | 7.013 | 6.952 | 21.536 | 2.983 | 2.641 |
| Standard deviation | 0.303 | 0.136 | 0.240 | 0.349 | 0.276 |
| Min. | 6.772 | 6.798 | 21.204 | 2.302 | 2.145 |
| Mak. | 7.774 | 7.297 | 21.981 | 3.481 | 3.228 |
| Skew | 0.966 | 0.931 | 0.233 | -0.244 | 0.315 |
| Pressure | 2.695 | 3.213 | 1.769 | 1.935 | 2.159 |
| Observation Number | 39 | 39 | 39 | 39 | 39 |
| $lnPIP_t$ | 1.000 | | | | |
| $lnBIST_t$ | 0.883 | 1.000 | | | |
| $lnMS_t$ | 0.849 | 0.556 | 1.000 | | |
| $lnIR_t$ | -0.506 | -0.362 | -0.469 | 1.000 | |
| $lnINF_t$ | -0.264 | -0.288 | -0.185 | 0.746 | 1.000 |

**Graph 1:** Trend of variables (January 2018 - March 2021)

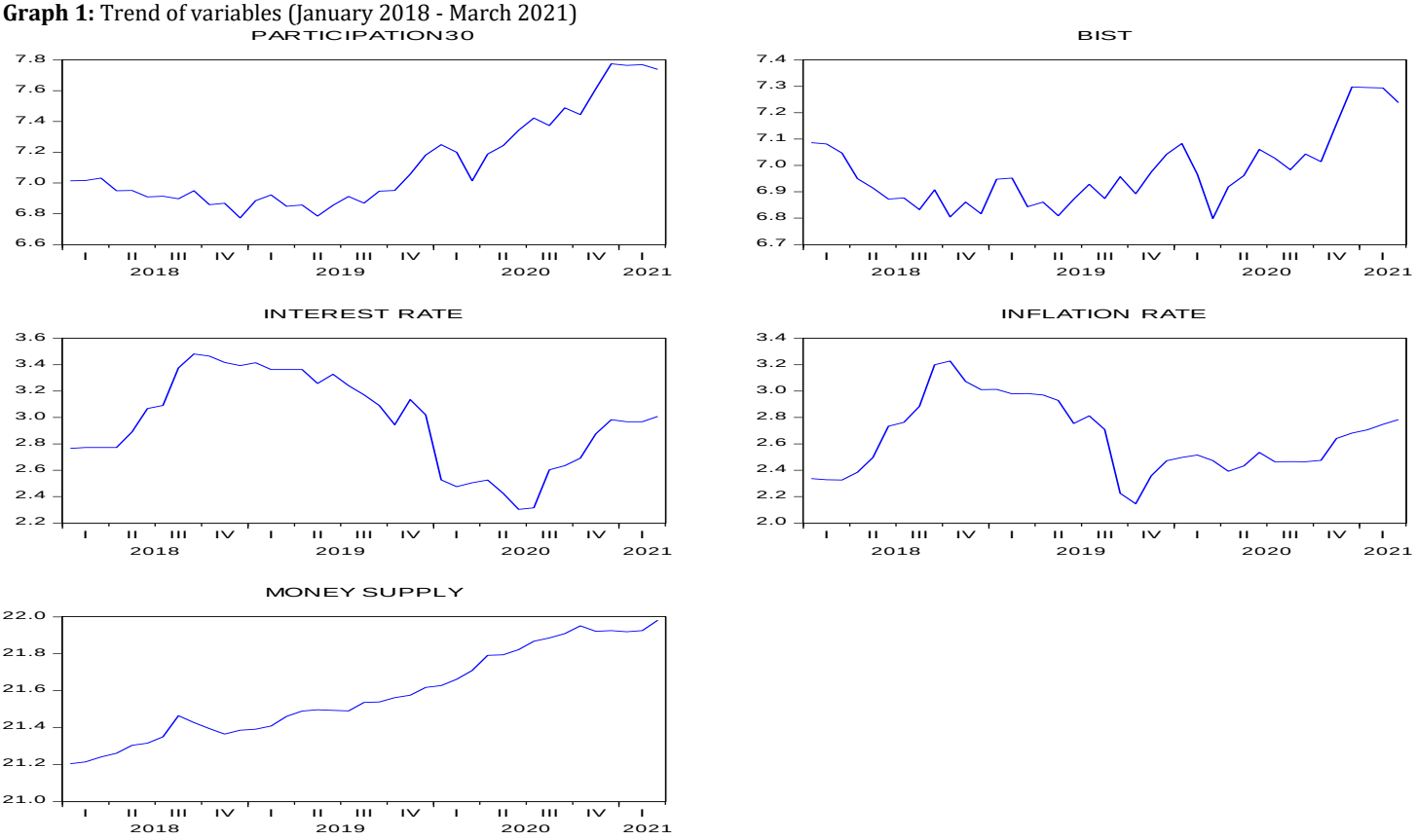



**Table 2:** ADF and Ng-Perron unit root tests

| | Ng-Perron | | | | ADF | |
|---|---|---|---|---|---|---|
| Regressor | $MZ_a$ | $MZ_t$ | MSB | MPT | Test statistics | Result |
| Panel A: Level | | | | | | |
| $lnPIP_t$ | -2.940 | -1.085 | 0.369 | 27.635 | -1.729 | - |
| $lnBIST_t$ | -6.301 | -1.647 | 0.265 | 14.424 | -2.596 | - |
| $lnMS_t$ | -6.778 | -1.838 | 0.271 | 13.445 | -1.977 | - |
| $lnIR_t$ | -2.797 | -1.153 | 0.412 | 31.680 | -1.549 | - |
| $lnINF_t$ | -3.547 | -1.313 | 0.370 | 25.371 | -1.756 | - |
| Panel B: First difference | | | | | | |
| $\Delta lnPIP_t$ | -17.959** | -2.961** | 0.164** | 5.287** | -6.582*** | I(1) |
| $\Delta lnBIST_t$ | -18.209** | -2.979** | 0.163** | 5.229** | -5.880*** | I(1) |
| $\Delta lnMS_t$ | -18.413** | -3.000** | 0.162** | 5.149** | -5.476*** | I(1) |
| $\Delta lnIR_t$ | -17.511** | -2.955** | 0.168* | 5.224** | -4.607*** | I(1) |
| $\Delta lnINF_t$ | -32.190*** | -4.010*** | 0.124*** | 2.838*** | -4.583*** | I(1) |

Note: ***and ** indicate 1% and 5% significant, respectively.

The Toda-Yamamoto causality test is based on the VAR model and firstly the appropriate lag length is detected through the VAR model for the implementation of this test. In the following process, the degree of cointegration of the variables in the model is determined. In the last period, the optimal lag length and the degree of cointegration are collected and estimated by Wald statistics by utilizing the VAR model.

## 5. Findings and discussion

First of all, the results of unit root tests utilized to analyze the stationarity features of series are evaluated in the study. Table 2 shows the results of the ADF and Ng-Perron tests. The findings demonstrate that the series is not stationary at this level. Then, unit root tests are applied again by taking the first differences of the series, and by rejecting the null hypothesis, it is detected that the variables are stationary at the first difference level.

In addition, the stationary characteristics of the variables are checked by the Vogelsang-Perron AO model unit root method under a single structural break and the findings are summarized in Table 3. These findings coincide with the results of ADF and Ng-Perron unit root tests and indicate that the series are integrated at the level *I*(1). Furthermore, the findings in Table 3 show the structural break dates of the Participation index performance, traditional stock market index, money supply, interest rate, and inflation rate variables as 2019M10, 2019M07, 2020M03, 2019M08, and 2019M02, respectively. The reason why the Participation index performance is broken in 2019M10 is that portfolio outflows due to the stock market in Turkey occur at that time and an interest rate cut of 250 basis points is made by the Monetary Policy Board, predicting that inflation would improve in October. As a result, the tight stance policy on monetary policy has also affected Islamic markets (Enflasyon Raporu 2019-IV, 31 October 2019, p. 1).

The optimal lag length for the model is determined through the VAR model before the ARDL bound test is applied. It is used the Schwarz information criterion (SIC), which provides reliable results to select the appropriate lag length. The findings obtained from the VAR model are summarized in Table 4. According to the findings, the optimal lag length is determined as one (1). After the optimal lag length is determined, the second part of the empirical findings of the study is based on ARDL bound test findings and these findings are shown in Table 5. According to the findings, the *F*-statistics value calculated for the model is 3.638, which is statistically higher than the upper critical value at 10% significance. This means that there is cointegration between the Participation index performance and the traditional stock market, money supply, interest, and inflation under the structural break. Coefficient $ECT_{(t-1)}$ in Table 5 is negative at the level of 5% significance, which points out a long-term linkage between dependent series and independent variables.

At the same time, Table 6 shows the findings of the Johansen procedure. According to the findings, it is seen that there are statistically least two vectors at the level of 1% significance and these findings coincide with the results of the ARDL bound approach. Thus, it is identified that there exists a long-term linkage between Participation performance and the traditional stock market and macroeconomic series like money supply, interest, and inflation. This finding is similar to the findings revealed by Sakti and Harun (2013) for Jakarta and by Erdogan et al. (2019) for Turkey, who show that there is a cointegration link between Islamic Participation and macroeconomic series. After the cointegration methods are performed, in the third part of the empirical findings, the long-term coefficients of the series are estimated with the ARDL model and these results are reported in Table 7. According to the results, the coefficient of the traditional stock market index is 1.454% and statistically at a level of 1% significance. This indicates a positive correlation between Participation index performance and the traditional stock market index, and a 1% increase in the traditional stock market index increases Participation index performance by 1,454%. In other words, the traditional stock market index improves the performance of the Participation index. This finding coincides with the finding of Sakarya et al. (2018), who found a positive correlation between the Participation index and the Borsa Istanbul50 index in Turkey between January 10, 2011, and December 22, 2016. It also coincides with the findings of Hammoudeh et al. (2014), who found that there is a positive relationship between the global Islamic index and the

**Table 3:** Vogelsang-Perron test

| Model | Additive outlier | | |
|---|---|---|---|
| Variables | *t-statistics* | Break Time | Result |
| Panel A: Level | | | |
| $\ln PIP_t$ | -4.638(8) | 2019M10 | - |
| $\ln BIST_t$ | -4.907(8) | 2019M07 | - |
| $\ln MS_t$ | -3.506(0) | 2020M03 | - |
| $\ln IR_t$ | -3.717(5) | 2019M08 | - |
| $\ln INF_t$ | -2.872(1) | 2019M02 | - |
| Panel B: First difference | | | |
| $\Delta \ln PIP_t$ | -8.977(0)*** | 2020M03 | *I*(1) |
| $\Delta \ln BIST_t$ | -8.167(0)*** | 2020M03 | *I*(1) |
| $\Delta \ln MS_t$ | -6.025(0)*** | 2020M04 | *I*(1) |
| $\Delta \ln IR_t$ | -6.642(0)*** | 2020M01 | *I*(1) |
| $\Delta \ln INF_t$ | -6.979(1)*** | 2019M08 | *I*(1) |

Note: *** shows the level of 1% significance.

**Table 4:** Appropriate lag length selection

| Latency length | *LR* | *FPE* | *AIC* | *SIC* | *HQ* |
|---|---|---|---|---|---|
| 1 | 272.463* | 9.20e-13* | -13.542 | -12.208* | -13.081* |
| 2 | 25.431 | 1.46e-12 | -13.173 | -10.729 | -12.329 |
| 3 | 35,105 | 1,24e-12 | -13.592 | -10.037 | -12.365 |
| 4 | 22.785 | 1.79e-12 | -13.791* | -9.125 | -12.180 |

Note: * indicates optimal lag.

US, European, and Asian traditional stock market indices by utilizing the kopula model approach from January 4, 1999 to July 22, 2013. Our finding is similar to the finding of Bahloul et al. (2017) for 20 developing and developed countries and of Rahman et al. (2021) for the world, developing world, developed world, Asia Pacific, the UK, and the US.

As shown in Table 7, the coefficient of the money supply is 0.549% and statistically, at a level of 1% significance The results indicate that a 1% increase in money supply increases Participation index performance by 0.549%, and expresses a positive relationship between money supply and Participation index performance. This finding is similar to the outcomes of Erdogan et al. (2019), who found that the money supply of Turkey in the short term positively affects the Islamic stock market index, and Majid and Yusof (2009), who conclude that the money supply of Malaysia after the 1997 financial crisis improved the return of the Islamic Stock Exchange. However, it is not similar to the result obtained by Wongbangpo and Sharma (2002) for Indonesia and the Philippines.

According to the ARDL model long-term estimate, the elasticity of the interest rate is -0.172% and statistically significant at 1%. A 1% increase in the interest rate reduces Participation index performance by 0.172%. In other words, there is a negative relationship between the interest rate and Participation performance. This finding from the study is in line with the result obtained by Hammoudeh et al. (2014), who found a negative correlation between global Islam and interest by using the kopula model approach based on daily data between January 4, 1999, and July 22, 2013. This finding also supports the conclusions revealed by Wongbangpo and Sharma (2002) for the Philippines, Singapore, and Thailand, by Albaity (2011) for Malaysia, by Habib, Moya-Martínez, et al. (2015) for Spain, and by Islam (2017) for Malaysia. However, the findings obtained by Rana and Akhter (2015) for Pakistan, Akhtar et al. (2017) for 11 countries, and Sakti and Harun (2013) for the Jakarta Islamic stock market index do not match this finding of the study.

At the same time, according to the long-term results, there is a statistically insignificant relationship between Participation index performance and inflation rate in a positive way. This study finding is similar to Naifar's (2016) study, in which the dynamics of the global Dow Jones Islamic stock market return are examined by utilizing the Quantile regression analysis with data between January 2003 and October 2014. However, Erdogan et al. (2019) do not argue that the Turkish inflation rate negatively affects the Islamic stock market index from 2011-2019.

Finally, Table 7 reports the results of diagnostic tests which are used to determine whether the model is appropriate and whether it presents strong and reliable findings. According to these results, it is stated that there are not any heteroscedasticity and autocorrelation problems in the model and the model shows the normal distribution and there are not any modelling errors.

Graph 2 illustrates the results of the CUSUM and CUSUM2 tests, and according to the results, the model is among the critical limit values at the level of 5% significance. This expresses that the long-term coefficient estimate for the model is stable.

In the last part of the empirical findings, the analysis results of the Toda-Yamamoto Granger causality test are evaluated and these results are summarized in Table 8. First, the optimal lag length is determined as one (1) by the SIC criteria through the VAR model, and the cointegration level of the variables is an $I(1)$. Then, optimal length and cointegration values are collected and then number two (2) is obtained, and accordingly, Wald statistics and Toda-Yamamoto Granger causality results are obtained. The results show a two-way causality linkage between the traditional stock market and Participation performance at the level of significance of 1%. This finding is similar to the finding of the Ajmi et al.'s (2014) study, in which a two-way causality link between the Down Jones Islamic stock market, the global Islamic stock exchange, and the traditional stock market indices of the US, Europe, and Asia are found by conducting a linear Granger causality test with the daily data of the period January 4, 1999-October 8, 2010.

According to causality results, a one-way causality is determined, running from money supply to Participation performance at the level of 5% significance. This result does not coincide with the conclusion of Wahyudi and Sani (2014), who examined the causal linkage between the Islamic financial market and macroeconomic series in Indonesia by using the Toda-Yamamoto method for the period of 2002-2011 to find that the money supply is not the cause of Islamic stock market return. In addition, the results in Table 8 point out a one-way linkage from the interest rate to Participation index performance at the level of 10% significance. This finding of the study does not coincide with the findings of Sakti and Harun (2013), who found that there is no causality link between the Jakarta Islamic stock market and the money supply during January 2000-December 2010.

Finally, it is determined in Table 8 that there is a two-way causality between the inflation rate and Participation index performance at the level of a significant 1%. This finding is not similar to the finding revealed by Wahyudi and Sani (2014) for Indonesia.

## 6. Conclusion and policy recommendations

In recent years, the world Islamic finance market has attracted international capital flows from both Muslims and non-Muslims, causing the Islamic market index to grow rapidly in national and international markets, and the performance determinants of the Islamic finance market are examined by several researchers. Thus, this study investigates the traditional stock market index and macroeconomic factors as determinants of Islamic stock market index performance in the Turkish economy from January 2018 to March 2021.

Empirical results show that under the breakdown using the ARDL boundary test and the Johansen cointegration technique, there is cointegration between the performance of the Participation index and independent variables. In addition, by applying the ARDL model forecaster, it is obtained that the traditional stock market index and the money supply positively affect the Participation index performance, while the interest rate has a negative effect. Finally, using the Toda-Yamamoto method during the January 2018-March 2021 period, it is concluded that there is a two-way causality between the participation performance and traditional stock market and inflation, and a one-way causality relationship running from money supply and interest rates to Participation index performance. Thus, it can be said that the traditional stock market index and macroeconomic variables affect the Participation index in the Turkish economy from January 2018 to March 2021. These study findings are supported by the results of Bahloul et al. (2017) for 20 developing countries who used the Markov transition regression and MS-VAR model and contributed to the literature.

The findings of our study provide valuable and important recommendations regarding Islamic market index performance for both investors and financial market regulators, portfolio managers, and policymakers. First, these study findings and other study findings (Jawadi et al., 2014; Majdoub et al., 2016; Bahloul et al., 2017; Hassan et al., 2021) show that the interoperability relationship between the Islamic finance market and the traditional market provides important information to investors and market regulators in both portfolio diversification and risk management, and these findings suggest that investors and market regulators control risk in the portfolio and strike a balance between earnings and risk by investing in Islamic funds. Second, the study findings could help portfolio managers combine assets with a strong immune structure, such as Islamic securities, and traditional securities to determine optimal portfolio weights and hedging ratios in different market segments. Therefore, for investors and market regulators in Turkey, the Islamic finance market is a haven

**Table 5:** ARDL Bound test

| Panel A: *F*- Bound test | | |
|---|---|---|
| Equation | *F(PIP/BIST,MS,IR,INF)* | |
| Optimal lag structure | [1,1,0,1,0] | |
| *F*-statistic | 3.638* | |
| Time to break | 2019M10 | |
| $ECT_{(t-1)}$ | -0.338*** | |
| Pesaran et al. (2001) critical values | | |
| Level of Significant | The lower limit, *I*(0) | The upper limit, *I*(1) |
| 1% | 3.74 | 5.06 |
| 5% | 2.86 | 4.01 |
| 10% | 2.45 | 3.52 |

Note: Optimal lag length is selected by SIC. *** and * indicates 1% and 10% significance.

**Table 6:** Johansen cointegration test

| Hypothesis | Trace statistic | Max-Eigenvalue Statistic |
|---|---|---|
| R=0 | 112.5932*** | 56.69856*** |
| R≤1 | 55.89462*** | 31.10682*** |
| R≤2 | 24.78781 | 13.99402 |
| R≤3 | 10.79378 | 10.46558 |
| R≤4 | 0.328202 | 0.328202 |

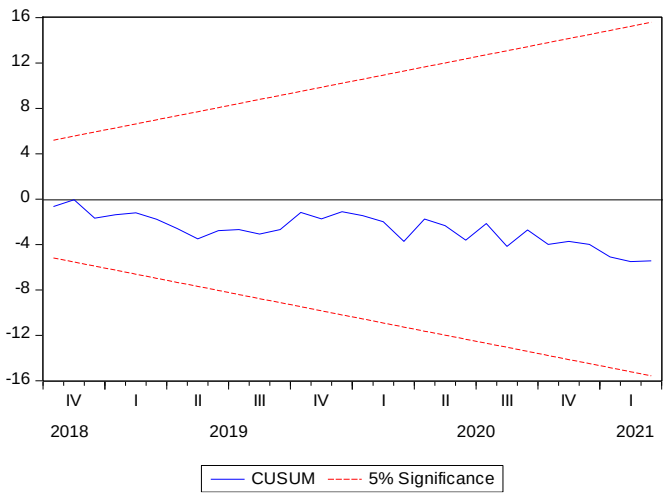
Note: *** indicates a 1% level of significance.

**Table 7:** ARDL long-term results

| Variables | Coefficient | *t-statistics* |
|---|---|---|
| Constant | -14.491 | -10.310*** |
| $lnBIST_t$ | 1.454 | 12.864*** |
| $lnMS_t$ | 0.549 | 7.609*** |
| $lnIR_t$ | -0.172 | - 2.843*** |
| $lnINF_t$ | 0.053 | 0.739 |
| Diagnostic Tests | | |
| $R^2$ | 0.994 | |
| Adj. $R^2$ | 0.992 | |
| F-statistics | 734.721*** | |
| Breusch-Godfrey LM test[a] | 2.012 (0.152) | |
| ARCH LM test[b] | 0.857 (0.360) | |
| J-B normality test[c] | 1.122 (0.570) | |
| Ramsey RESET[d] | 0.364 (0.550) | |

Note: an Autocorrelation, b heteroscedasticity, c the Jarque –Bera for normality test and d model specification. *** and ** show the significance at 1% and 5% level of significance, respectively.

**Graph 2:** CUSUM and $CUSUM^2$ Tests



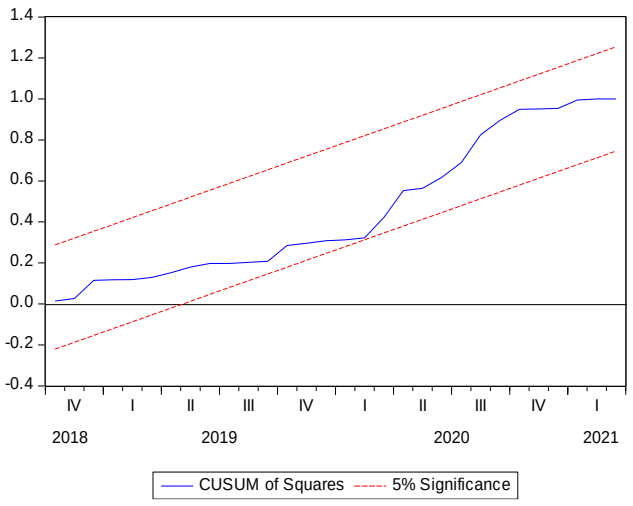



**Table 8:** Toda and Yamamoto causality test

| Hypotheses | Test Statistics | p-value |
|---|---|---|
| BIST is not the Granger cause of PIP. | 10.403 | 0.005*** |
| PIP is not the Granger cause of BIST. | 6.374 | 0.041*** |
| MS is not the Granger cause of PIP. | 8.355 | 0.015** |
| PIP is not the Granger cause of MS. | 0.656 | 0.720 |
| IR is not the Granger cause of PIP. | 5.593 | 0.061* |
| PIP is not the Granger cause of IR. | 3.126 | 0.209 |
| INF is not the Granger cause of PIP. | 13.987 | 0.000*** |
| PIP is not the Granger cause of INF. | 11.104 | 0.003*** |

Note: ***, ** and * show the level of significant of %1, 5% and 10%, respectively.

from many crises. Third, the study findings suggest that policymakers should support the Islamic finance market, especially in times of financial turbulence, and provide information on market policies and risk-distress and how important macroeconomic variables are in stabilizing Islamic financial markets. Fourth, since adverse shocks in interest rates negatively affect participation index performance in the long run, the findings suggest that a stable interest rate policy through intervention in interest rates will promote the trade balance and eventually the improvement of stock market index performance. On the other hand, this study and other studies can help policymakers publish a "safe havens guide for investors" that lists possible combinations of assets that can minimize the positive and negative impact of traditional stock market yield, money supply, interest rate, and inflation rate on portfolio returns. Finally, market regulators should revise the laws and regulations related to Islamic market instruments so that the Islamic market in Turkey can develop and become an international target.

Finally, there are some limitations to this study. First of all, the effect of other macroeconomic factors such as economic growth, VIX-index, treasury bond ratio, industrial production index, and exchange rate on Participation index performance is not mentioned in the study. In future studies, these macroeconomic variables may also be taken into account. Secondly, this study focuses on Turkey as a developing country, but in future studies, the determinants of Islamic capital market performance can be examined based on various developing or developed countries.

This study is applied the ARDL model estimators, but for the future studies, new ARDL methods such as bootstrap ARDL, dynamic ARDL should be used. On the other hand, as stated in Işık et al. (2020)'s study, in the future studies should be taken account the economic politic uncertainty index, as an additional independent variable besides the traditional variables related to the economic factors in the performance model. Finally, this study examines the determinants of Participation index performance based on a narrow period sample, but in future studies, the study can be improved by expanding the sample period.

***Ethics Statement:*** *In this study, no method requiring the permission of the "Ethics Committee" was used.*

***Author Contributions Statement***: *1st author's contribution rate is 50%, 2nd author's contribution rate is 50%.*

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# Sustainability as a communication policy created by the economic system

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**ABSTRACT**

Today's world, in which we need the effort to make it livable both in terms of material resources and spiritual satisfaction, has many other borders and layers, despite physical ones. One of these layers is understanding sustainability. In this study, the relationship between sustainability and communication has been examined. Sustainability and communication are broad topics. For this reason, the study has the characteristics of a literature review and a general evaluation. In this study, questions were asked about how these two main topics can be related since it is possible to examine sustainability in the context of communication, education, various fields of media, and even cinema. The question of how sustainability can be evaluated in parallel with brand and communication strategies is the base of the critical view on the subject. The sustainability studies of institutions and organizations, which are the cause of the main complaints about sustainability, have been the points that obscure the issue and lead to various inquiries. As a result, it is emphasized that sustainability has supra-disciplinary importance. According to the results of the study, sustainability is an issue that can be guided by communication processes and strategies and requires both individual efforts of consumers as well as public professionalism and cooperation.

## *I. Introduction*

In many movies about the future, we see an "unsustained" world depiction. Individuals who cannot meet their basic needs are unhappy, lonely, and have no belief or security and a system of economic, cultural, and social failure surrounds the dark atmosphere of the movies. When we return to the present day and from the fictional world to the real world, we observe that an intense effort is made in academia and in different sectors to define and achieve sustainability. We can assume that these efforts are well-intentioned as sustainability is based on the achievement of each person's sustainable state of well-being. However, this paper is not designed entirely from this point of view, as sustainability is not an independent and disconnected concept. Is sustainability a principle or a compulsory communication policy created by the economic system? Can we implement the strategies and messages contained in this communication policy, or are these policies sustainable? These questions will be the basic questions that this study will leave in the minds of the readers.

Sustainability has become a popular concept that has recently been emphasized and discussed in academic activities. It is also possible to evaluate the concept as a field of study or interest that can bring together many disciplines in a wide range, from environmental, climate, and nutrition problems to energy problems, from education to refugee and migration issues. Before mentioning the relationship between the concept of sustainability and communication, it is necessary to reveal the dynamics of the emergence of the concept.

Ulrick Beck introduced the concept of *risk society* in 1986 and focused on the possible environmental and climate crises that humanity will experience with industrialization and modernization and emphasized that people live with many risks today. According to Beck, with modernization, people started to encounter problems that they had not encountered before. The ecological and climatic risks that Beck but put forward that threaten our present and future have increased the importance of the concept of sustainability, especially in recent years.

In this context, the concept of risk society put forward by Beck emphasizing that humanity puts itself in danger also recalls the need for people to produce sustainable solutions. Accordingly, it is possible to ask the following basic questions: To whom does sustainability serve? What is the core of sustainability? In addition to all these, what is the place and importance of communication and media in the subject of sustainability, which is the subject of this article?

## 2. Literature review

Although it is one of the popular topics of the last century, it was possible to see the roots of the concept in the 18th century. Malthus (1798) touched upon the basic facts discussed within the term of sustainability in his study and focused on the link between rapid population growth and social problems (Barkemeyer et al., 2018). At the end of the 20th century, sustainability was discussed intensively. The main reason for this is that economic growth is interrupted, and awareness about ecological problems is formed (Wolff, 2020). It is possible to take sustainability studies in the academic field even further. In some studies, conducted in the 1960s, discussions on sustainability were started (Wolff, 2020; Roosa, 2008). The Green Revolution is one of the spectacular examples of the subject, which has been recognized as a good example of sustainability to save people's futures. The Green Revolution was a movement initiated by Norman Borlaug, especially between 1940 and 1970. It covers the studies aimed at improving agricultural activities such as irrigation and seeding, and accordingly, increasing the productivity of agricultural lands with hybrid seeds and artificial fertilizers, and millions of people have been

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spared from hunger and paved the way for long-term agricultural productivity (Borlaug, 2002).

The Green Revolution, which started to sprout in Mexico in the 1940s, was based on innovations in agricultural practices in the first place. The fact that it is possible to produce more food thanks to the innovations introduced has been seen as an important solution worldwide for the risks of famine, which started to be talked about after the 1960s. In this way, it has become possible to get rid of hunger in countries such as Mexico and India. Considered the creator of the Revolution, Dr. Borlaug was awarded the Nobel Prize in 1970.

Boschele (2020) presents a work that can carry forward the studies on communication and sustainability in Turkey by defining the concept with a broad as well as a critical perspective on the subject in her article "*Sustainability, Consumption, and Media*" and defines sustainability as one of the remedies for the ecological crisis and the key to a sustainable future. The author states that sustainability cannot be understood without examining the consumption society and the social role of consumption.

Green Movement and Green Operation are political formations that emerged especially in the 1980s and focused on environmental problems and have a democratic, participatory structure that emerged in the 1970s due to the development of states and the intensification of production activities. The centralization of the concept of sustainability is related to a report put forward by the Brundtland Commission called "*Our Common Future*" published in 1987 (Aydoğan Boschele, 2020:11; Bendor, 2018). *Our Common Future* is also referred to as the Brundtland Report**,** through Oxford University Press. The main purpose of this study was to provide international solidarity for sustainable development. It was ensured that the problems related to the environment and development around the world were dealt with as a single problem in an integrated manner. The Commission focused on three main tasks in the report: to develop innovative approaches to review and tackle environmental and development problems, to strengthen international cooperation, and to strengthen the linkage of structures such as governments, organizations, and institutes (WCED, 1987).

Today, the Brundtland Commission's work at that time is of great importance in the approach to the concept of sustainability. According to the definition of the commission, sustainability is meeting the development needs of the present without hindering the ability of future generations to meet their needs (Barkemeyer et al., 2017; WCED, 1987). In the following period, the concept of sustainability with its 21 different dimensions was discussed and defined at the United Nations World Conference on Environment and Development held in Rio de Janeiro such as neo-liberal policies, rapidly increasing consumption, and environmental destruction lead people toward an unlivable world (Kuşay, 2019). From this point of view, sustainability, which is being heard more frequently, especially after the 1980s, has become the policy of many institutions.

Shahzalal and Hassan (2019) state that communication tools should be accepted, and effective communication techniques should be used to ensure a meaningful and continuous change in attitudes and behaviors in society. With effective communication tools, people can access information simultaneously and exchange views and information as producers and practitioners. In this study, community radio (CR) is examined, which is a small-scale, local, community-run radio genre with a decisive actor who informs, guides, and motivates listeners on various topics. The study states that CR is a pioneering tool for localizing sustainability goals since communicative sustainability focuses on locality and encourages people to share the results of their ideas. The functions of CRs overlap with the sustainability communication perspective. In this context, it would be appropriate to include the purpose of the existence of CRs (https://amarceurope.eu/the-community-radio-charter-for-europe):

The functions of CRs overlap with the sustainability communication perspective. In this context, it would be appropriate to include the purposes of CRs (https://amarceurope.eu):

- Promoting the right to communicate, assisting the free flow of information and opinions, encouraging creative expression, and contributing to the democratic process and pluralistic society,
- Providing access to training, production, and distribution facilities; encouraging local creative talent and promotes local traditions; and preparing programs for the benefit, entertainment, education, and development of its listeners,
- Including representatives of geographically recognizable local communities or communities of common interest,
- Editorially independent from government, commercial and religious institutions, and political parties in determining program policies, (not a purpose, but a characteristic)
- Providing access to minority and marginalized groups and protect cultural and linguistic diversity,
- Based on information received from various sources, trying to keep its audiences informed honestly and provides the right to reply to any person or organization exposed to serious misrepresentation,
- Established as non-profit organizations that ensure their independence by being financed from various sources, (not a purpose, but a characteristic)
- Recognizing and respecting the contributions of volunteers, recognizes the right of wage workers to join trade unions, and providing satisfactory working conditions for both, (not a purpose, but more of a “code of conduct” or a “good practice”)
- Conducting management, programming, and employment practices that are against discrimination and that are open and accountable to all supporters, staff, and volunteers,
- Promoting exchange between community broadcasters who use communication to foster greater understanding to support peace, tolerance, democracy, and development.

In this respect, the study also includes studies stating that messages coming from sources that are significant and trusted by the user are accepted and that the needs and benefits of users (viewers, listeners, readers, etc.) are also determinative in this acceptance process (Happer & Philo, 2013). Ballestar et al. (2020), on the other hand, transferred the statements about sustainability to a semantic map in their work. Researchers compiled these statements from Twitter. One of the hypotheses of the study is that the concept is mostly used in social media with a positive meaning. In this context, users generate dialogue, seek information, and spread them on social networks, magnifying the impact of the message. As a result of the research, in which the word cloud, one of the most used words related to sustainability in social media, was created, it was revealed that the term sustainability is associated with environmental sustainability. In their study, Ilieva and McPhearson (2018) emphasize that there is a huge amount of valuable big data on social networks such as Twitter and Flickr for scientists who study human behavior in cities. Sustainability studies to be conducted with these data may offer opportunities such as improving human-environment relations, increasing the importance of public health, and contributing to social equality. Ibrahim et al. (2021) blended the issues of the pandemic, sustainability, media, and employee engagement in their research, including current themes. Calcagni et al. (2021) examined the issue in terms of the benefits of cultural ecosystems (CES). The equivalent of CES is Cultural Ecosystem Services. Human life depends on the environment to meet basic needs such as food, clean air, and water. People also take advantage of their environment to satisfy a wide variety of desires. However, human activities that utilize ecological resources to sustain life and maintain certain lifestyles have degraded the environmental resources on which they depend.

The concept of ecosystem services (ES), the benefits that people derive from the environment, first emerged in the 1970s to highlight a critical gap in policy and decision-making, an almost complete underappreciation of societal dependence on natural ecosystems (Hirons et al., 2016). Pinpointing exactly what counts as CES is not easy, at least as there is little consensus on what it means culturally. However, the purpose of distinguishing a culturally determined service category is to emphasize that it is the non-consumptive ecosystem outputs from ecosystems that are important to humans, mostly intangible outputs that affect people's physical and mental states.

The support and regulation of cultural ecosystem services (CES) have been neglected by researchers and policymakers. While valuing CES poses several conceptual and methodological challenges, the topic is of great interest and importance because of the links between decision-making, cultural values, valuation methods, and the individual and the collective that affect ecosystems and human well-being.

## 3. **Transformation of sustainability into a commodity**

The concept of sustainability and technology are so intertwined that sometimes when referring to sustainability, technology is directly referred to. The definition of the Oxford Dictionary provides a good perspective; according to the dictionary, sustainability is the continuous use of natural resources and energy in a way that does not harm nature ("Sustainability", 2021).

Although the concept of development has a positive meaning, rapid and unmeasured development is linked to consumption. From the 1970s to the present, establishing a balance between development and protecting the environment and ensuring sustainability is a vital goal for most the states. As a result, sustainability has become a global priority (Caradonna, 2014).

In addition to its many dimensions, sustainability points to a cycle between sustainable development and the requirements for environmental protection (Aydoğan Boschele, 2020). In other words, the concept includes taking the steps to protect our future in a way that does not hinder global progress. Although pointing to continuous improvement, there are many different opinions on it. Latouche (2004) discussed the relationship between development and sustainability in his article and defined sustainable development as an oxymoron. According to him, sustainable development has problems. For example, sustainable consumption will have more troubling and destructive consequences at some point. For this reason, sustainable development is positioned in contrast to the concept of modernization by many researchers and is directly related to limiting the return to traditional social structures and excessive consumption (Yanitsky, 2000).

Another point that needs to be emphasized is the relationship between technology and sustainability. Technological tools, which are developing and renewing day by day, allow more rapid production and consumption and cause more intensive use of energy. With this approach, sustainability is seen as one of the reasons for unlimited consumption. Martin Heidegger (1977) evaluates technology both as a danger due to its destructive effect and as an opportunity due to its potential to save energy in his work titled *The Question Concerning Technology* (Bendor, 2018). Accordingly, Bendor (2020) establishes a direct link between sustainability and technology.

One of the important conditions for ensuring sustainability is education. Societies must undergo certain training to protect the climate, nature, and our future. Education is one of the most powerful tools for changing the world and making it a better place. It is the enabler of economic growth, preservation of cultures, and collective orientations (Johnstone et al., 1998).

Many researchers have touched on the relationship between sustainability and education (Jain et al., 2013; Foster, 2002; Felgendreher, 2018; Aleksejeva, 2016). It is possible to read this in Althusser's (1971) and Antonio Gramsci's (1997) works. The basic approach is to harmonize children or young people with the system by receiving ("providing" or "through"?) education. The approaches that deal with the relationship between sustainability and education above tend to ignore this perspective in general. The Rio Summit, which was held in 1992 and considered an important event in the inclusion of sustainability in higher education, also focused on the changes that sustainability education can bring. The approach, initiated by the initiatives of the United Nations and aiming at sustainable development, was considered important for all parts of society, together with education and related awareness (Jain et al., 2013). In this respect, the approach of Huckle and Sterling (1996) is of great importance for sustainability as well as a better society and future. According to them, sustainability education helps societies gain a critical view of technologies, economic productions, cultural systems, and their reproduction. Today the human species use the world separately from other species and is superior to other living things. Although resources are considered free and unlimited, we can solve many of our problems with the help of technology. A large part of the information given to students mentions this fact (Cortese, 1999). Human-oriented solutions and approaches cause us to destroy nature, the climate, and the environment we live in. At this point, education is of great importance for sustainability. Especially in the United States, many universities have taken steps in this direction. For example, The Georgia Institute of Technology has identified three core missions of teaching, researching, and applying sustainable technology. Likewise, Tufts University added environmental literacy course to its curriculum for the first time in the USA (Cortese, 1998). In this direction, the university established an institute and provided environmental literacy education to students from all disciplines. This approach is of great importance because it is crucial to abandon the anthropocentric view that nature was created for human use and emphasis the fact that environmental or ecological literacy and critical literacy education constitute the most basic approaches for sustainable resources and a good future. The balance between human interest and nature interest should be planned very well, and nature must continue its existence with all its functions as well as the continuation of human activities. Otherwise, all sustainability approaches may be designed on the turning of economic or political wheels and may cause the current conditions to be planned to ensure the continuity of only a group of people. Like the examples above, many numerous universities in our country offer courses on sustainability. In 2019 Robert College established the Robert College Environmental Movement ("Robert College | Sustainability", 2021) to gather environmental activities under one roof and ensure stability. In addition, institutions such as the Turkish Quality Association provide sustainability training from many different approaches. Sustainability can be addressed in a broad sense, both in promotional and educational videos of non-governmental organizations, as well as in films and serials, and the education of individuals in schools can be made sustainable too. At this point, the constant emphasis on ecological problems and the human future in various media platforms will both support education in schools and, on the contrary, may reveal the necessity for more education. It is possible to take advantage of the possibilities of technology and the internet to a large extent.

Communication tools, which continue to develop in parallel with technology, have been considered within the scope of sustainability studies in recent years. Advertising, television broadcasting, cinema, media literacy, digital media literacy, public relations, and media mediated education have recently begun to be discussed under the concept of sustainability.

Görland and Kannengießer (2021) gathered the subject of sustainability in communication and media studies under four basic areas. These studies are primarily related to the inclusion of the concept of sustainability in media content. These contents are mainly related to ecological and climate issues defining questions about what the media can do and how to achieve sustainability. Similarly, there is a focus on climate and ecological problems in this study area. Another field of study is on how the content produced in the media is perceived, and the last field of study covers the studies on how different actors use the media to ensure sustainability (Görland & Kannengießer, 2021).

Especially in recent years, environmental initiatives compatible with nature in the context of sustainability can benefit from social media positively. Organizations have important advantages thanks to social media in terms of making themselves heard, raising awareness, gathering supporters, and spreading the work done. Social media platforms offer brands and entrepreneurs many opportunities, such as growth, the opportunity to respond quickly and effectively to customers, the ease of collecting feedback from customers, the possibility of the slightest event going viral with low budgets, and learning the opinions of customers on environmental investments (Williams et al., 2014). Thus, brands can meet the expectations of their customers and reach their contributions by addressing environmental problems and offering a sustainable life.

The media undertakes a task to announce and raise awareness rather than ensure sustainability. De Witt (2011) tried to determine the position of the media in the relationship between the media and sustainability by considering the functions of the media and emphasizing the concept of sustainable communication. According to De Witt, new media tools vastly expand people's lives and communication networks. People now have a medium where they can talk about ecological problems, exchange ideas and, most importantly, act, regardless of country borders. These opportunities pave the way for people to stay in communication about an ecological problem in a sustainable way without boundaries.

This contributes positively to people's motivation and awareness. In recent years, environmental communication specialists have carried out studies on raising awareness about environmental problems, providing information, establishing dialogue, and participating in activist movements, especially by using new media tools (Bendor, 2020). In particular, the expanded public space opportunities offered by social networks provide the chance to discuss and exchange ideas on issues such as the environment, migration, climate, and energy. These advantages allow discussions in terms of sustainability and the development of collective intelligence, which is a concept used by Pierre Levy in the context of digital media. According to Levy, not everyone can know everything, but thanks to digital networks, people can gain different skills and strengths by combining their expertise and knowledge. These networks bring people together and bring them different power and influence potential (Jenkins, 2016).

Bendor (2020) states that public spaces provided through social networks increase collectivity and indirectly motivation and nourish solidarity movements for permanent solutions. When digital media is considered in the context of sustainability, content producers, by using digital texts, visuals, and sounds, can place the concept of sustainability in the center of life by making it more vivid and dynamic and, most importantly, permanent in memories (Bendor, 2018). These opportunities, which have emerged in connection with technology, enable environmental groups to take an attitude against environmental problems and make their voices heard with the help of the media. In other words, people who are aware of the risk of developing various sensitivities and struggling for a more livable world.

However, examining the media in the context of its relationship with sustainability involves a very optimistic one-sidedness. A critical perspective can be put forward in the approach to the relationship between sustainability and media.

Today, many companies announce their sustainability campaigns using mass media and conduct public relations studies on how sensitive they are to environmental crises. However, these studies also constitute a good example of Latouche's definition of the oxymoron mentioned above. Today, the sustainability policies created by many companies aim to attract more attention. In other words, it is an implicit way of finding more consumers. At this point, the use of mass media is of vital importance for companies. Aydoğan Boschele (2020) also addresses this problem in her article. Companies that carry out public relations and advertising activities that give importance to ecological disorder or problems and struggle with it, reach new consumers with their advertising policies. In short, the aim is to touch new customers under the name of solutions to ecological problems. It is possible to consider this situation as the transformation of sustainability into a commodity. In this context, the media becomes an effective tool for acquiring new consumers. At that point, one of the approaches to be considered is to find an answer to the question of why companies prefer media for sustainability campaigns planned for social and ecological problems (Lodhia, 2018).

In the next section, it will be possible to see different approaches more clearly by referring to examples of communication strategies in the context of the relationship between sustainability and mass media.

## 4. Communication as an image-building tool for various industries

We can describe sustainability with various titles and various communication actions within the communication discipline. The most common of these is the structuring of sustainability communication of brands and the creation of sustainable communication strategies (UNEP, 2005). For instance, Futerra, which describes itself as a change agency, puts changing the world at the center of its goals. In their reports on sustainability communication, which are cited from many different sources, the basic emotion is to imagine a better world. To achieve these goals, well-known communication process principles come into play (Kayaalp & Toprak, 2017) which are:

- Determine target audience,
- Link the topic to other topics,
- The message must be personal and practical.

There are many campaigns in which we can exemplify these three items. Such as Good Heating Week in France, which promotes energy-saving products. Some other cases can be seen in Austria, where a responsible consumerism campaign targeting the home decor industry was prepared, or in New Zealand, increasing sales of ethical products and offering environmental health checks on a household basis was planned. A good example is the Eco-Media Forum in Poland, which enabled people to learn through activities, with events such as the Great Clean campaign, seminars, films, music (using tools made from recycled materials), fashion shows, and trade fairs (Kayaalp & Toprak, 2017). For sustainability communication finding a basis to help determine its place, relate to other discourses, and specify these goals is crucial (Akbayır, 2019). In this process, psychology is the first of the disciplines that help the concept, which has encountered many disciplines. The success and longevity of sustainability campaigns lie in an organization. We can see sustainability as defined, targeted, and included in practices within corporate communication strategies. Sustainability can be added to communication plans in many ways at this point which can be briefly shown in the following table:

Table 1: Sustainability activities in corporate communication

| Communication Activity | Target group |
|---|---|
| Communication strategy and message development | Internal and external |
| Stakeholder engagement | External |
| Competitor analysis | External |
| Campaign management | External |
| Quantification and consideration | Internal and external |
| Complete strategic marketing campaigns | External |
| thought leadership | Internal and external |
| Generating green and ethical messages in advertising and branding applications | External |
| Doing market research | External |
| Special campaigns for new media | External |
| media planning | External |
| Ensuring employee engagement | Internal |
| Printed, live, and online customized learning materials | Internal and external |
| Innovative and engaging communication tools | Internal and external |

Although the majority of society has a positive attitude towards sustainability ideas, most of these citizens and consumers exhibit limited structural behavior aimed at environmental sustainability (Moser & Dilling, 2007, cited in Langley & Broek, 2010). At the *Internet Policies and Policy Conference* held in Oxford in 2010, David Langley and Tijs van den Broek explained the barriers that prevent people from displaying their positive intentions for sustainability through behavior and touched on the role of social media in removing these barriers. According to them, there are two reasons for the inconsistency between people's attitudes and behaviors about sustainability. The first is the understanding of 'fatalism', in other words, the lack of belief in sustainability. The second is being 'busy' explained, as the majority who have a positive disposition about sustainability do not give themselves the time and energy to turn it into action (Langley and Broek, 2010). So, what is the role of social media, which we can describe as the most up-to-date form of communication channels, in removing these two obstacles?

Social media has the power to reach and influence large masses at the same time. The realization of these features and the increase in the number of users day by day has led to the use of social media by brands, political parties, or non-governmental organizations to gather members or customers. As an ideal, sustainability is one of the intellectual movements that can be disseminated through social media. In 2010, Greenpeace published a video on YouTube to draw attention to the palm oil used by Nestle during the production of KitKat. This video is presented in the form of a fake KitKat ad: A man, tired at work, takes a break and opens a KitKat package, indifferently picking up a piece of orangutan and biting it: people at work watch him with frightened eyes as blood pours from his mouth. Drawing attention to deforestation for the use of palm oil, this video demonstrated the power of social networks, and within a month, Nestlé agreed to use only environmentally friendly palm oil.

Besides this, participation in an online sustainability initiative can also be encouraged if current participants share their experiences with people in their social networks. In other words, it plays an important role in raising the awareness of other users and closing the gap between their sustainability intentions and behaviors by showing their knowledge of sustainability. Seeing behaviors and projects on sustainability by non-participant users encourages them and facilitates the conversion of intention into behavior. Another result of the study shows that initiatives that expect less behavior change have the most participants, and initiatives that expect the biggest behavior change attract the least number of participants. The less effort required of the behavior; the more people acquire that behavior. At this point, individual posts showing sustainable behaviors on social media play an important role in coding that behavior as easy or difficult in the human mind. For example, Hale Aucun Aydın, known as "turkisiminimalizm" on Instagram, started a movement called "*Kahve Termosta*" in 2019 to reduce the consumption of plastic and cardboard cups. Within the scope of this movement, sharing various content, it enabled both users to support this movement, and some companies started to offer discounts to customers who come with thermos from cafes such as Starbucks, Craft Kadıköy, and John's Coffee. The movement has become widespread as many users who drink their coffee with a thermos include it in their daily shares. In other words, social media is of great importance for users to acquire a behavior, join a new organization or support a movement.

## 5. The cultural cache associated with green products

When Philip Kotler's definition of "product" is examined, we can say that consumers look at everything as a product based on a rational or psychological reason. According to Kotler, a Sony CD player, a Ford Taurus, a trip to Costa Rica, a cafe mocha at Starbucks, your family doctor's recommendations; are all products. The concept of the product has a very wide content; it can be not only tangible things but also objects, services, events, people, places, organizations, ideas, or a combination of these can be products (Kotler and Armstrong, 1996). A product is handled at three main levels (Tek, 1999). The core product, tangible product, extended product. The essence product, as one Revlon executive said, "We make cosmetics in the factory, we sell hope in the market." which means the tangible product is the material structure and appearance in which the core products are clad. The extended product is the sum of the additional benefits and services offered by the tangible product (Ertike, 2019). The intensity of the efforts of manufacturers to transform all kinds of tangible and intangible assets into salable products is striking. Today, consumption is encouraged, presented as attractive, and various opportunities are offered to the target audience —credit cards, installments, discounts, promotions, etc. In this period, which Marx called the "age of decay" and in which even abstract concepts such as love, affection, goodness, and friendship have become commodities, many commercials offer viewing pleasure to the viewers and, repeatedly, with the cinematic techniques used in the production of commercials. In other words, the nature of advertising is to try to position the audience

as a consumer. However, advertisements do not only offer the product they show, but they also establish a connection with the target audience on different issues by including cultural, political, economic, or technological phenomena. One of these topics is sustainability, which is meeting our own needs without compromising the ability of future generations to meet their own needs (Oxford: Oxford University Press, 1987), http://www.un-documents.net/wced-ocf.htm, Accessed 04.10 .2021).

So, while the nature of advertising convinces the audience to consume, how sustainability is positioned in advertising? Although the inclusion of sustainability in various media tools such as television, cinema, and social media at first glance seems to aim to raise people's awareness on this issue, Craig (2019) claims that advertising is the opposite of sustainability and explains this contrast as follows: Advertising promotes consumption and economic growth, but environmental sustainability is based on challenging the basic need for less consumption and the principles of the consumer society. In this sense, advertising is the opposite of sustainability (Craig, 2019).

Advertisements on sustainable products appear as "green advertisements" in the literature. While positioning citizens as consumers, green advertising raises issues of public interest and, at the same time, places special cultural value on the policies of sustainable or ethical forms of consumption (Craig, 2019). These ads, which seem to have an innocent purpose offer their viewers a lifestyle that they can only have by purchasing these products. Consumption of green products can also be a strategy of discrimination and a way of easing the guilt that privileged consumers feel about their consumption action while marginalizing less privileged consumers at the same time; thus, the cultural cache associated with green products is certainly a value recognized and abused by advertisers (Craig, 2019).

## 6. Conclusion

Sustainability can be defined as a state of well-being which has a very broad meaning but is also a good explanation because sustainability is not just about the material resources that society has. As U. Beck (1986) stated, sustainability, which is proposed as a solution to escape from many vital problems introduced by modernization, has been conceptualized since the 18th century. Different communication tools and techniques are used to implement the concept. Namely, the discipline of communication can play a role in sustainability in different ways. Mass media plays a role in delivering sustainability-themed messages to large masses and can support the design and sharing so that these messages can be effective. In addition to communication tools, communication strategies, along with sustainability, appear in many different sectors. So, the relationship between sustainability and communication can be associated with using tools and developing strategies.

When research on the subject is reviewed, it is seen that environmental sustainability is more prominent in the eyes of the public. As human life is fundamentally dependent on food, air, water, and the environment, healthily and adequately supplied sources have physical and mental effects on society. From this point, the situation of a person who is dependent on ecological resources but established a system to destroy them corresponds to a great dilemma.

In this case, the first romantic answer that comes to mind in response to the question of what can be done is education, but does the education system provide students with the ability to question, ask, learn, and criticize, that is necessary to design a sustainable world? Or does it raise individuals who think and act uniformly, do not question the system they live in, and sacrifice their originality and freedom to adapt to it, functioning like an ideological device (Althusser, 1971; Gramsci, 1997)? Is it possible for the education system to raise individuals who know their place in nature and respect different species and the right to life?

Besides, the media can also be questioned from a similar dual perspective: do the media instill awareness of sustainability, or do it simply serve as a confessional and image-building tool for various industries?

This study made some clear definitions and presented various keywords, thus trying to guide those who are interested in the subject. In addition, by asking some questions and emphasizing various dilemmas, we tried to show how sustainability can be read in different ways within the framework of the communication discipline.

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# Realizing food security through the development of urban farming to support the family economy during the Covid-19 pandemic

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**ABSTRACT**

Food is a basic need for humans. Since March 2020, Covid-19 has been detected in Indonesia, which is feared to have an impact on food availability. Banten is a province that is included in Priority Category 3 in handling food insecurity. Cilegon is one of the cities in the Banten Province that is experiencing shrinkage of agricultural land. The purpose of this research is to formulate an urban farming development strategy in Cilegon. The method used in this research is the survey method. This type of research is descriptive, namely research that interprets the factors with the SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis method to produce strategies that can support the development of urban farming. The number of samples is 22 residents who carry out urban farming in Ramanuju Baru, Cilegon. The results showed that the internal factor that became the strength was the residents having high motivation and initiative in carrying out urban farming, while the internal factor that became the weakness was the limited knowledge of the residents in developing urban farming from an economic perspective. The results of research from external factors that become opportunities are Cilegon Government Policies in realizing food security, while the threats are pests and diseases in urban farming plants that need to be controlled naturally. Based on the analysis of internal and external factors using the SWOT matrix, the strategy to develop urban farming in Cilegon is to collaborate with the government and urban farming experts to provide consistent assistance to make urban farming activities in Cilegon economically valuable. To realize food security in Cilegon, collaboration is needed in aiding the community to manage urban farming professionally, so that it can provide economic value for the community.

## *I. Introduction*

The Food and Agriculture Organization (FAO) states that food security is realized if all people have equal access to high-quality food, to be active and healthy (Zhu, 2016). According to Law 18 of 2012 concerning Food, the State is tasked with realizing food availability, food access, and food stability (Hadi et al., 2020). Food security can be interpreted by not only the availability of food but also the quality of the food so that people can carry out activities actively and live healthy lives.

Economic growth in the community can affect food needs (Rusdiana & Maesya, 2017). At the beginning of 2020, the world was hit by a novel coronavirus called Covid-19 and the majority of countries in the world imposed a lockdown (Inegbedion, 2020). The lockdown has an impact on the limitations of various community activities, including economic activities. The stability of food security for certain regions is also hampered. According to the research of Meuwissen et al., (2021) the impact of Covid-19 on the agricultural sector is that it hampers agricultural production and also the distribution of agricultural products. In a study by Kumar et al., (2021) the authors reached the conclusion that the closures carried out in India caused insufficient food to supply, so food prices rose, which affected the economy of urban residents and the poor. In China the negative impact is felt on agricultural exports for food due to disruptions in the supply chain (Cao et al., 2021). This has an impact on economic stability in China.

This is in line with the research of Stephens et al., (2022) which shows that the Covid-19 pandemic has an impact on the agricultural sector. The first aspect of the agricultural sector that has been affected by the pandemic is the availability of household food for both urban and rural residents, the second is chronic food-related diseases such as diabetes, hypertension, and obesity whose conditions can be fatal if exposed to Covid-19 (Lopez-Ridaura et al., 2021). However, in Turkey, the occurrence of Covid-19 did not have a significant impact on the level of food consumption, except for bread, and increased consumption of multivitamin (Başaran & Pekmezci, 2021). This contrasts with what happened in China and India.

The Food Security and Vulnerability Atlas (FSVA) of Banten Province is in a condition of food security (Priority 5), but when viewed from each indicator there are some areas or households that are still vulnerable. The order of the nine most vulnerable indicators in Banten Province is the percentage of stunting under five, the percentage of under-five malnutrition, the average length of schooling for girls over 15 years, the percentage of households without nutrition access to clean water, the proportion of expenditure on food to total expenditure, life expectancy, the percentage of households without access to electricity, the percentage of the population below the poverty line, and the best indicator is the ratio of population per health worker (Budiawati & Natawidjaja, 2020). In 2016, agricultural land in Cilegon shrank from 2500 hectares to 1600 hectares (Efendi, 2016).

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The mandate of the Cilegon Regional Regulation Number 2 of 2017 concerning Food Administration, contains the government's goal to protect the community from food insecurity. On the Based regulation, the government conducts urban farming counseling and training for residents of Cilegon, including one resident of Ramanuju Baru, Citangkil, Cilegon. However, out of 67 households, only 22 households carry out urban farming on a small scale (private consumption). Economically, urban farming which is managed in a modern way using technology applications can povide additional income because it produces quality plant products and has a specific market (Sedana, 2020).

Figure 1. Urban Farming in Ramanuju Baru

## 2. Literature Review

According to Pinstrup & Andersen, national food security is self-reliance in food provision (Devi, Andari, & Wihastuti, 2020). According to the Life Science Research Organization (LSRO), food security is the availability of access to food that at least includes a) the availability of safe and adequate food nutrients, and b) the guaranteed ability to get food (Devi et al., 2020). Urban farming management has various benefits for the community as well as the environment. Some of the benefits of urban farming include economic benefits, health, and environmental benefits (Sedana, 2020). The urban farming program is one of the programs of the Department of Agriculture and Food Security that aims to help the poor in meeting the consumption of nutritious food funds to reduce family expenditure (Junainah, Kanto, & Soenyono, 2016). Urban farming is done by utilizing limited land in urban areas for agricultural activities (Khasanah, 2021).

The use of space or limited land with various urban farming models has been successful in the contribution of family food (Fauzi, Ichniarsyah, & Agustin, 2016). In Makassar, developing urban farming can support the economy in a sustainable manner (Abdullah, DirawKirwanertiwl, 2017). Economically, urban farming, which is managed in a modern way using technology applications, can provide additional income because it produces quality crop products and has a specific market (Sedana, 2020). Sumardjo et al., (2020) research suggests that families that can adjust the market needs to organic urban farming products, by creating innovative products, can increase productivity and develop their businesses.

In research Alynda & Kusuby mo, (2021) women have a high initiative in urban farming to increase agricultural yields within limited land. In Salampua, urban farming is one of the efforts to increase regional income. The results of the study Khasanah, (2021) of strategies to develop urban farming in Salampua include

- Making an appropriate urban farming concept.
- Creating policies governing urban farming.
- The government provides education about urban farming.
- Supporting facilities to carry out urban farming.
- Choosing the right type of seed.
- Taking good care of the trees that have been planted.
- The government also helping market produced by the urban farming process.
- The private sector providing CSR funds for the implementation of urban farming.

## 3. Methodology

The method used in this study is the survey method. With descriptive research, it is research that interprets strategies used in efforts to realize urban farming to improve the family economy. These factors are studied by SWOT (strengths, weaknesses, opportunities, and threats) analysis methods to produce strategies that can support the family economy through urban farming, especially in the era of the Covid-19 pandemic. This research is funded by the Faculty of Economics, University of Sultan Ageng Tirtayasa. The field survey was carried out in May-June 2022. This research was conducted through interviews, where groups of respondents were interviewed separately about the strengths, weaknesses, opportunities, and perceived threats during urban farming in Ramanuju Village. The population in this study is the residents of Ramanuju Baru, Cilegon as many as 22 families, so all were taken as respondents by census means. 22 representatives of each family are taken based on the number of residents who are actively carrying out urban farming in Ramanuju since 2019. Interview questions are as follows:

- What kind of urban farming concept was developed by the people of Ramanuju?
- What facilities do the community have, at their own expense or with assistance from other parties?
- What kind of help is provided?
- Who is the community supporter in urban farming?
- What kind of support is provided?

SWOT analysis examines an internal and external factors separately, then the next stage of pairwise analysis to produce the strategy. The analysis begins with internal factor analysis summary (IFAS) and external factor analysis summary (EFAS). The next stage is to draw up a table or matrix of IFAS and EFAS to formulate what strategy is most appropriately used. According to Solihin, SWOT analysis is often used in conducting situational analysis in formulating strategies (Yurianto, 2020). The use of SWOT analysis, including analyzing the internal and external conditions of a business, also finding out the ability of a business in running a business faced with competitors (Luthfiyah, Djamhur, Melinda, Rashid, & Putri, 2021).

## 4. Result and Discussion

Identification of internal factors is done to find out the strengths and weaknesses that are owned. The results of these identifications are:

4.1. Strengths

- 22 families in Ramanuju Baru have carried out urban farming to meet their household needs.
- The Cilegon Government routinely provides counseling on urban farming in Ramanuju Baru.
- Used goods are utilized in carrying out urban farming.
- Seed assistance from both the government and the private sector with its CSR program is provided.
- The residents are in collaboration with several universities including Sultan Ageng Tirtayasa University and Bogor Agricultural Institute in Community Service Program.

4.2. Weaknesses

- There are still about 60% of all Ramanuju residents have not carried out urban farming.
- Urban farming has not been developed as a profitable business

4.3. Opportunities

- Increasingly narrow agricultural land in the Cilegon makes the government focus on urban farming programs to realize food security.
- There is still an opportunity to work with parties who have concerns about food and the environment to collaborate in developing urban farming to a larger scale.
- The society is encouraged to optimize their yards by planting food crops following the policy of the Minister of Agriculture in the face of the Covid-19 pandemic.
- Urban population in Indonesia increases every year. About 55.8% of Indonesia's population was urban in 2019.

4.4. Threats

- The Covid-19 pandemic made the economy and food conditions uncertain due to social restrictions in daily mobility.
- Rapid technological advances discourage young people from being interested in agriculture.

Strategy Formula

A. Input the factor

The first step is to input the factors in the IFAS and EFAS tables. The IFAS matrix is based on internal factors consisting of strengths and weaknesses. The identification was through questionnaires filled out by 22 respondents. The 22 respondents were families who did urban farming in Ramanuju Baru.

After identifying internal factors, the rating is then carried out, and continued with the weighing of each factor by the paired comparison method. Ratings and weights on each factor produce a score that indicates the level of strength and weakness of the internal factors.

Based on the results of Table 1 calculation, the community routinely following counseling on urban farming carried out by the Cilegon City Government is the main factor with the highest score of 0.728. This shows that these factors have a major contribution in realizing food security to improve the economy. While the factor with the main disadvantage is urban farming which is only limited to household needs, it has not been developed larger, with a score of 0.45. Overall, the total internal factor score was 2.76. The score for internal factors was above average at 2.5. This shows that Ramanuju is internally ready in realizing food security to improve the family economy.

Based on the results of table 2 calculations, the increasingly narrow agricultural land in the city of Cilegon making the government focus on urban farming programs to realize food security is the main factor with the highest score of 0.8. While the factor with the main weakness is the Covid-19 pandemic makes the economy and food conditions uncertain due to social restrictions in daily mobility, with a score of 0.8. The overall number of internal factor scores was 3.27. The score for internal factors was above average at 2.5. This shows that Ramanuju has been able to respond well to opportunities, and threats, in order to realize food security to improve the family economy.

B. Matching Steps

Next is the matching steps. The matching steps has the function of blending the strengths and weaknesses of the internal environment with external opportunities and threats, using the SWOT matrix.

Table 1 Matrix Internal Factor Analysis Summary (IFAS)

| Internal Factor | | | | |
|---|---|---|---|---|
| | Strengths | Weight | Rating | Weight x Rating |
| 1 | 22 families Ramanuju Baru has carried out urban farming to meet their household needs. | 0,152 | 3 | 0,456 |
| 2 | The Cilegon Government routinely provides counseling on urban farming in Ramanuju Baru. | 0,182 | 4 | 0,728 |
| 3 | Utilizing used goods in carrying out urban farming. | 0,156 | 2 | 0,312 |
| 4 | The existence of seed assistance from both the government and the private sector with its CSR program. | 0,13 | 3 | 0,39 |
| 5 | The farmers are in collaboration with several universities including Sultan Ageng Tirtayasa University and Bogor Agricultural Institute in Community Service Program. | 0,12 | 2 | 0,24 |
| Amount | | 0,74 | | 2,126 |
| | Weakness | | | |
| 1 | There are still about 42 families who have not been moved to carry out urban farming. | 0,11 | 2 | 0,22 |
| 2 | Urban farming, which is done only on a small scale for household purposes, has not been developed larger. | 0,15 | 3 | 0,45 |
| Amount | | 0,26 | | 0,67 |
| TOTAL | | 1 | | 2,76 |

Source: primer data

Table 2 Matrix ExtTable Factor Analysis Summary (EFAS)

| Faktor Eksternal | | | |
|---|---|---|---|
| Opportunity | Bobot | Rating | Bobot x Rating |
| 1 Increasingly narrow agricultural land in the Cilegon makes the government focus on urban farming programs to realize food security. | 0,2 | 4 | 0,8 |
| 2 There is still an opportunity to work with parties who have concerns about food and the environment to collaborate in developing urban farming to a larger scale. | 0,15 | 3 | 0,45 |
| 3 The policy of the Minister of Agriculture in dealing with the covid-19 pandemic by directing for the optimization of yard land by planting food crops. | 0,17 | 3 | 0,51 |
| 4 Urban population in Indonesia increases every year. About 55.8% of Indonesia's population was urban in 2019. | 0,13 | 2 | 0,26 |
| Amount | 0,65 | | 2,02 |
| Threats | | | |
| 1 The Covid-19 pandemic made the economy and food conditions uncertain due to social restrictions in daily mobility. | 0,2 | 4 | 0,8 |
| 2 Rapid technological advances discourage young people from being interested in agriculture. | 0,15 | 3 | 0,45 |
| Amount | 0,35 | 7 | 1,25 |
| TOTAL | 1 | 19 | 3,27 |

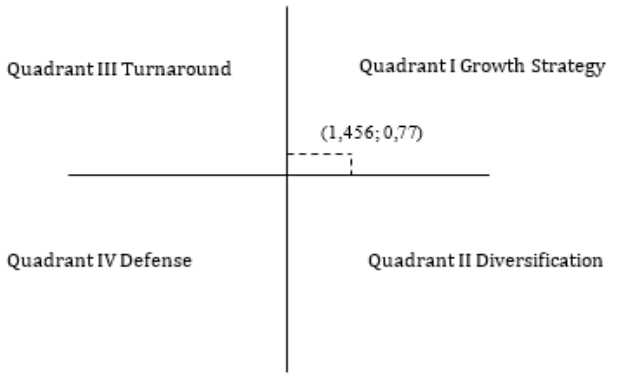
Source: primer data

Table 3. The SWOT matrix

| IFAS / EFAS | Strength<br>**a)** 22 families Ramanuju Baru has carried out urban farming to meet their household needs.<br>**b)** The Cilegon Government routinely provides counseling on urban farming in Ramanuju Baru<br>**c)** Utilizing used goods in carrying out urban farming.<br>**d)** The existence of seed assistance from both the government and the private sector with its CSR program.<br>**e)** In collaboration with several universities including Sultan Ageng Tirtayasa University and Bogor Agricultural Institute in Community Service Program. | Weakness<br>**a)** There are still about 42 families who have not been moved to carry out urban farming.<br>**b)** Urban farming, which is done only on a small scale for household purposes, has not been developed larger. |
|---|---|---|
| | S-O | W-O |
| Opportunity<br>**a)** Increasingly narrow agricultural land in the Cilegon makes the government focus on urban farming programs to realize food security.<br>**b)** There is still an opportunity to work with parties who have concerns about food and the environment to collaborate in developing urban farming to a larger scale.<br>**c)** The policy of the Minister of Agriculture in dealing with the Covid-19 pandemic by directing for the optimization of yard land by planting food crops.<br>d) The number of urban population in Indonesia increases every year, in 2019 it was recorded that about 55.8% of Indonesia's population is urban. | The government collaborates with various parties such as universities, private, central government, and the community to increase the production of urban farming products to a larger scale. | Motivate the community through counseling and mentoring to educate higher economic benefits for the community if it increases urban farming production to a larger scale. |
| | S-T | W-T |
| Threat<br>**a)** The Covid-19 pandemic made the economy and food conditions uncertain due to social restrictions in daily mobility.<br>b) Rapid technological advances discourage young people from being interested in agriculture. | Include young people in urban farming held by the government. | Educating young people on higher economic benefits to society if they increase urban farming production to a larger scale. |

C. Decision-Making action and calculation results of the IFAS and EFAS tables obtained the number of IFAS scores of 2.76 with a strength of 2,126 and weaknesses of 0.67 by a margin of 1.456. While the EFAS score is 3.27 with a chance of 2.02 and the threat of 1.25 the difference is 0.77. Based on the results of IFAS and EFAS analysis, the current urban farming situation can be described as follows:

Figure 3. SWOT Diagram




As seen in the SWOT diagram, the condition of food security in Ramanuju Baru, Cilegon is in quadrant I. This means that the strategy taken is a growth strategy, which maximizes the power to capture opportunities. This strategy supports at aggressive stages to continue to develop all the factors that must capture the opportunities that exist. So, the right strategy is to develop consistent urban farming by collaborating with various parties such as universities, private, central government, and the community to increase the production of urban farming products to a larger scale.

In a previous study conducted by Maharisi et al., (2014)in urban communities in South Tangerang carried out an aggressive strategy to increase the intensity of the implementation of programs and activities as an effort to increase agricultural production. In line with the results of this research, this research also produces an aggressive strategy that needs to be implemented in Cilegon, in an effort to increase urban agricultural output. This is also supported by the results of research by Tittonell et al., (2021) where during times of crisis such as the Covid-19 pandemic, direct adaptation is needed in maintaining local food security, by implementing aggressive strategies including:

- Selling food directly from producer to consumer,
- Cutting the food supply value chain so that it is shorter with the support of local and central governments,
- Support and training programs for sustainable food production for self-consumption or local, rural, urban or suburban trade,
- Food aid and aid initiatives that focus on populations vulnerable to food shortages.

In line with research Pieter et al., (2022), as a strategy for survival, farmers cultivate agroforestry crops, both for their own consumption and for sale.

Rahmadiyanti, (2021) in his research stated that in maintaining food availability during the Covid-19 pandemic, the strategies used were increasing production capacity, facilitating the development of farmers' expertise, and increasing the spirit of entrepreneurship in the agribusiness sector. Likewise the research (Adhila Amalia et al., 2022; Rahayu et al., 2021) reveal that strategies used by farmers during the Covid-19 pandemic are intensive and integrative strategies, which include maintaining product quality and sustainability.

## 5. Conclusion and recommendations

Realizing food security to improve the family economy with urban farming, especially in Ramanuju Baru, Cilegon can be achieved using growth strategy. The strategy is to develop consistent urban farming by collaborating with various parties such as universities, private sector, central government, and also the community to increase the production of urban farming products to a larger scale. The activities that can be carried out in this collaboration include:

- The government and the university sharing knowledge with the community regarding the economic impact of increasing agricultural output through urban farming, especially during the Covid-19 pandemic.
- The government providing assistance in the form of seed supply.
- The private sector through CSR programs in collaboration with universities providing guidance in the management of urban farming.
- Making plans to further commercialize the results of urban farming.
- The university providing assistance to increase agricultural yields in urban farming through service programs.

Further research should be conducted in a wider radius and supplemented with quantitative data. There needs to be data on plant types developed urban farming by the community, and the average amount of production in a simple table. So, a more in-depth research can be carried out on the amount of production that needs to be increased, so that the welfare of the community is raised through urban farming.

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