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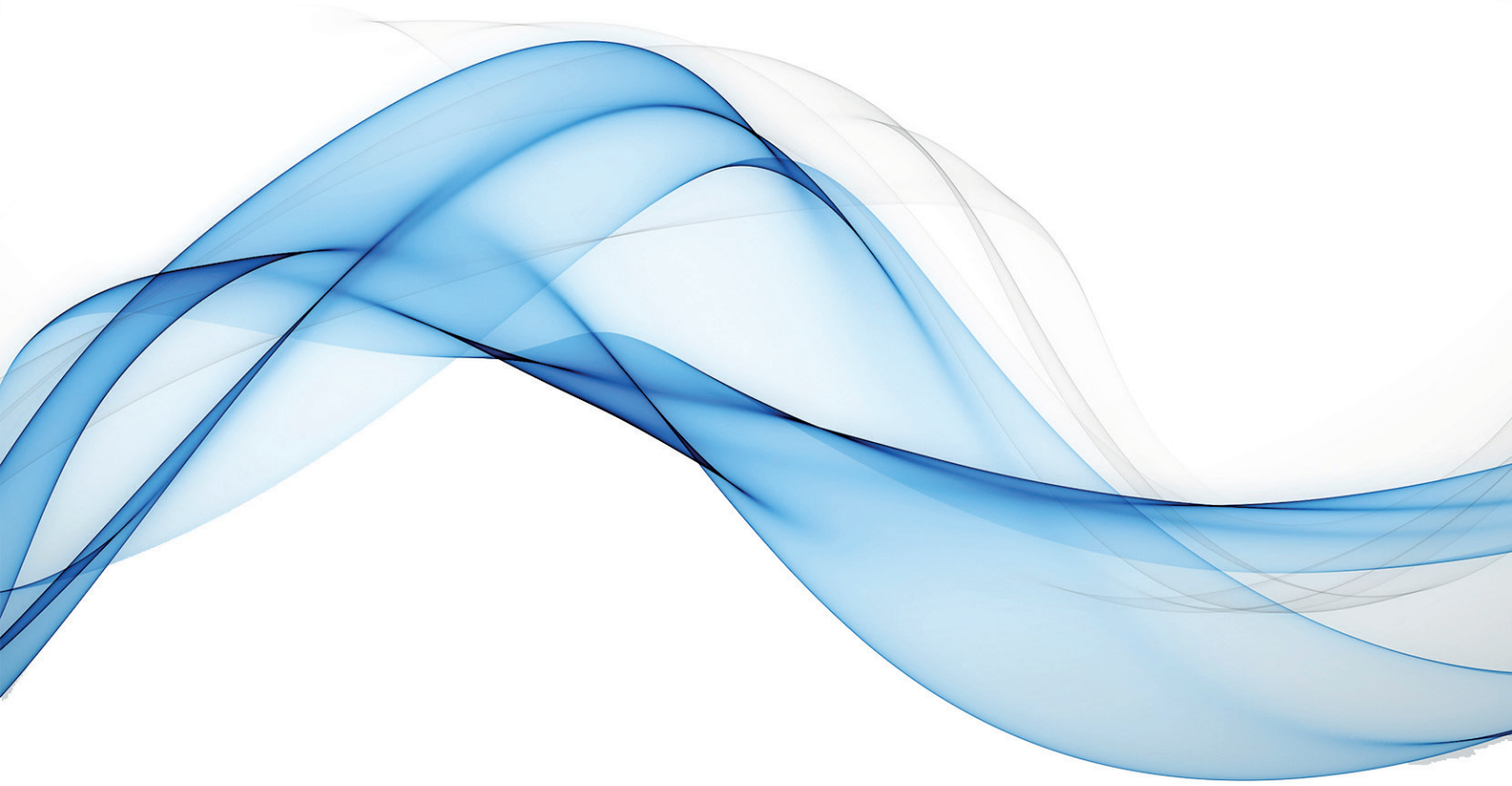

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RESEARCH ARTICLE

The impact of IFRS 16 on earnings management: Evidence from Borsa Istanbul*

Göksal Selahatdin Kelten[1] **Ali Atilla Perek**[2]

[1] Pamukkale University, Department of Business Administration, Türkiye, e-mail: gkelten@pau.edu.tr

[2] Marmara University, Department of Business Administration, Türkiye, e-mail: atillaperek@marmara.edu.tr

Abstract

This study explores the relationship between earnings management (EM) and the implementation of IFRS 16 - Leases in Borsa Istanbul. Using panel and panel quantile regression analyses, the study examines how IFRS 16, and closely related items (Size, ROA, Leverage, and CFO) effect EM. The analysis includes the annual data of 218 companies traded continuously on Borsa Istanbul in 2014–2021 and uses the Kasznik (1999) model to calculate discretionary accruals. According to the panel regression result, no significant link is observed between IFRS 16 and EM, while quantile regression reveals that IFRS 16 reduces EM in firms implementing small-scale EM applications but increases it in large-scale ones. These findings provide insights for investors, policymakers, regulators, and other market participants, highlighting the complex interplay between accounting standards and managerial discretion in financial reporting at Borsa Istanbul.

Keywords: Earnings Management, Discretionary Accruals, Panel Quantile Regression, IFRS 16 Leases, Borsa Istanbul, Kasznik Model

Jel Codes: M41, C58

* This study is generated from the PhD. thesis entitled "The impact of IFRS 16 on earnings management" prepared by Göksal Selahatdin KELTEN, a student at Marmara University Institute of Social Sciences Accounting and Finance Doctoral Program under the supervision of Assoc. Prof. Dr. Ali Atilla PEREK."

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Corresponding Author:
Göksal Selahatdin Kelten
E-mail: gkelten@pau.edu.tr

1. INTRODUCTION

Agency theory suggests that accounting plays a key role in mitigating the conflicts of interest inherent in the principal-agent relationship between managers and shareholders (DeAngelo, 1986: 400). Financial reporting and disclosure serve as tools to mitigate information asymmetries between managers and counterparties (Ball, 2001: 127). Thereby necessitating the provision of fair and accurate information. However, financial statements may deviate from this purpose through various means, with EM featuring prominently in the literature as one such method.

According to Needles Jr. et al. (2018), EM is the term used to describe an artificial increase or decrease in revenue, profit, or earnings per share, and representing a strategic tool that managers can utilize for their benefit. It can be used as a means for opportunistic aims, such as increasing managers' performance-based compensation, instead of conveying information to which only the firm has access (Barth, 2018: 10).

Various methods are employed to manage earnings, encompassing adjustments to the company's activity level, timing of activities and disclosures, and selection of accounting methodologies for reporting performance (Makar et al., 1996: 34). Fischer and Rosenzweig (1995) generalize EM into two types: those involving changes in accounting methods and those related to operating decisions. Furthermore, Kothari et al. (2016) categorize EM into accruals management and real activity management.

One of the most current developments in the field of accounting is related to leasing transactions. Keeping operating leases off the balance sheet has been a matter of debate, and the issue of accounting for all leasing transactions has been the subject of many studies in the literature since the 1980s (Öztürk, 2016: 6). That's why Financial Accounting Standards Board (FASB) and International Accounting Standards Board (IASB) carried out a joint project to improve the accounting for leases (IFRS Foundation, 2016: 3). The IASB released IFRS 16 as a result of this project, and operating leases are rearranged with IFRS 16, and it is decided to report them on the balance sheet. The intention to provide the most accurate representation of the leased property is the driving force behind IFRS 16 (Liviu-Alexandru, 2018: 510).

On the other hand, De George et al. (2016), state that enhancing reporting quality is one of the primary goals of adopting International Financial Reporting Standards (IFRS). The IFRS Foundation (2024) also asserts that IFRS increases transparency and empowers market participants to make well-informed financial decisions by improving international comparability and financial information quality. In this context, this paper aims to investigate the impact of IFRS 16 on EM. To evaluate the impact of IFRS 16 on improving financial information quality, this study utilizes Kasznik's (1999) accrual-based earnings management (EM) model to scrutinize the relationship between EM and IFRS 16. The impact of IFRS 16 on EM at Borsa Istanbul is analyzed with the balance sheet and income statement data covering 2014-2021 to reveal whether it reduces the management's discretion.

In the following section, a review of the literature on the relationship between IFRS and EM is presented. In the third section there is a theoretical background and hypotheses development. The fourth section is devoted to the data and to the methodology. The fifth section provides findings. Lastly, there is a discussion and conclusion in the sixth section.

2. LITERATURE REVIEW

In order to shed light on EM, many studies have been carried out since the early 1970s. It has been discussed by researchers from different perspectives. One of these perspectives is the interpretation of EM by considering the accounting system used by enterprises. Researchers focus on whether principle-based accounting system and rule-based accounting system have different effects on EM. From this perspective, one of the most frequently used variables in the studies is the use of principle-based IFRS. In particular, the effect of the transition from rule-based local generally accepted accounting principles (GAAP) to IFRS is investigated. In addition, the impact of the changes made in IFRS on EM is among the topics covered. However, since the update in IFRS 16 is relatively new, the studies addressing its effect on EM are scarce. Therefore, it is thought that this study will contribute to filling the gap in the literature.

DeAngelo (1986) posits that managers are incentivized to employ income-reducing tactics through accrual-based EM due to its relatively lower possibility of being discovered by external parties. In contrast, Kothari et al. (2016) argue that real-based EM is comparatively more difficult to detect than accrual management. However, it is pertinent to note that regardless of the method used, EM is detrimental to the interests of financial statement users and undermines the principles of fair presentation.

When the literature is examined, EM is linked to many factors such as the company's performance (Burgstahler & Dichev 1997), auditor (Ronen & Yaari, 2008), corporate governance and ownership (Aybars, 2013), and size (Watts and Zimmerman, 1990). The accounting standards followed by the reporting company (Lo, 2008) are one of the most researched variables whether it affects EM or not. More precisely, whether the set of standards used by the company is rule-based or principle-based is used as a determinant of EM. The effect of principle-based IFRS on EM has been the subject of many studies, both as a set and individually. However, contradictory results are obtained as follows.

The study by Van Tendeloo and Vanstraelen (2005) sought to determine whether German enterprises that have voluntarily adopted IFRS have significantly fewer EM practices than those that followed German local GAAP. The study's findings indicate no significant difference in EM practices between voluntary IFRS adopters and other companies.

Goncharov and Zimmermann (2006) examine whether the level of EM differs between German GAAP, International Accounting Standard (IAS), and US GAAP. Their findings reveal that while EM levels are approximately the same under GAAP and IAS, there is a considerable decrease under US GAAP.

In their study, Paananen and Lin (2008) investigate the accounting characteristics of German companies across three periods: the 2000-2002 IAS period, the 2003-2004 IFRS voluntary period, and the 2005-2006 IFRS mandatory period. The objective is to examine whether there is a change in accounting quality between these periods. The study examines accounting quality with regard to timely loss recognition, earnings smoothing, and value relevance metrics. The results indicate a decline in accounting quality over time.

In their study, Aussenegg et al. (2008) analyze the impact of the transition of listed companies from local GAAP to IFRS on EM in 17 European countries with 18,896 firm-year observations. They find that, in general, the EM level of IFRS adopters is lower than that of domestic GAAP appliers. To understand the impact of IFRS enforcement on EM, Cai et al. (2008) examine more than 100,000 observations for the period 2000-2006 from 32 IFRS adopters and non-adopters countries. They find that strong enforcement can reduce EM. Chen et al. (2010) examine the impact of IFRS adoption on accounting quality by examining companies in 15 EU countries. One of the five different indicators they use to measure accounting quality is EM. According to the results of the analysis, it is reported that improvements in most of the quality indicators found after IFRS. One of these improvements is the reduction in EM practices.

Jeanjean and Stolowy (2008) examine whether the adoption of IFRS standards affects financial reporting quality through EM. The study encompasses Australia, France, and the United Kingdom. The results show that EM increased in France and remained stable in the other two countries following the transition to IFRS. In light of these findings, the authors conclude that the transition to IFRS has not been successful in improving earnings quality.

Before and after the implementation of IFRS in the EU, Callao and Jarne (2010) conduct an investigation into the behavior of discretionary accruals. The results of the study indicate that, following the implementation of IFRS as a mandatory, there is an increase in discretionary accruals. Furthermore, they propose that there may be greater potential for EM under a principles-based accounting model. Capkun et al. (2011) also provide evidence that flexibility during the mandatory transition to IFRS in the EU has the effect of increasing EM.

In their study, Zéghal et al. (2011) examine the discretionary accruals of 353 listed companies between 2003 and 2006 to find out whether the mandatory apply of IFRS in France is related to EM. According to their findings, the authors report that there is a decrease in the level of EM in the 2005-2006 period, when IFRS is mandatory, compared to the 2003-2004 period.

Arum (2013) analyses whether the mandatory application of IFRS in Indonesia has an impact on the quality of the information provided in the financial statements. To this end, the author attempts to measure EM, value relevance, and timely loss recognition. He uses data from 117 companies listed on the stock exchange in 2010 (pre-IFRS) and 2011 (post-IFRS). The results of the analyses show that there is a decrease in EM following the implementation of IFRS.

Doukakis (2014) employs 15,206 firm-year observations from 22 European countries to examine the impact of the mandatory implementation of IFRS on accruals and real-based EM. As a result of comprehensive analysis, it is reported that the mandatory adoption of IFRS in 2005 does not significantly impact real or accrual-based EM practices.

Bryce et al. (2015) investigate to ascertain whether the adoption of IFRS led to an enhancement in the accounting quality of 200 companies listed on the ASX. Their analysis, encompassing the period from 2003 to 2008, concludes that there is no substantial improvement in accounting quality following the transition to IFRS.

Cengiz and Tosunoğlu (2017) conduct a study to examine the EM behavior of companies traded on the Borsa Istanbul after and before the implementation of IFRS. The analysis of data from 50 companies over the 2001-2008 period reveal an increase in EM following the implementation of IFRS.

Ipino and Parbonetti (2017) analyze the impact of mandatory IFRS implications on accrual-based and real EM, using 101,331 firm-year observations from 33 countries. The analysis reveals a decline in accrual-based EM and an increase in real EM in countries with strict enforcement regimes. This demonstrates that, in addition to the impact of accounting standards, other institutional factors also influence EM.

The aim of Morawska (2021) is to ascertain whether the implementation of IFRS 15 has an impact on EM in Poland. In order to achieve this objective, an analysis is conducted using data from 80 companies traded on the Warsaw Stock Exchange. The study employs Caylor's (2010) model to analyze data from 2016 to 2019. The findings indicate that companies employed discretion in the recognition of accrued revenue in order to avoid reporting losses. Nevertheless, the adoption of IFRS 15 does not appear to have a statistically significant impact on revenue-based EM.

The aim of the study by Souza et al. (2022) is to determine the impact of IFRS 15 on the quality of accruals and EM in publicly held Brazilian companies. A sample of 305 Brazilian companies with annual data spanning from 2011 to 2021 is selected. The researchers apply Dechow and Dichev's (2002) model for accruals quality and Pae's (2005) model for EM. The results indicate a decline in accrual quality and an increase in EM following the implementation of IFRS 15.

Hedqvist and Lennerskog's (2022) aim is to examine the potential impact of IFRS 16 on the utilization of EM by publicly traded firms in the Scandinavian (Sweden, Norway, and Denmark) stock exchange markets. The research involved the analysis of data from 304 companies over the period 2015-2020. Discretionary accruals are computed using the modified Jones model. The statistical results of the multiple linear regression indicate a negative relationship between discretionary accruals (the dependent variable) and the implementation of IFRS 16 (the independent variable). In other words, the implementation of IFRS 16 has reduced the incentive for managers to utilize discretionary accruals in order to increase reported earnings.

3. THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Financial accounting necessitates a degree of judgment and critical thinking. This affords managers discretionary power in selecting accounting methods, operations, investments, financing policies, and estimations (McNichols & Wilson, 1988: 2). Although IFRS provide uniformity in accounting, there is always the possibility that managers may manipulate reported numbers. EM, which is considered a manipulation technique as stated by Stolowy and Breton (2004), is usually obtained in the form of applying accounting preferences within the legal framework of the accounting process (Healy, 1985: 89; Goel, 2012: 576-577). However, investors require access to accurate and fair information to make the right decisions.

Upon examination of the extant literature on the relationship between IFRS and EM, it becomes evident that a definitive conclusion is not readily attainable. Although numerous studies reveal the relationship between IFRS and EM, there is conflicting evidence regarding the direction of this relationship. While some studies indicate that the implementation of IFRS may result in a reduction in EM (Aussenegg et al., 2008; Cai et al., 2008), other studies provide findings suggesting an increase in EM (Souza et al., 2022). Accordingly, in this study, which examines the impact of the updates to leasing standards set out in IFRS 16 on EM, it would be more appropriate to focus on the existence of a relationship rather than its direction when developing research hypotheses. In this context, the null and alternative hypotheses of the research are as follows:

H_0: Mandatory implementation of the updated leasing standard IFRS 16 has not a statistically significant impact on EM.

H_1: Mandatory implementation of the updated leasing standard IFRS 16 has a statistically significant impact on EM.

4. DATA AND METHODOLOGY

4.1. Data and Sample Selection

The data set analyzed in this study comprises annual data of companies continuously traded in Borsa Istanbul for the 2014-2021 period. Table 1 outlines the sample selection process and details the distribution of observations across industries. As illustrated in Table 1 Panel A, the initial sample, extracted from the financial data provider Finnet, comprises 321 firms, with a total of 2,568 firm-year observations. Subsequently, 97 firms operating in the financial sector are excluded (Aussenegg et al., 2008; Chen et al., 2010) because the legal framework these companies are subject to and the financial statements they prepare structurally differentiate from the others.

Furthermore, six firms with one or more missing data points that could not be accessed are excluded from the sample, resulting in a final sample of 218 firms and 1,744 firm-year observations designed as a balanced panel data set. In this context, the sample of 218 firms with 8 years of data represents a typical micro-panel[1]. Consequently, the analyses should be conducted following the micro-panel methodology. Panel B of Table 1 presents data on the sectoral distribution of firm-year observations, from largest to smallest. There are a total of 13 sectors included in the study. The manufacturing sector is the most represented, comprising approximately 65% of the sample. The lowest number of observations is found in the Administrative and Support Service Activities sector, with only one company represented.

Table 1. Sample Selection Process and Industrial Distribution

Panel A: Sample selection process		
	Number of firms between 2014-2021	**Number of firm-years observations**
Initial Sample	321	2,568
(-) Financial sector	97	(776)
(-) One or more missing data	6	(48)
Final Sample	**218**	**1,744**

Panel B: Industrial distribution of final sample			
Industry	**Number of firms between 2014-2021**	**Total firm-years observations**	**% of firm-years observations**
Manufacturing	143	1144	65.60%
Technology	14	112	6.42%
Wholesale And Retail Trade	13	104	5.96%
Construction And Public Works	8	64	3.67%
Hotels And Restaurants	8	64	3.67%
Electricity Gas and Water	7	56	3.21%
Transportation And Storage	6	48	2.75%
Information And Communication	5	40	2.29%
Education, Health, Sports, and Other Social Services	5	40	2.29%
Mining And Quarrying	4	32	1.83%
Real Estate Activities	2	16	0.92%
Agriculture, Forestry and Fishing	2	16	0.92%
Administrative And Support Service Activities	1	8	0.46%
Total	**218**	**1744**	**100.00%**

4.2. Research Methodology, Models and Variables

This study has three stages of analysis. First, in the first stage, discretionary accruals are calculated. The second stage covers how IFRS 16 and other factors affect discretionary accruals analyzed with panel regression. The third and last stage is a further examination of IFRS 16 and other factors with quantile regression.

To see if IFRS 16 affects EM, we first calculate discretionary accruals. This study uses the Kasznik (1999) model to calculate discretionary accruals. Kasznik's (1999) model is based on Jones's 1991 model. The Jones model relates total accruals to changes in revenues and plant, property, and equipment (Beneish, 2001: 6). The Jones model is criticized for accepting all income as normal accrual. Dechow et al. (1995) solve this problem by subtracting receivables from revenues. This is the modified Jones model. Kasznik (1999) adds cash flows from operations as an additional explanatory variable to the modified Jones model as given in Eq. 1.

$$\frac{TA_{it}}{A_{it-1}} = \alpha_i \left[\frac{1}{A_{it-1}}\right] + \beta_{1i} \left[\frac{\Delta REV_{it} - \Delta REC_{it}}{A_{it-1}}\right] + \beta_{2i} \left[\frac{PPE_{it}}{A_{it-1}}\right] + \beta_{3i} \left[\frac{\Delta \mathrm{CFO}_{it}}{A_{it-1}}\right] + \varepsilon_{it} \quad (1)$$

Notes: TA refers to total accruals. Total accrual is calculated in accordance with the literature (Kothari et al., 2005) as $[(change\ in\ non\ cash\ current\ assets) - (change\ in\ current\ liabilities\ excluding\ the\ current\ portion\ of\ longterm\ debt)] - [depreciation\ and\ amortization]$. (α) is a constant term; (REV-REC) is adjusted revenue; PPE refers to plant, property, and equipment; and CFO is cash flow from operations; (ε) is error term. All variables are divided by total assets (A) to prevent heteroscedasticity (Jones, 1991).

The Kasznik (1999) model says that total accruals (TA) are equal to non-discretionary accruals (NDA) plus discretionary accruals (DA). The DA, which is used as an indicator of EM in the literature such as (Jones, 1991; Dechow et al., 1995; Zéghal et al., 2011; Hedqvist and Lennerskog, 2022), is represented by residuals (on the right-hand side of Eq. 1 as in Kothari et al. (2005). The remainder of Eq. 1 refers to NDA.

The second stage of the analysis reveals the impact of IFRS 16 and other factors on discretionary accruals. The error term from the first stage represents discretionary accruals. In the second stage, this error term is used as the dependent variable, and IFRS 16 and related items (Leverage, ROA, Size, and CFO)[2] are used as independent variables. The model in the second stage is shown in Eq. 2.

$$DA_{it}^{Kasznik} = \alpha_i + \beta_1 IFRS16_{it} + \beta_2 Leverage_{it} + \beta_3 ROA_{it} + \beta_4 Size_{it} + \beta_5 CFO_{it} + \varepsilon_{it} \quad (2)$$

Notes: DA refers to discretionary accruals obtained from first stage, IFRS 16 is a dummy variable, 1 if financial reports are prepared using IFRS 16, 0 otherwise; Leverage refers to the total debt within total resources ($total\ debt_{it}$ / $total\ asset_{it}$); ROA refers to return on asset ($net\ income_{it}$ / $total\ asset_{it}$); Size refers to the logarithm of total assets ($\ln(total\ asset)_{it}$); CFO refers to cash flow from operating activities ($cash\ flow\ from\ operation_{it}/total\ asset_{it}$); α is a constant term; (ε) is error term.

In the second stage, the panel regression results show that IFRS 16 is statistically insignificant. Therefore, in the third stage panel quantile regression analysis is performed to determine the impact of IFRS 16 and other factors on discretionary accruals through panel quantile regression. In other words, the third stage involves a more comprehensive examination of the analysis conducted in the second stage across different quantiles. The model employed at this stage is presented in Eq. 3.

$$Q_\tau(DA_{it}|X_{it}) = \beta_1(\tau) IFRS16_{it} + \beta_2(\tau) Leverage_{it} + \beta_3(\tau) ROA_{it} + \beta_4(\tau) Size_{it} + \beta_5(\tau) CFO_{it} + \alpha_{it} + \varepsilon_{it} \quad (3)$$

Notes: τ refers to the quantiles, where τ takes values between 0 and 1; DA refers to discretionary accruals obtained from first stage; X is the vector of independent variables; $Q_\tau(DA_{it}|X_{it})$ is the τth quantile of DA given X; IFRS 16 is a dummy variable, 1 if financial reports are prepared using IFRS 16, 0 otherwise; Leverage refers to the total debt within total

5. FINDINGS

Table 2 provides the descriptive statistics of variables. It contains the total number of observations, means, standard deviations, minimum, and maximum values of the variables. As shown in Table 2, there are 1744 firm-year observations in the analyses. As stated before, all variables in Table 2, are divided by lagged total assets to avoid heteroscedasticity.

Table 2. Descriptive Statistics of the Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Total Accruals	1,744	-0.0213681	0.1638271	-1.025995	0.932664
Adjusted Revenue	1,744	0.1467514	0.3516657	-2.365702	4.113435
PPE	1,744	0.3757401	0.3007247	0.00012	2.700680
CFO	1,744	0.0157234	0.1876101	-2.123084	1.264122

The total accruals are calculated as *[(change in non cash current assets)-(change in current liabilities excluding the current portion of longterm debt)]-[depreciation and amortization],* and they are divided by lagged total assets. The mean of this variable is nearly (-0.02). It means that the absolute value of the average total accruals corresponds to nearly two percent of the average lagged total assets. According to the same logic, we can say that the absolute value of the average adjusted revenue corresponds to nearly fourteen percent of the average lagged total assets; the absolute value of the average PPE corresponds to nearly thirty-seven percent of the average lagged total assets; the absolute value of the average CFO corresponds to nearly one point fifty percent of the average lagged total assets. Total accruals have the lowest standard deviation, while adjusted revenue has the highest. When we look at the minimum and maximum values, the biggest difference, which is consistent with the standard deviation, is seen in adjusted revenue, and the smallest difference belongs to total accruals.

Table 3. Pearson Correlation Matrix of Variables

	Total Accruals	Adj. Revenue	PPE	CFO
Total Accruals	1			
Adjusted Revenue	0.0018	1		
PPE	-0.0808	-0.0058	1	
CFO	-0.3494	0.0748	0.0413	1

The correlations between the variables shown in Table 3. If the correlation coefficient of two variables is between 0 and 0.10, it is a negligible level. If it is between 0.10 and 0.39, it is interpreted as a weak correlation; if it is between 0.40 and 0.69, it is interpreted as a moderate correlation; if it is between 0.70 and 0.89, it is interpreted as a strong correlation; and if it is between 0.90 and 1, it is interpreted as very strong correlation (Schober et al., 2018: 1765). Including variables with high correlation in the same model creates a multicollinearity problem (Uyar and Sarak, 2020: 548). When the correlations between the variables shown in Table 3 are examined, it is seen that all coefficients are less than 0.40, indicating a weak correlation. Therefore, there is no risk in including these variables in the same model.

As stated above (data and methodology), the data used in the analysis is designed as panel data, and panel and panel quantile regression methods are used to analyze the data. In econometric analysis, models and estimators appropriate to the data should be used to obtain reliable results. The data set used in this study has micro panel and balanced panel characteristics, and the models are static.

5.1. Unit Root, Hausman, and Heteroscedasticity Tests Results

The data of this study have micro-balanced-panel data characteristics. Panel data analysis involves some assumptions and requires testing these assumptions. These tests are the cross-section dependence test, panel unit root test, Hausman (1978) test, autocorrelation, and heteroscedasticity test. However, Uyar and Sarak (2020) state that Baltagi (2008) showed that it is unnecessary to use cross-section dependence and autocorrelation tests in micro panel data sets. Therefore, Levin, Lin, and Chu (2002) unit-root test, Hausman (1978) test, and Modified Wald heteroscedasticity test are applied to the current data set and the results are given in Tables 4, 5, and 6 respectively.

Table 4. Levin-Lin-Chu Unit Root Test Statistics

	t statistic	p value
Total Accruals	-28.4104	0.0000***
Adjusted Revenue	-32.9947	0.0000***
PPE	-4.3e+02	0.0000***
CFO	-32.4687	0.0000***

***, **, * are refers to statistically significant values at 1%, 5% and 10% levels, respectively.

In Levin, Lin, and Chu test zero and alternative hypotheses are as follows:

H_0: Panels contain unit roots

H_a: Panels are stationary

When Table 4 is analyzed, it is concluded that the hypothesis is rejected at a 1% significance level for all series. At the 1% level of statistical significance, this means that all series are stationary.

In the panel data analysis, the Hausman (1978) test is used to choose between estimators in panel data models. The Hausman (1978) test is applied to choose which of the fixed effects and random effects models is more appropriate. One of the biggest differences between fixed effects and random effects is whether individual effects are correlated with independent variables. Hausman (1978) test compares random and fixed effects under the null hypothesis that individual effects have no correlation with the independent variables. If this hypothesis is not rejected, although both fixed and random effect estimators are consistent but random effect is efficient. But if it is rejected, fixed effect is consistent while random effect is inconsistent and requires utilization of fixed effect (Aybars, 2013: 105; Tatoğlu, 2021: 195-196).

Table 5. Hausman Test Statistics of Models

	χ^2	Prob. Value
Kasznik Model (1999)	19.34	0.0002***

***, **, * are refers to statistically significant values at 1%, 5% and 10% levels, respectively.

When Table 5 is examined the null hypothesis of Kasznik (1999) model is rejected at 0.01 significance level. Rejection of null hypothesis means that fixed effect estimators is efficient.

Table 6. Modified Wald Heteroscedasticity Test Statistics

	χ^2	Prob. Value
Kasznik Model (1999)	1.3e+05	0.0000***

***, **, and * refer to 1%, 5%, and 10% significance levels, respectively.

When the modified Wald test statistics in Table 6 are examined, the presence of heteroscedasticity in the error term at the 1% statistical significance level is detected. This means that the null hypothesis "variances between error terms are constant" is rejected. Since the null hypothesis is rejected, the problem of heteroscedasticity arises, and therefore a robust estimator must be used in regressions. To solve the heteroscedasticity problem, a Generalized Least Squares (GLS) estimator (in Stata: xtgls dependent variable independent variables, panels(heteroskedastic)) is employed in this study.

5.2. Total Accruals Estimation Results

As mentioned before, the analyses consist of three stages. The first stage is the calculation of discretionary accruals according to the Kasznik (1999) model. Total accruals are equal to the non-discretionary plus discretionary accruals. Eq. 4 provides a mathematical representation of this expression.

$$Total\ Accruals = Nondiscretionary\ Accruals + Discretionary\ Accruals \quad (4)$$

We have previously stated that the residual () on the right-hand side of Eq. 1 represents discretionary accruals, while the remaining parts of the equation represent non-discretionary accruals. Therefore, when we apply Eq. 1 to our data, we can naturally calculate discretionary accruals as .

The results of the estimation of total accruals, obtained when the Kasznik (1999) model is applied to the data, are presented in Table 7. Kasznik (1999) employs adjusted revenue, PPE, and CFO as explanatory variables for total accruals. All independent variables are statistically significant at the 1% level, as shown in the table. Upon examination of the coefficients, it can be observed that adjusted revenue has a positive coefficient, whereas PPE and CFO have a negative effect on total accruals.

Table 7. Total Accruals Estimation Results of Kasznik Model

Dependent variable: Total accruals
Number of observations: 1744
Number of groups: 218
Time periods: 8

Variables	Coefficient	Std. Error	P Value
Adjusted Revenue	0.0261809	0.0074858	0.000***
PPE	-0.0243906	0.0062371	0.000***
CFO	-0.2886894	0.0161432	0.000***
Constant	-0.0151914	0.0032662	0.000***

***, **, and * refer to 1%, 5%, and 10% significance levels, respectively.

5.3. Panel Regression Results of the Earnings Management

In the second stage of the analyses, the residual () gathered from the implementation of Eq. 1 is used as the dependent variable, which is an indicator of EM, and the variables in the right-hand sides of Eq. 2 are used as independent variables. The estimation results of the panel regression analysis are presented in Table 8. The discretionary accrual obtained in the first stage is used as the dependent variable, IFRS 16, leverage, ROA, size, and CFO are used as independent variables.

Table 8. Panel Regression Estimation Results of the Earnings Management

Dependent variable: Total accruals Number of observations: 1744 Number of groups: 218 Time periods: 8			
Variables	**Coefficient**	**Std. Error**	**P Value**
Adjusted Revenue	0.0261809	0.0074858	0.000***
PPE	-0.0243906	0.0062371	0.000***
CFO	-0.2886894	0.0161432	0.000***
Constant	-0.0151914	0.0032662	0.000***

***, **, and * refer to 1%, 5%, and 10% significance levels, respectively.

With the exception of IFRS 16, all variables in Table 8 are statistically significant at the 1% level. Upon examination of the coefficients, it can be observed that leverage, ROA, and size have a positive influence on EM, whereas CFO has a negative influence. The coefficient of IFRS 16 is negative, although the statistical significance is not observed. The potential significance of IFRS 16 at various quantiles (0.25, 0.50, and 0.75) will be examined in the third stage of the analysis with quantile regression.

5.4. Quantile Regression Results of the Earnings Management

This section, the third stage of the analyses, can be considered a more in-depth analysis of the second stage. Table 9 provides the estimation results of the earnings management with quantile regression. The dependent variable in this regression is the discretionary accrual (), which is derived from the first stage. The independent variables are IFRS 16, leverage, ROA, size, and CFO. The quantiles are 0.25, 0.50, and 0.75.

Table 9. Quantile Regression Estimation Results of the Earnings Management

Dependent variable: Discretionary accruals Number of observations: 1744 Number of groups: 218 Time periods: 8				
Quantiles	**Variables**	**Coefficient**	**Std. Error**	**P Value**
Q25	IFRS16	-0.0050145	0.0016268	0.002***
	Leverage	0.0048306	0.0035105	0.169
	ROA	0.088124	0.0151026	0.000***
	Size	0.0027991	0.0004138	0.000***
	CFO	-0.289214	0.010517	0.000***
	Constant	-0.0839079	0.0081639	0.000***
Q50	IFRS16	-0.0017696	0.0013665	0.196
	Leverage	0.0085104	0.0038593	0.028**
	ROA	0.0905585	0.0130666	0.000***
	Size	0.0022613	0.0004046	0.000***
	CFO	-0.2826339	0.0080169	0.000***
	Constant	-0.063454	0.0077432	0.000***
Q75	IFRS16	0.0056112	0.0028831	0.052*
	Leverage	0.0203438	0.0067451	0.003***
	ROA	0.0983183	0.0208221	0.000***
	Size	0.0003874	0.0005257	0.461
	CFO	-0.2812614	0.0127697	0.000***
	Constant	-0.0180112	0.009867	0.068*

***, **, and * refer to 1%, 5%, and 10% significance levels, respectively.

Upon analysis of the outputs of the quantile regression, it is observed that all independent variables, with the exception of leverage, are significant at the 1% level in the first quantile. The coefficients for IFRS 16 and CFO are negative, while those for ROA and size are positive. In the second quantile, all variables except IFRS 16 are statistically significant. The significance level for leverage is 5%, while that for ROA, size, and CFO is 1%. The coefficients of significant variables show that the CFO has a negative coefficient, while the other variables have positive coefficients. In the third quantile, the coefficient for IFRS 16 is significant and positive at the 10% level. Leverage and ROA exhibit a significant and positive coefficient at the 1% level. The coefficient of CFO is significant and negative at the 1% level.

6. CONCLUSION

It is acknowledged that there is a conflict of interest between agents and principals that pursue self-interest in an opportunistic manner (Makar et al., 1996: 33). In the early 2000s, one of the biggest scandals in the history of accounting is experienced in the USA. Many researchers argue that the causes of these scandals are the incentives and opportunities for personal gain faced by managers (Erickson et al., 2006: 114).

EM is closely related to accounting and reporting standards that reporting companies. Whether these standards are principle-based or rule-based is a subject of research in the literature. In this sense, the relationship between principle-based IFRS and EM has been investigated by researchers.

One of the latest updates in the principle-based IFRS set is IFRS 16 - Leases. As stated before, this study aims to reveal the relationship between IFRS 16 and EM. To evaluate whether IFRS 16, which aims to improve financial quality inherently, enhances the quality of financial information and restricts the management's discretion at Borsa Istanbul, the relationship between EM and IFRS 16 is analyzed. DA, estimated with the help of the Kasznik (1999) model, is used as an indicator of EM. IFRS 16, size, ROA, leverage, and CFO are used as independent variables in panel and quantile panel regression analyses.

Kasznik (1999) states that the expected coefficients of revenue in the literature is positive, and the coefficients of PPE and CFO are negative. In this sense, our EM model estimations are consistent with prior literature. In the panel regression results although no relationship can be detected between IFRS 16 and EM it is seen that leverage, ROA, and size have an increasing effect on EM, and CFO has a decreasing effect. On the other hand, according to quantile regression results, it is possible to say that IFRS 16 is decreasing EM in companies that engage in small-scale EM practices while increasing EM in companies that engage in large-scale EM practices. In general, leverage, ROA, and size have increasing effects on EM practices while the CFO is decreasing EM practices.

Tort (2013) claims that IFRS may provide some opportunity for EM. There are studies providing evidence that supports Tort in the current literature. According to Callao and Jarne (2010), Capkun et. al. (2016), and Cengiz and Tosunoğlu (2017), the application of IFRS increases EM. In this sense, the detected positive relationship between IFRS 16 and EM coincides with these studies. On the other hand, Cai et al. (2008) argue that IFRS may take longer to have a significant effect on financial reporting because of other factors besides accounting standards that are related to accounting quality. Doukakis (2014) affirms that the quality of financial reporting is shaped more by firm-level reporting incentives than by accounting rules. As a result of institutional and environmental factors as well as country-specific characteristics. These institutional and environmental factors can be examined in future studies. In addition, sectoral analysis of the impact of IFRS 16 on earnings management also constitutes a potential subject of study in future studies. Since earnings are an indicator widely used by market participants, it is important to reveal the relationship between IFRS 16 and EM at Borsa Istanbul. The findings offer valuable insights for policymakers, regulators, and market participants, informing decision-making processes. It would be better for market participants to make decisions by considering the obtained results.

Final note

[1] If the data is collected for a large number of N individuals over a short time period T (N>T), it is called a micro-panel (Baltagi, 2021: 1).

[2] IFRS 16 adds operating leasing transactions to the balance sheet. Thus, the size of the company increases. This affects the return on assets and leverage ratio. IFRS 16 also changes the classification of cash flows related to leasing transactions. So, cash flow from operating activities changes after the implementation of IFRS 16.

Conflict of Interest

The authors declare no conflict of interest.

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RESEARCH ARTICLE

The empirical analysis of the effectiveness of internal audit and sustainability practices in businesses during the 2018 Turkish economic crisis*

Kadriye Hilal Topal[1] **Alper Deniz Demir**[2]

[1] İstanbul Nişantaşı University, Department of Computer Programming, Türkiye, e-mail: hilal.topal@nisantasi.edu.tr
[2] İstanbul Nişantaşı University, Graduate Education Institute, Department of Business, Türkiye, e-mail: alpdenizdemir@gmail.com

Abstract

The ability of businesses to survive in the competitive market and increase productivity depends on the strategies they implement. While businesses can achieve successful results under normal conditions, only businesses with good strategies can be successful in times of economic crisis. Some of these strategies are internal audit and sustainability. The main objective of internal audit is to effectively meet the requirements of business management. Due to the fact that businesses direct the economic life, their environmental and social responsibilities in other words, sustainability have become visible as well as their financial responsibilities. The aim of this study is to reveal the importance of internal audit and sustainability of businesses in times of economic crisis. For this purpose, the data is obtained as a result of surveys is conducted to businesses' employees within the scope of the research are examined. In this study, which is based on employees working as manager in businesses, simple random sampling method is used and surveys are conducted to 122 business managers. The 10 incomplete and incorrectly filled surveys are excluded from the study, and the remaining 112 survey data are used. Descriptive statistics of internal audit and sustainability scales are obtained and interpreted. In addition, normality tests are performed for these two scales, and as a result, Mann Whitey-U and Kruskal-Wallis tests are applied to examine the differences between the means according to demographic variables in the series that are not normally distributed. As a result, it has been determined that there are significant differences in internal audit and sustainability practices for businesses according to the demographic characteristics of employees working as manager during the economic crisis period. In particular, it is concluded that there are significant differences according to age in terms of both internal audit and sustainability and education level only in terms of internal audit. In conclusion, it has been determined that the conscious and effective use of internal audit and sustainability contributes to performance of businesses in time of the 2018 Turkish economic crisis.

Keywords: Sustainability, Internal Audit, Economic Crisis, Crisis Management, Non-parametric Tests

Jel Codes: Q56, M42, G01, H12, C14

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Corresponding Author:
Kadriye Hilal Topal
E-mail: hilal.topal@nisantasi.edu.tr

1. INTRODUCTION

Today, rapidly developing technology and increasing globalization have caused various changes in the public and private sectors. The managerial practices such as widespread communication, transparency, strategic planning to increase risks and opportunities, performance and risk-based management, internal control and audit have started to gain importance. Businesses have been obliged to use their financial statements clearly and concisely in order to increase their value and security and to use their assets and resources more effectively. Since businesses' ability to achieve efficiency depends on having an effective internal control system, internal auditing in business is a tool used to ensure that management achieves its goals (Yurtsever, 2015: 90). The aim of internal audit: (i) Verification of compliance of the audited economic entity's policies, programs and their managerial decisions with legal regulations; (ii) Evaluation of financial and non-financial controls performed to increase economic efficiency; (iii) Evaluation of the adequacy of financial and non-financial data and information for management to know the reality of the economic entity; (iv) Determination of the measures to protect these assets off-balance sheet and prevent any fraud and loss (Daniela, 2010: 242).

Sustainability is the another effective practice in increasing the value of businesses. Sustainability for businesses is defined as the ability of businesses to achieve their financial goals with social and environmental sensitivity. Businesses dominated the international financial markets take social, environmental and financial responsibilities. Today, businesses have become responsible not only to their partners and investors, but also to everyone. These responsibilities have required businesses to create the necessary management policies by taking sustainability into account.

In the 1987 United Nations report, "The 1987 Brundtland Report", also known as "Our Common Future" by the World Commission on Environment and Development (WCED), sustainable development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainability for businesses is explained as a balance between environmental and social sensitivity depending on economic expectations. Because of their role in the international economy, businesses have social and environmental responsibilities as well as economic responsibilities. The reasons why businesses should consider sustainability in their management strategies: (i) To be more sensitive to the environment in their activities due to climate change; (ii) International trade and finance companies are obliged to fulfil the sustainability specifications in the contracts for use of credit; (iii) To include economic, social and environmental indicators within the integrated supply chain management; (iv) Social and environmental performance are as important as financial performance in investors' investment decisions; (v) To have gained a place international financial market terms such as "sustainable" and "responsible investment"; (vi) Customer and consumer sensitivity to environmental and social issues; (vii) Inclusion of social and environmental indicators in addition to financial statements in stock market trading conditions; (viii) The view that environmental and social sensitivity of businesses increases the value and reputation of their brands; (ix) The idea that the long-term sustainability of businesses depends on the optimum usage of resources in these three areas in order to gain competitive advantage in social, environmental and economic areas (Aksoy, 2013: 1-2).

Businesses are quite fragile during economic crisis periods. Directors of businesses need to be conscious and careful in the administrative decisions. In business science, crisis is defined as a difficult process that requires taking precautions about the future of the business in light of the current situation and current developments. The problems that the crisis has caused in the organizational and managerial structures of enterprises are; increased tension in organizational employees, deterioration in the quality of decisions and centralization of control, increase in organizational conflict, weakening of the ability to adapt to environmental changes, authoritarian tendencies brought about by the necessity of making quick decisions, shortness of time and stress (Öztürk, 2003: 390).

In August 2018, Turkish economy has gone through hard times because of the currency depreciation. The dollar exchange rate has reached 7.24 as a result of the currency crisis triggered by the priest Andrew Brunson crisis with the USA, along with the mistrust of economic policies. Afterwards, bankruptcies and concordat process have started to a significant decline in domestic demand consequence of high interest and inflation rates and companies' failure to meet their payment obligations (Sezal, 2020: 17). According to the statistics on companies established and closed by the Union of Chambers and Commodity Exchanges of Türkiye (TOBB) within the scope of the official statistics program, the number of individual proprietorship decreased by 20.6% in 2018 compared

to the previous year. The number of closed joint stock companies increased by 5.7% and the number of limited companies increased by 33.3% compared to the previous year. The number of bounced checks, which is the most one of the important factor in the appearance of commercial life, increased by 35.1% to 588 (TOBB, 2019: 31).

The sustainability practices aim to reduce the negative environmental and social impacts arising from companies' commercial activities are very important during crisis periods. Administrative mistakes made in company management during a crisis period in which economic instability negatively affects the real sector can lead to irreversible bad results. After the 2001 financial crisis, the total number of companies closed increased by 30.6% compared to the previous year (TOBB, 2006: 46). After the 2008 global economic crisis, a total of 10395 companies were closed in 2009, including 102 collective companies, 11 limited partnerships, 9151 limited companies, 888 joint stock companies, and 243 cooperatives. While the number of companies closed increased by 8.5% compared to the previous year, there was a 7.1% decrease in the amount of capital (TOBB, 2010: 46). Due to the 2018 Turkish economic crisis, the number of joint stock companies closed in 2019 increased by 5.4% and limited companies by 5.9% compared to the previous year, while the number of limited partnerships decreased by 25.0%, and the number of collective companies closed remained unchanged. The number of individual commercial enterprises closed increased by 34.3% and the number of cooperative companies decreased by 16.7% (TOBB, 2020: 65). Based on these statistics, this study investigates whether making effective managerial decisions to ensure sustainability and ensuring that these decisions are controlled by internal audit mechanisms plays an important role in the surviving of companies during crisis periods.

In the literature, there are a limited number of studies on internal audit and sustainability practices of businesses during economic crisis periods. Most of these studies have focused on the determinants of internal auditing, except from the concept of sustainability. Bednarek (2018) examined the factors that determine the effectiveness of internal auditing by conducting a survey of 342 organizations in Poland. Bednarek (2018) stated that the characteristics of internal auditing are affected by auditing activities and inter-institutional relationships. Differ from Bednarek (2018), Musah et al. (2018)' study reveals that size, competence, support and relationships with external auditors have an impact on the effectiveness of internal auditing in state economic enterprises in Ghana. Shamki and Alhajri (2017) examined the extent to which internal audit effectiveness in the Omani public sector can be affected by selected factors such as internal audit coverage, internal auditor experience and senior management response. In addition to employees, managers were also included in the study. Multiple regression analysis and correlation analysis were used to examine the relationships between the variables. They found that there is no significant relationship between internal audit effectiveness and senior management's response. However, managers are concerned with the performance of the organization by evaluating the results and observations of internal auditing practices. Similar to other studies in the literature, Hailemariam (2014) investigated the determinants of internal audit effectiveness in selected public sector offices in Ethiopia. However, in this study, the research was conducted by focusing on 15 selected public sector departments of all other sectors. Hailemariam (2014) revealed that direct relation effects of management perception, management support, organizational independence of internal auditors, adequate and competent internal auditor's staff and the presence of approved internal audit charter with the internal audit effectiveness on the public sector. While the studies in the literature focus only on internal audit, the concept of sustainability is also mentioned in Özcan (2019)'s study. Özcan (2019) aimed to reveal the importance of internal audit and sustainability in businesses and for this aim made a survey with business employees. This study determined that the importance of internal audit and sustainability for differences of businesses are significantly depending on the demographic characteristics and experinces of the managers.

In the literature, studies generally focus on the effectiveness of internal auditing in businesses. Bednarek (2018) differs from these studies by focusing on private sector business rather than public sector business. Shamki and Alhajri (2017), unlike other studies, included not only employees but also managers in the research. Özcan (2019) study, similar to this study, examined the importance of internal auditing and sustainability in businesses in Türkiye. Although Özcan (2019) evaluated the effectiveness between both internal audit and sustainability, the research was conducted on employees. Unlike Özcan's study, this study investigates the auditing of decision-making mechanisms regarding sustainability from the perspective of company managers. The 2018 Turkish economic crisis started in the second half of 2018 and its effects continued until 2023. Therefore, this study reveals the how important the internal audit and sustainability practices by taking into account the crisis period 2018-2023 when this research is conducted.

1.1. Internal Audit, Sustainability in Economic Crisis Periods

The economic sustainability is based on the development of strategies to ensure a beneficial relationship between business and society by using current resources in the optimum way. This concept covers the asset allocation processes carried out by institutions to create value maximization by adopting the principle of managing their organizational resources n the manner of optimum and sustainable (Selimoğlu &Saldı, 2021: 8).

In times of crisis, it is very important to make strategic management decisions to prevent companies from going bankrupt and to ensure sustainability. In crisis periods, the results of internal auditing practices are very important in terms of creating long-term value for sustainability purposes in order for businesses to survive, predicting social, environmental and financial risks, taking precautions, and establishing appropriate management policies.

Internal audit reports provide businesses with useful information during times of crisis. To Identify the risks of businesses, to report them to senior management and thus to make functional management decisions are important contributions of internal audit in crisis periods. Internal audit reports provide guidance for achieving financial targets during crisis periods, establishing appropriate investment policies, and solving liquidity problems to businesses It can be said that businesses that take the necessary precautions in a crisis environment thanks to internal audit get through the crisis period with less loss (Uzun &Yurtsever, 2009: 7).

In addition, fraudulent activities by malicious personnel may increase in businesses during times of crisis. Thanks to internal audit, business assets are protected by preventing abuse and fraud, and losses of money and goods are prevented (Uzun, 2008).

Businesses need effective strategies and practices to survive in times of crisis. In this context, theoretical and practical information is required to develop and implement different strategies for time of crises. This study aims to reveal how important internal audit and sustainability practices can be in businesses in times of 2018 Turkish economic crisis.

There are not enough studies in the literature on both sustainability and internal auditing practices. The studies generally are not focused on sustainability, but only attempted to determine the effectiveness of internal auditing. In addition, within the scope of the research, company managers, who are the decision-making mechanism of the businesses, are not included in the sample, but employees in general are included in the sample. The porpose of the this study to reveal how important internal audit and sustainability practices can be in businesses in times of 2018 Turkish economic crisis. To this aim, the importence of internal audit and sustainability practices is examined and 112 business managers are taken as a sample. In the study, a model is created that reveals that the effectiveness of internal audit and sustainability practices will differ in terms of employees's demographic characteristics and experiences. In addition, this study differs from other studies in the literature that it covers the 2018-2023 period, when the effects of the 2018 Turkish economic crisis continued, in order to reveal the impact of the crisis on sustainabiliy and internal audit practices in Turkish businesses.

To evaluate the benefits of internal audit and sustainability, which businesses generally use as a strategy, during economic crisis periods, through an application, and to make the necessary contribution to meet the need for information in this field.

Following the introduction of the study, section 2 describes empirical results with dataset and hypothesis. Finally, section 3 provides the conclusion of the study.

2. METHODOLOGY OF THE RESEARCH

2.1. Data and Hypothesis

In this study, research is conducted on business managers in order to reveal the importance of internal audit and sustainability for businesses during economic crisis periods. In this context, large enterprises are used as the basis,

and a survey is conducted among employees with managerial status in these enterprises.

To obtain values that will prove the model and hypotheses of the study, the opinions of business employees in terms of internal audit and sustainability are needed and in this context, standard scale surveys existing in the literature are used. In this study, the survey used by Özcan (2019) is revised and conducted. The survey is consists of two parts. While the first part of the survey contains questions revealing the characteristics of employees such as gender, age, educational status and professional experience; the second part contains questions about internal audit and sustainability. 20 questions about internal audit and 8 questions about sustainability are created with a 5-point Likert Scale. To get more accurate results, face-to-face survey studies are conducted and the data analyze by using the IBM SPSS Statistics program. In the study, which is based on employees working as managers in businesses, simple random sampling method is used and surveys are conducted to 122 business managers. The 10 incomplete and incorrectly filled surveys are excluded from the study, and the remaining 112 survey data are used.

The limitations of this study are that it is not easy to communicate with company managers because of their workload and the number of managers in the companies is less than the number of employees. Under these conditions, a limited sample size is obtained. However, sufficient sample size (n=112>30) is reached for the normal distribution and comparison tests applied in the study (Krithikadatta, 2014: 97). Based on established relationship found by previous scholars, research model is developed for these demographic variables involved in this study, which is exhibited in Figure 1.

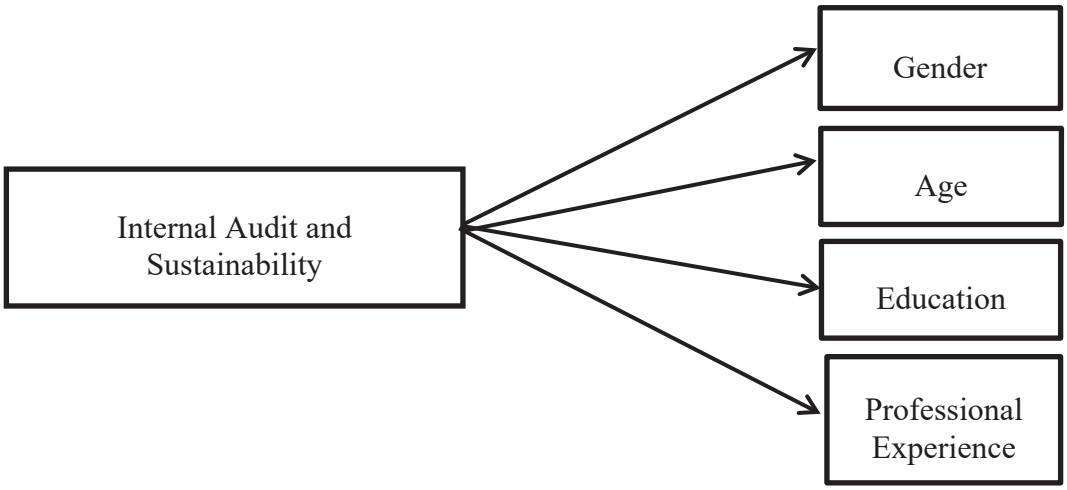

Figure 1. Research Model

In this research model, altogether four hypotheses are developed to test the relationships among the various variables. The hypotheses that reveal that internal audit and sustainability will differ according to the demographic characteristics of business managers (employees) and professional experience are presented below.

$H_0^{(1)}$: Internal audit and sustainability do not differ according to the gender in businesses.

$H_0^{(2)}$: Internal audit and sustainability do not differ depending on the age in businesses.

$H_0^{(3)}$: Internal audit and sustainability do not differ according to the educational level in businesses

$H_0^{(4)}$: Internal audit and sustainability do not differ according to the professional experience in businesses

2.2. Empirical Findings

In this study, Kolmogorov-Smirnov and Shapiro-Wilk normality tests are applied to the dataset to investigate the assumption of normal distribution, and Cronbach's alpha value is calculated to test the reliability of the scales. Frequency analyzes are performed and Mann Whitney-U and Kruskal-Wallis tests are applied to test the hypotheses of the study. To determine whether the variables used in the study would be suitable for parametric or non-parametric analyses, the normality tests are applied and presented in Table 1.

Table 1. Tests of Normality

Variables	Kolmogorov-Smirnov			Shapiro-Wilk		
	Test Statistics	d.f.	p-value	Test Statistics	d.f.	p-value
Internal Audit	0.132	132	0.000	0.916	112	0.000
Sustainability	0.131	132	0.000	0.922	112	0.000

Contrary to the null hypothesis, which is based on the assumption that the series are normally distributed, the alternative hypotheses advocating the assumption that they are not normally distributed are tested with Kolmogorov-Smirnov and Shapiro-Wilk normal distribution tests. Since [$p < 0.05$], the null hypothesis is rejected, and it is concluded that the series do not follow a normal distribution. The Cronbach's alpha value, which shows reliability of the scales with the internal consistency measure of the items, is presented in Table 2.

Table 2. Test of Reliability

Variables	Number of Items	Cronbach's Alpha
Internal Audit	20	0.857
Sustainability	8	0.696

In Table 2, Cronbach's alpha values of internal audit and sustainability are 0.857 and 0.696, respectively. As seen from the results, reliability of internal auditing is at a good level and reliability of sustainability is at an acceptable level.

In the study, in order to demonstrate how important the internal audit and sustainability practices of businesses are during periods of economic crisis, the distribution of the statements from the surveys conducted with employees with managerial status in the businesses are examined according to their agreement levels. The scale statements about taking risks during crisis periods such as "Internal audit contributes to the business in risk management" and "Our business's sustainability practices are effective during economic crisis periods" are used to ensure that survey respondents made their assessments with economic crisis periods in mind. The average value ranges of the survey statements consisting of 28 statements, which have been created with a 5-point Likert scale (1- Strongly Disagree, 2- Disagree, 3- Neither/Nor Agree, 4- Agree, 5- Strongly Disagree). It is classified as very high level in the value range of 4.20-5.00; high in the range of 3.40-4.19; medium in the value range of 2.60-3.39; low in the range of 1.80-2.59; very low in the range of 1.00-1.79 (Özcan, 2019: 79).The average values of internal audit and sustainability are presented in Table 3.

Table 3. The Average Values of Internal Audit and Sustainability

Variables	N	Mean	Standard Deviation
Internal Audit	112	4.09	0.49
Sustainability	112	4.17	0.60

As seen in Table 3, the means of both internal audit and sustainability scales in businesses are greater than 4. In addition, the mean of sustainability scale is greater than mean of internal audit (4.17>4.09). It is revealed that the answers "Agree" are more in both scales and the level of agreement in the sustainability scale is greater than the internal audit scale. The level of agreement with the statement of the participants for internal audit practices and sustainability practices in businesses are presented as Table 4 and Table 5.

Table 4. The Statistics of Internal Audit Practices

Item	Question	Strongly Disagree	Disagree	Neither / Nor Agree	Agree	Strongly Agree	Mean
1	An internal control and internal audit system compatible with the policies and objectives of the business will increase the effectiveness of the management of the business.	5	4	6	23	74	4.40
2	The duties, authorities and responsibilities of the employees in the enterprise are clearly known to the employees.	1	6	4	19	82	4.56
3	The business has procedures to ensure that accounting transactions are carried out completely and accurately.	3	7	10	19	73	4.35
4	Registries made in our business are approved separately by the person performing the transaction and the person controlling it.	5	6	7	21	73	4.34
5	All activities in our business are carried out are checked in accordance with the legislation, articles of association and internal company regulations.	1	3	15	13	80	4.50
6	Administratively, who is responsible for financial and monetary matters is determined by a formal delegation of authority.	4	7	12	25	64	4.23
7	The reporting system in the business allows management to evaluate whether the main goals of the business have been achieved.	3	2	13	12	82	4.50
8	It is important to create a database for auditing and reporting business activities and to prepare the necessary technological infrastructure for this.	2	9	16	21	64	4.21
9	Risks to the goals and objectives are determined and evaluated and updated at least one time in a year and/or according to changing conditions.	9	12	8	24	59	4.00
10	The effectiveness of the internal control system is constantly evaluated and supervened by management.	3	7	12	21	69	4.30
11	Internal audit aims to prevent and detect erroneous and fraudulent transactions.	2	7	12	24	67	4.31
12	Internal audit ensures to comply with ethical values in the company.	5	3	4	25	75	4.44

13	Internal audit provides objective guarantee to management by measuring and evaluating the effectiveness of control systems.	2	5	13	15	77	4.42
14	Internal audit and internal control systems ensure cooperation (coordination) between other participants of the corporate governance process (board of directors, audit board and external audit).	2	11	10	26	63	4.22
15	Information whose integrity, accuracy and impartiality has been inspected and verified by internal audit units is considered reliable information by decision makers.	2	3	10	23	74	4.46
16	Internal auditing in the business improves the transactions and activities in the organization and adds value to the business.	7	5	21	18	61	4.08
17	Internal audit has a certain impact on the input, output, result, efficiency, effectiveness and quality elements that are performance indicators in businesses and provides a significant contribution or support to the development of these elements.	6	7	7	34	58	4.16
18	The internal audit system plays an active role in ensuring that the business achieves its goals.	2	5	11	21	73	4.41
19	The internal audit system ensures that business activities comply with legal regulations.	12	8	14	19	59	4.93
20	Internal audit contributes to the business in risk management.	3	5	6	19	79	4.48

It is understood from the Table 4, the 9th statement, 16th statement and 17th statement are at a high agreement level [mean <4.20] and the other statements are at a very high agreement level [mean >4.20] for internal audit practices in businesses. In addition, it is observed that the 5- Strongly Agree value is accepted more frequently than other values in the agreement levels of the statements. In this regard, it is understood that internal audit practices in businesses are generally at a very high level.

Table 5. The Statistics of Sustainability

Item	Question	Strongly Disagree	Disagree	Neither/Nor Agree	Agree	Strongly Agree	Mean
1	Business employees are aware of the sustainability approach.	2	3	16	14	77	4.43
2	Business managers are sufficiently concerned with sustainability issues.	8	10	14	27	53	3.95
3	The Information flow is provided between business employees and managers regarding sustainability.	5	6	16	16	69	4.23
4	Training is provided to explain the importance of sustainability within the institution.	25	26	11	20	30	3.03
5	There is a separate department or manager for sustainability in our business.	2	5	14	11	80	4.44
6	Our business prefers appropriate strategies to reflect sustainability practices to society and stakeholders.	2	5	13	28	64	4.31
7	Our business regularly publishes sustainability reports.	4	4	8	12	84	4.50
8	Our business's sustainability practices are effective in times of economic crisis.	4	2	10	13	83	4.50

In Table 5, it is seen that the level of agreement for the 2nd statement is at a high level [mean<4.20], the 4th statement is at a medium level [mean<3.40], and the other statements are at a very high level [mean>4.20]. In addition, it is observed that the 5- Strongly Agree value is accepted more frequently than other values in the agreement levels of the statements. It can be said that from the results internal audit practices in businesses are generally at a very high level.

Since the internal audit and sustainability variables do not have a normal distribution, non-parametric Mann Whitney U and Kruskal Wallis tests are used to compare the means. The Mann Whitney-U test is applied for gender and the results are presented in Table 6.

Table 6. Mann Whitney-U Test Results

Variables			N	Mean of Ranks	Mann-Whitney U Test Statistics	p-value
Internal Audit	Gender	Female	61	58.30	1446	0.522
		Male	51	54.35		
Sustainability		Female	61	58.25	1448	0.531
		Male	51	54.40		
		Single	54	60.61		

The results of the Mann Whitney-U test given in Table 6 show that the differences between the means are not statistically significant. It is understood that the *"$H_0^{(1)}$:* Internal audit and sustainability do not differ according to the gender in businesses" hypotheses cannot be rejected [p>0.05]. The Kruskal Wallis test results are applied for age, educational status and professional experience variables are presented in Table 7.

Table 7. Kruskal Wallis Test Results

Variables			N	Mean of Ranks	Kruskal Wallis Test Statistics	p-value
Internal Audit	Age	26-35	28	62.41	36.030	**0.000**
		36-45	29	73.79		
		45-55	26	57.35		
		56+	12	56.83		
		Total	112			
Sustainability		18-25	17	28.35	18.893	**0.001**
		26-35	28	64.21		
		36-45	29	67.76		
		45-55	26	51.52		
		56+	12	61.96		
		Total	112			
Internal Audit	Educational Status	High School	11	36.82	35.168	**0.000**
		Associate Degree	27	45.87		
		Undergraduate	36	43.94		
		Postgraduate	38	81,64		
		Total	112			
Sustainability		High School	11	43,55	4.645	**0.200**
		Associate Degree	27	53,19		
		Undergraduate	36	54,29		
		Postgraduate	38	64,70		
		Total	112			
Internal Audit	Professional Experience	0-5	20	41.75	6.383	**0.170**
		6-10	21	60.6		
		11-20	19	52.68		
		21-30	38	63.14		
		31+	14	58.57		
		Total	112			
Sustainability		0-5	20	47.48	3.495	**0.480**
		6-10	21	59.29		
		11-20	19	50.97		
		21-30	38	62.33		
		31+	14			
		Total	112			

It is seen that from the Table 7, the internal audit and sustainability variables have statistically significant differences according to the age variable. The mean of ranks of individuals between the ages of 36-45 is found to be higher. The "$H_0^{(2)}$: Internal audit and sustainability do not differ according to the age in businesses" hypothesis is rejected [$p<0.05$]. It is seen that the internal audit variable has statistically significant differences according to the educational level variable ($p<0.05$), whereas the sustainability variable does not have any difference [$p>0.05$]. According to the mean of ranks, it is seen that postgraduate education category has the highest value in terms of

the internal audit variable. It is understood that the test results in Table 7 "$H_0^{(3)}$: Internal audit and sustainability do not differ according to the educational level in businesses" is rejected for the internal audit variable, but is confirmed for the sustainability variable. There is no difference between the means of the professional experience variable for internal audit and sustainability. It is found that the " $H_0^{(4)}$: Internal audit and sustainability does not differ according to the professional experience in businesses" hypothesis cannot be rejected [p>0.05].

3. CONCLUSION

The study investigates the importance of internal audit and sustainability for businesses during 2018 economic crisis periods through an application. In this study, a survey was conducted with a random sampling method on 122 business managers in Türkiye to reveal the opinions of businesses according to internal audit and sustainability practices during the crisis period in 2022, when the effects of the 2018 economic crisis continue. Since 10 surveys were incorrect and/or incomplete, 122 surveys were included in the study. Reliability test was performed on the internal audit scale consisting of 20 sentences and the sustainability scale consisting of 8 sentences. It is found that reliability of internal auditing is at a good level and reliability of sustainability is at an acceptable level. The differences between the means of the internal audit and sustainability for the demographic variables of age, gender, education level and professional experience were investigated with the Mann Whitney-U and Kruskal-Wallis non-parametric tests since they were not normally distributed.

In order to understand the importance of internal audit and sustainability for businesses in times of economic crisis, firstly the distribution of agreement levels regarding the statements was examined. As a result, it was observed that most of the participants in the surveys answered that they strongly agree with the positive aspects of internal audit and sustainability. It was investigated whether there were differences in internal audit and sustainability according to the gender, age, educational status and professional experience of the employees working as manager.

Although there are not enough similar studies in the literature, the results obtained from the study are similiar to Özcan (2019) as determined that the importance of internal audit and sustainability for differences of businesses are significantly depending on the demographic characteristics of participants. However, unlike Özcan (2019) study, no significant difference is found in terms of internal audit and sustainability studies according to gender. While the perspective on sustainability during the crisis period does not differ according to the education status, as Özcan (2019), the evaluation of internal audit differs. As the level of education increases to postgraduate, the importance of internal auditing also increases. In this study it is revealed that experience is not a distinguishing feature in internal audit and sustainability. Although Özcan (2019) reached the same conclusion, when only the management team is evaluated expect of employees, it can be said that business managers have the same perspective regardless of their professional experience. In this study, unlike Özcan (2019), the age variable is also examined. It is found that there are significant differences according to age for both of internal audit and sustainability. In addition, this situation reveals that the importance of internal audit and sustainability practices in businesses during periods of economic crisis is evaluated by individuals between the ages of 36-45.

In conclusion; The study has partially revealed that internal audit and sustainability practices are important for businesses in times of economic crisis. The fact that each crises have different effects shows that some strategies can be partially successful. From this perspective, it seems necessary to diversify the studies according to different businesses, sample size or type of crises experienced. It is recommended that a study that would evaluate employees at different levels of work in different times of crisis for example, before, during and after the crisis in businesses.

Conflict of Interest

The authors declare no conflict of interest.

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RESEARCH ARTICLE

Alternative price and quantity indices for fresh fruits and vegetables

Aslıhan Atabek Demirhan[1] **Saide Simin Bayraktar**[2]

[1] Central Bank of the Republic of Türkiye, Türkiye, e-mail: aslihan.atabek@tcmb.gov.tr
[2] Central Bank of the Republic of Türkiye, Türkiye, e-mail: simin.bayraktar@tcmb.gov.tr

Abstract

For central banks, whose main objective is price stability, it is crucial to expand information sets that support monitoring price development and advance methods that contribute to timely and sound predictions. Fruit and vegetable prices, which make up about a quarter of the food and non-alcoholic beverages group with the highest weight in the CPI basket, exhibit high seasonal and irregular changes due to unbalanced demand and supply conditions. Although monitoring developments in the fruit and vegetable sub-group is important due to both food security and the weight structure of the basket, available data sets and indicators are quite limited. This study aims to introduce new leading indicators that we have developed that enable monitor supply, demand and price developments of fruits and vegetables closely.

Keywords: Fresh Fruits and Vegetables, Unprocessed Food Inflation, Alternative Indicator, Price Index, Quantity Index

JEL Codes: C81, E31, Q11

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Corresponding Author:
Saide Simin Bayraktar
E-mail: simin.bayraktar@tcmb.gov.tr

1. INTRODUCTION

Food prices have surged significantly during the post-2019 era with the pandemic. Increasing food prices has been felt more profoundly in developing countries due to high share of food consumption in total spending. This in turn caused deterioration in the inflation expectations (Goyal and Parab, 2021). Therefore, the development in food prices is not only the primary agenda of the general public and the policy makers but also followed closely by the central banks whose main objective is to attain price stability.

Food prices are an essential part of Türkiye's economy with its impacts on various sectors of the economy. For Türkiye, with 24.98% of direct and 7.40% of indirect share, the food and non-alcoholic beverages group is primarily important due to its high share in the consumption basket. Fluctuating food prices especially for critical goods like fresh fruits and vegetables affect consumers, farmers as well as the policymakers with critical consequences on food security and inflation. In this regard, understanding the dynamics of these prices, from farm to retail is important for policymakers to mitigate the volatility and promote more stable food prices.

Türkiye plays an important role in fruit and vegetable production due to its large, fertile and productive agricultural lands with ecological diversity. In 2023, approximately 59.2 million tons of fresh fruits and vegetables produced in Türkiye, which is among the top 10 countries in total fruit and vegetable production, were consumed in both domestic and foreign markets (TURKSTAT, 2023). According to FAOSTAT (2022), Türkiye with a share of 2.3% in total global production, ranks the 6th in global fruits and vegetables production after China, India, Brazil, the USA and Indonesia.

In Türkiye with an aim to contribute cost reduction and price stability in unprocessed food prices in the short and medium terms Law No. 5957 on "Regulating the Commerce of Fruits and Vegetables and Other Goods Having Enough Supply and Demand Level" was enacted in 2010 (Official Gazette of Türkiye, 2010). Pursuant to this law, the Ministry of Trade in Türkiye established the Wholesale Market Registration System (WMRS). This study aims to introduce new indicators based on this data from the Republic of Türkiye Ministry of Trade's Wholesale Market Registration System (WMRS) in order to closely monitor the supply, demand and price developments of fresh fruits and vegetables. Those proposed new indicators are expected to make an important contribution for monitoring the supply and demand balance and prices of fresh fruits and vegetables and may serve as an input for modelling and forecasting studies.

There exist a considerable body of literature on food prices focusing on fresh fruits and vegetables in Türkiye. Moreover, various theories have been proposed to construct alternative prices and quantity indices which can be applied for agricultural products. However, as to our knowledge, there is no alternative indicator to observe supply and demand dynamics in the fresh fruits and vegetables market. The next section provides a literature review on alternative indices and summarizes the previous research on fresh fruits and vegetable prices in Türkiye. Literature review is followed by introducing our comprehensive and up-to-date dataset and how we used it to construct alternative price and quantity indices for fresh fruits and vegetables.

2. LITERATURE REVIEW

Developing alternative price and quantity indices for food prices has become significantly important as the complexities in agricultural markets are being observed more profoundly. The existing literature on alternative indices for food prices mainly focus on measuring the price changes for food products especially the products experiencing high volatility. Traditional price and quantity index models (e.g. Laspeyres, Paasche and Fisher Indices) has long been used to estimate food inflation especially in volatile markets such as fruits and vegetables. While these indices provide essential information on how prices evolve over time, traditional methods come with trade-offs. Using traditional methods in agricultural markets come with challenges due to the unique nature of the products. Traditional indices often fail to capture the quality changes especially in perishable goods like fresh fruits and vegetables. Moreover, incorporating seasonality is lacking in using traditional models. Lastly, the models might fail to capture the substitution effect associated with demand shifts due to changes in prices.

Constructing alternative indices seek to address the limitations of traditional indices mentioned above particularly

in the highly volatile sectors like agriculture and especially fresh fruits and vegetables. There are numerous studies in regards to developing alternative index construction in economic theory applied to agricultural products. The US Bureau of Economic Analysis has established models to develop alternative price and quantity indices using index number theory and its applications (Kornfeld, 2021). They use chain-type indices which updates the weights more often to reflect consumption and production patterns more up-to-date. Regression models are also widely used to capture the price changes. Volpe (2013) focuses on the dynamics between transportation costs and wholesale prices of fresh produce, finding a significant impact. Wohlgenant (2001) analyzes the transmission system in beef prices which can be adopted to fresh produces as well. He explores how price changes at different levels of the supply chain impact consumer prices using linear regression models.

Another point to mention is to incorporate weather variations. It is well-known that fresh fruit and vegetables production is highly sensitive to sudden and unexpected weather changes. In this regard, there are weather and risk-based indices to incorporate climate variability. These indices mainly focus on meteorological data or satellite data to capture the impact of climate variability on quantity and price. For instance, Climate Risk Index combines data on storm intensity, flood frequency and drought conditions making it an essential tool for understanding how changing climate patterns affect food security and agricultural production (Germanwatch, 2020). Another example is Agricultural Stress Index System by Food and Agriculture Organization (FAO) using satellite data to monitor agricultural stress which is shown to be useful in early warning systems for global agricultural production (Kogan, 2000). There are significant amount of weather and risk-based indices highlighting the growing importance of weather changes in agricultural markets. Another type of index is crop-specific price indices. These indices require weighting methodologies that reflect both price and quantity changes over time. The shares are mostly driven by expenditure shares emphasizing the importance of different products in a region. Studies show that selecting weighting schemes is particularly important to accurately reflect market conditions (Diewert, 2010). Holt and Craig (2006), using dynamic pricing models, incorporates real-time data to adjust crop price indices dynamically. FAO Food Price Index uses a similar methodology with an aim to create a global indicator (FAO, 2024). Unites States Department of Agriculture's Fruit and Vegetable Reports include price indices for major fruits and vegetables which are used to track market movements and inform trade policies (USDA, 2023). European Union's Fresh Produce Index is another example tracking the retail and wholesale prices of fresh fruits and vegetables helping to analyze supply chain efficiency (EU, 2024). Crop specific indices are highly valuable in terms of providing useful insights on market dynamics and support the policymakers in managing the price risks. In this study, we aim to construct an alternative price and quantity index based on Wholesale Market Registration System.

Food prices in Türkiye play key roles in maintaining economic stability and food security. Within food prices, fresh fruits and vegetable prices is particularly important. Fruits and vegetables constitute a significant portion of agricultural output and is important for the overall performance of the economy. Moreover, Türkiye is a major exporter of fresh produces. In this regard, stability in domestic prices is important with its potential impacts on trade. Several studies have analyzed fruit and vegetable prices in Türkiye identifying the factors influencing changes in prices, market structure and policy impacts. Some studies indicate inefficiencies due to high transaction costs, inadequate infrastructure and the role of intermediaries causing an increase in the food prices (Uçak et al., 2018). Sayin et al. (2010), evaluate the effect of Türkiye's wholesale market laws on pricing efficiency and producer incomes. Their findings find that regulatory frameworks might cause additional cost for producers. Studies using econometric models such as VAR and GARCH approaches indicate that exchange rate fluctuations and global food prices significantly impact Türkiye's food price indices. Dudu and Cakmak (2018) demonstrate that proximity to key export markets and trade agreements positively influence export volumes. On the other hand, political instabilities like the Arab Spring and economic crises found to have negative impacts.

There are several different studies conducted by the Central Bank of the Republic of Türkiye (CBRT) on unprocessed food prices which is a major component of the food and non-alcoholic beverages group. In a study by Başkaya et al. (2008) analyzing the impacts of various variables including supply, demand, cost and trade on unprocessed food price developments, production and trade were found to be the main determinants of the price developments in unprocessed foods group. Öğünç (2010) mentions that unexpected volatility in unprocessed food prices is 5 times higher than that of the headline inflation. The study by Orman et al. (2010) on the structural factors that cause high volatility in fresh fruit and vegetable prices points out that the concentration of production in certain regions of the country and inadequate warehousing activities may cause sudden price movements. Eren et al. (2017) argue that the main factors that put the greatest pressure on food prices are the amount of production and producer prices. Another important cause of price increase is the high consumer-producer price margins. Atabek-Demirhan and Bayraktar (2024) assess that increased temperature and extreme weather events due to climate change are

associated with fresh fruit and vegetable production, costs and prices.

As the general literature and existing studies indicate, the main determinants of fresh fruit and vegetable prices are the demand and supply levels in which influenced by many different factors such as climatic conditions, production quantity, wastage rate and stocks. To our best knowledge, there is no available indicator for supply and demand conditions for fresh fruits and vegetables. In addition to supply and demand, it is also important to monitor price developments in the fruit and vegetable subgroup due to its high weight in the consumer basket. However, it is also difficult to monitor and forecast fresh fruit and vegetable prices, which exhibit high seasonal and irregular variations due to weather conditions as well as unbalanced demand and supply conditions.

3. DATA AND METHODOLOGY

The data used in this study come from the Wholesale Market Registration System (WMRS). WMRS was established by the Ministry of Trade of Türkiye in 2010 pursuant to the Law No. 5957. This law was enacted in order to prevent informal trade and increase traceability in vegetable and fruit production together with the aim to contribute cost reduction and price stability, which has become increasingly important in terms of food safety and sustainability.

According to the Law No. 5957, it is mandatory to report all wholesale purchases, sales and shipment transactions to the WMRS and to buy and sell fruits and vegetables from the wholesale market, with some exceptions. Provided that the WMRS is notified, fruits and vegetables sold by producer organizations, used in industrial production,

Table 1. Fruits and Vegetables Products Contained in WMRS and CPI Basket*

Subcomponents of Fruits CPI (2024)				Subcomponents of Vegetables CPI (2024)			
	Code	Product	Contained in the WMRS**		Code	Product	Contained in the WMRS**
Fresh Fruits (01161)	0116101	Orange	1	Fresh Vegetables (Including Potatoes) (01171 & 001172)	0117114	Banana Pepper	1
	0116102	Grapes	1		0117115	Bell Pepper	1
	0116105	Pear	1		0117117	Green Pepper	1
	0116107	Quince	1		0117121	Dill	1
	0116110	Strawberry	1		0117122	Tomatoes	1
	0116112	Apple	1		0117125	Green Beans	1
	0116121	Watermelon	1		0117130	Carrots	1
	0116122	Melon	1		0117134	Spinach	1
	0116128	Kiwi	1		0117135	Zucchini	1
	0116130	Lemon	1		0117139	Cauliflower	1
	0116131	Tangerine	1		0117146	Onion	1
	0116134	Banana	1		0117148	Cabbage	1
	0116135	Pomegranate	1		0117150	Red Cabbage	1
	0116137	Peach	1		0117151	Mushroom	1
Dried fruit and nuts (01162)	0116201	Almond Kernel	0		0117152	Lettuce	1
	0116202	Walnut Kernel	0		0117153	Parsley	1
	0116203	Hazelnut Kernel	0		0117155	Mint	1
	0116204	Pistachio	0		0117158	Eggplant	1
	0116206	Peanuts	0		0117160	Leek	1
	0116207	Roasted Chickpea	0		0117161	Arugula	1
	0116208	Sunflower Seed	0		0117162	Cucumber	1
	0116209	Pumpkin Seed	0		0117164	Garlic	1
	0116210	Raisins	0		0117174	Radish	1
	0116212	Dried Apricot	0		0117201	Potatoes	1
				Legumes (01174) and Canned or processed (01175)	0117401	Dried Beans	0
					0117402	Chickpea	0
					0117403	Lentil	0
					0117501	Canned Food	0
					0117504	Pickles	0
					0117505	Tomato Paste	0
					0117506	Olives	0
					0117507	Chips	0

Source: TURKSTAT

* List of products contained in the main groups of CPI.

** "1" represents the products which are contained in the WMRS, "0" represents the products which are not contained in the WMRS.

procured from producers by retailers and establishments such as hotels and restaurants, or are exported and imported, may be bought and sold outside the wholesale market. The WMRS aims to monitor and record the vegetable and fruit trade, prevent informality in the sector and ensure transparency. In this context, data on average prices and transaction volumes on the basis of product, product category and product type are published daily as time series on the website www.hal.gov.tr and shared with the CBRT in 10-day intervals within the framework of the Early Warning System.

According to Turkish Statistical Institute's (TURKSTAT) Consumer Price Index Bulletin (TURKSTAT, 2023) there are 56 products in total under the Fruits and Vegetables group (Table 1). All 45 products under the fresh fruits (01161), vegetables excluding potatoes (01171) and potatoes (01172) groups under the CPI basket are covered in the WMRS database.

Ensuring stable food supply and price is not just an economic priority but also important for food security, social stability and the wellbeing of households. Türkiye is one of the major agricultural producers with staples such as wheats, fruits and vegetables. In 2023, approximately 59.2 million tons of fresh fruits and vegetables produced in Türkiye, which is among the top 10 countries in total fruit and vegetable production, were consumed in both domestic and foreign markets. In addition to its important role in supply chain, as a developing country, food prices are a significant component of consumer price indices and have a direct important impact on overall inflation. Hence, monitoring price and supply developments though high frequency and up-to-date indicators is a critical tool for governments and policymakers to address risks, design timely interventions and promote stability in food system. Timely detection of price spikes or supply shortages can prevent crises and give chance to intervene rapidly and on the spot. Despite its importance, up-to-date and timely quantity and price indicators are not currently available for monitoring. Yearly production data is published by the TURKSTAT Crop Production Statistics for selected products with a time lag (TURKSTAT, 2023). As a comprehensive and up-to-date data source for fresh fruit and vegetables, the WMRS is a unique resource with the potential to fill this important gap. Using the advantages of this unique and comprehensive dataset the WMRS data we construct new quantity and price indicators for fresh fruits and vegetables. WMRS dataset contains the supply amount (in terms of kilograms) and prices (in terms of Turkish Lira) of the products in type detail. The supply amount and prices are utilized for constructing the quantity and price indices respectively.

3.1. WMRS Based Fruits and Vegetables Quantity Indices

The quantity index for fresh fruits and vegetables group is constructed as a proxy for supply indicator. Using the supply amounts in WMRS for the products that are included in the CPI basket the quantity index is constructed. As mentioned before WMRS dataset contains products quantity supply and prices in product type details. For each product the supply amount is calculated by aggregating supply amounts by product type. Then in order to construct comparable indicator, products' total supply amounts are converted into an index with base January 2019.

$$Q_{it} = \sum_{j=1}^{J} Q_{ijt} \text{ and } QI_{it} = \frac{Q_{it}}{Q_{ib}} \times 100 \quad (1)$$

where Q_{ijt} is the quantity supplied of product type j of product i at time t, Q_{it} is the total quantity of product i at time t,Q_{ib} is the supply quantity of product i at January 2021 and QI_{it} is the quantity index of product i at time t.

The quantity index for fresh fruits and vegetables, Q_t, is calculated as the weighted average of the quantity indices of product that are included in the CPI basket.

$$Q_t = \sum_{i}^{\hat{I}} w_i Q_{it} \quad (2)$$

Where Q_t stands for the quantity index for fresh fruits and vegetables at time t, Q_{it} is the quantity index of product i at time t and is the weight of product i. Product weights are the latest publicly published product weights by TURKSTAT. WMRS-based quantity indices are calculated for fresh fruits and vegetables, fresh fruits and vegetables separately. For each group the weights are redistributed within the group to sum up 1.

3.2. WMRS-Based Fresh Vegetable and Fruit Price Indices

As mentioned earlier, it is compulsory to buy and sell products sold by producer organizations, exported and imported, used in industrial production, except for fruits and vegetables procured from producers by retailers and establishments such as hotels and restaurants, provided that they are notified to WMRS. In this context, WMRS exit prices are considered to be a good leading indicator for fresh vegetables and fruits consumer prices. In addition to the quantity indices, price indicators for fresh fruits and vegetables are also constructed using the price information contained in the WMRS dataset. First of all, for each product type price indices with base year 2019 are constructed as in the case of quantity index.

$$PI_{ijt} = \frac{P_{ijt}}{P_{ijb}} \times 100 \tag{3}$$

Where $\boldsymbol{PI_{ijt}}$ stands for the price index of type j of product i at time t and $\boldsymbol{P_{ijt}}$ and $\boldsymbol{P_{ijb}}$ are the prices of type j of product i at time t and base time January 2021 respectively. Then price index for particular product is calculated as the weighted mean of price indices of corresponding product types.

$$\boldsymbol{P_{it}} = \sum_{\boldsymbol{i}} \boldsymbol{PI_{ijt}} \cdot \frac{\boldsymbol{Q_{ijt}}}{\sum_j \boldsymbol{Q_{ijt}}} \tag{4}$$

$\boldsymbol{P_{it}}$ represents the price of product i at time t which is calculated by taking a weighted average of the prices of all varieties of product i in which weights are based on their WMRS exit quantities. After calculating a weighted average of monthly prices for each product that are included in the CPI basket, aggregation carried out as follows:

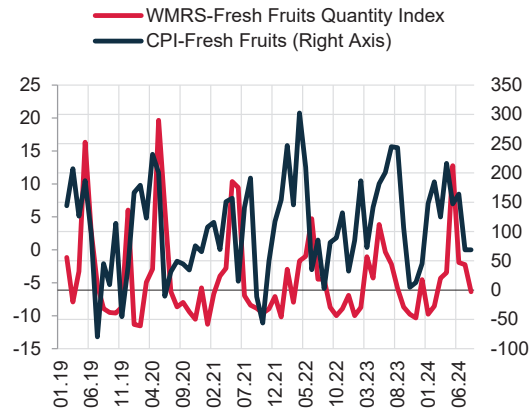
$$P_t = \sum_{i}^{I} w_i P_{it} \tag{5}$$

Where $\boldsymbol{P_t}$ represents the price index at time t and is the weight of product i. Product weights are the latest publicly published product weights by TURKSTAT. WMRS-based price indices are calculated for fresh fruits and vegetables, fresh fruits and vegetables separately. For each group the weights are redistributed within the group to sum up 1.

4. RESULTS

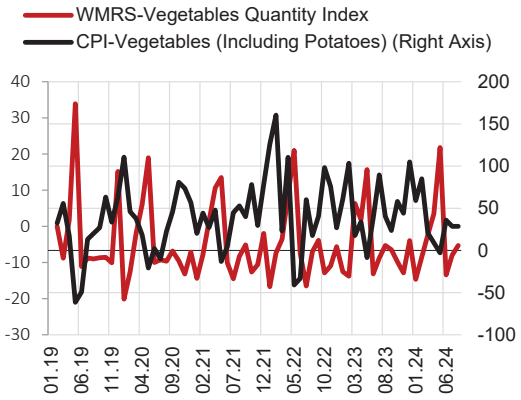
Food supply security has become increasingly important globally. In Türkiye, one of the world's and Europe's leading agricultural producers, "food supply security" and "sustainability" are among the prominent items in the new agricultural policy package announced. Food supply, which is related to production, stocks and demand, is critical for both sustainability and price stability. The monthly percentage change in the monthly supply indices for fresh fruits and vegetables based on the WMRS is presented in the graphs below along with the monthly consumer inflation of the relevant group.

Graph 1: WMRS Based Fresh Fruits Quantity Index and Consumer Price Index (Monthly % Change)



Source: MoT-WMRS, TURKSTAT, CBRT

Graph 2: WMRS Based Fresh Vegetables (Including Potatoes) Quantity Index and Consumer Price Index (Monthly % Change)

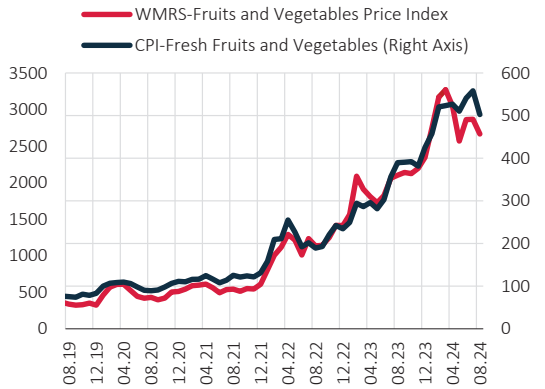


Source: MoT-WMRS, TURKSTAT, CBRT

As expected, the WMRS-based quantity indicators and consumer prices are negatively correlated (Graphs 1 and 2). Co-movement of quantity index and inflation against general pattern indicates the existence of shrinking supply pressure on prices.

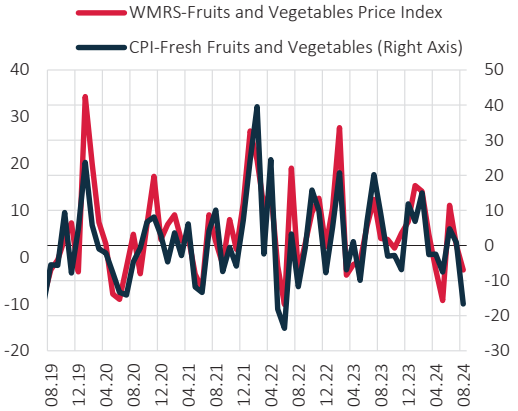
The indices constructed based on WMRS data provide high-frequency (10-day periods within a month) and timely information on fruit and vegetable prices. WMRS-based fresh fruit price indices move similarly to the CPI fresh vegetable price index, and monthly changes suggest that these indices are good indicators of monthly price developments (Graphs 3 and 4).

Graph 3: Fresh Fruits and Vegetables Price Indices



Source: MoT-WMRS, TURKSTAT, CBRT

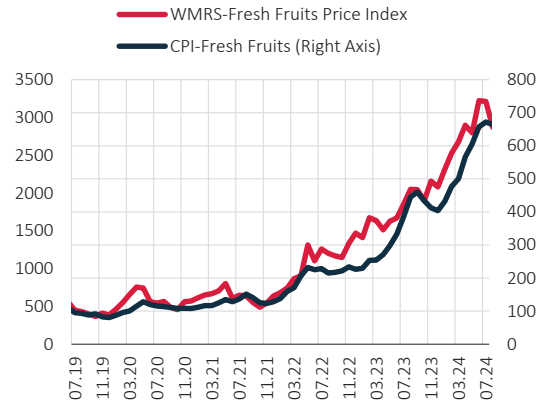
Graph 4: Fresh Fruits and Vegetables Price Indices (Monthly % Change)



Source: MoT-WMRS, TURKSTAT, CBRT

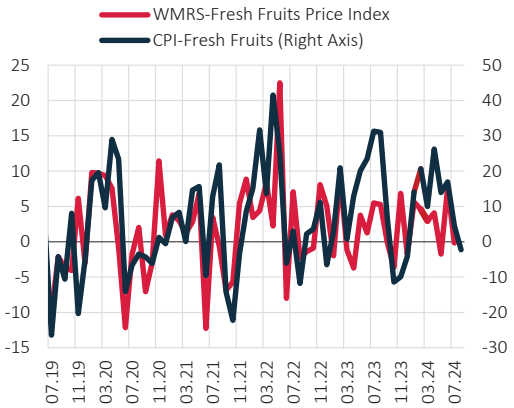
An analysis of the WMRS-based price indices for the fruits and vegetables subcategories reveals that both indices capture the general trend of the relevant consumer price index (Graphs 5,6 and 7,8). However, in the fruit group, the WMRS-based price index is generally higher than the CPI Fresh Fruits subcategory price index (Graph 5). The divergence observed in the fruit group may be mainly attributed to the higher export rate of the fruit group. As the WMRS based final consumption data suggests, in 2023 while 40.8% of total fruits were directed to exports, this number was limited to 13.4 for vegetables.

Graph 5: Fresh Fruits Price Indices



Source: MoT-WMRS, TURKSTAT, CBRT

Graph 6: Fresh Fruits Price Indices (Monthly % Change)

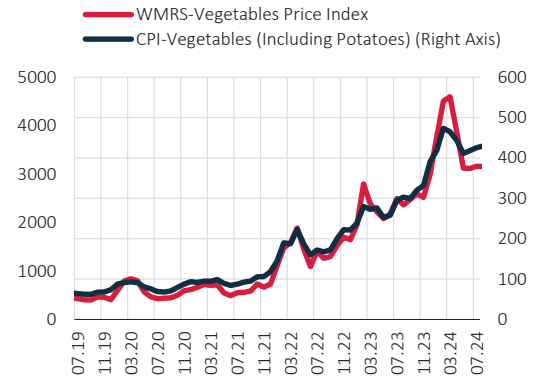


Source: MoT-WMRS, TURKSTAT, CBRT

Source: MoT-WMRS, TURKSTAT, CBRT

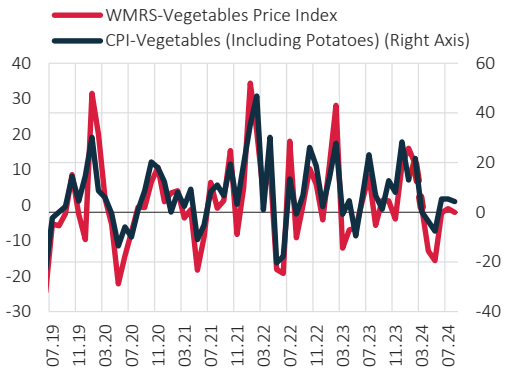
Source: MoT-WMRS, TURKSTAT, CBRT

Graph 7: Vegetables (Including Potatoes) Price Indices



Source: MoT-WMRS, TURKSTAT, CBRT

Graph 8: Vegetables (Including Potatoes) Price Indices (Monthly % Change)

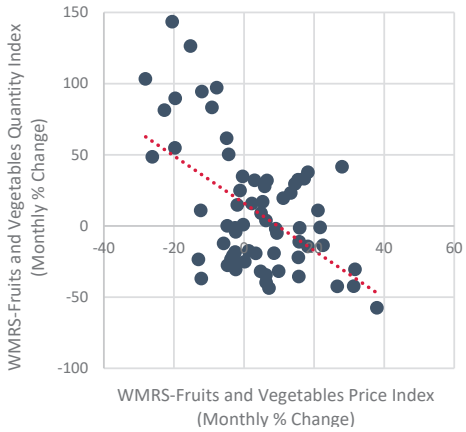


Source: MoT-WMRS, TURKSTAT, CBRT

WMRS-based fresh fruits and vegetables, fresh fruits and vegetables price indices, which are calculated using high-frequency current data, have a high capacity to reflect the general price trend.

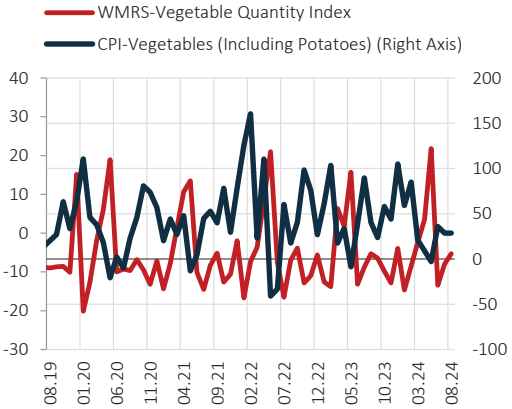
An analysis of the monthly changes in the quantity and price indices of fruits and vegetables constructed on the basis of the WMRS reveals a negative relationship between quantity and price, as expected (Graphs 9 and 10). For the periods in which the monthly changes in the quantity and price indices do not move in opposite direction as expected, non-supply factors may be the driver of price developments (Graph 10). For instance, the downward co-movement of the quantity and price indices of fruits and vegetables in July and August points to a contraction in consumer demand.

Graph 9: WMRS Fruits and Vegetables Quantity and Price Indices (Monthly % Change)



Source: MoT-WMRS, CBRT

Graph 10: WMRS Fruits and Vegetables Quantity and Price Indices (Monthly % Change)



Source: MoT-WMRS, TURKSTAT, CBRT

The CBRT tries to follow closely supply, demand and price developments in the fruit and vegetable group, which is important but not easy due to high volatility caused by weather conditions. Considering the relationship between the WMRS-based quantity and price indices both among themselves and with the CPI, it is assessed that they have a high information content for monitoring supply and price developments in the fruit and vegetable group and have the potential to provide input for forecasting studies.

5. CONCLUSION

Fruit and vegetable prices, which make up about a quarter of the food and non-alcoholic beverages group with the highest weight in the CPI basket, are among the most volatile components of Türkiye's inflation. They significantly influence food inflation, which is a major contributor to the overall inflation in the country. The unpredictability of the volatility caused by strong seasonality on overall consumer prices may pose difficulties for monetary policy communication. Therefore, forecasting the supply, demand and price movements of the fruit and vegetable subcategory is crucial for monetary policy. One of the most important factors in forecasting prices is supply and demand indicators. In Türkiye, there is no monthly indicator to monitor the supply of fresh fruits and vegetables and stocks for storable products. This study introduces the Wholesale Market Registration System, which provides a comprehensive data set on the supply and demand of fruits and vegetables, and alternative quantity and price indicators based on this system.

The dataset provided by the Wholesale Market Registration System is highly advantageous for analyzing the supply and demand dynamics in the fresh fruits and vegetables. Its higher frequency and detailed nature allow understanding price dynamics and their contribution to overall inflation. It enables policymaker to respond more quickly to the sudden price changes caused by potential supply shocks. Moreover, analyzing the quantity and price trends more detailed would enable to decompose inflation into its components, such as, seasonal patterns, weather shocks, regulatory shocks or trade shocks. Therefore, we believe this unique dataset is a valuable tool for improving demand and supply analysis in Türkiye.

This study shows that the fresh fruit and vegetable quantity and price indicators constructed from the Wholesale Market Registration System data, which contain comprehensive and timely quantity and price information on fresh fruit and vegetable products, are consistent with consumer prices. It is critical that these indices, which are considered to be consistent with the CPI, provide monthly indicators on the production, consumption and stocks of fresh fruit and vegetable products, which are difficult to forecast supply and demand due to their structure. We believe this paper makes a significant contribution to the literature by providing insightful information on market dynamics and policy-making. Forecasts based on these indicators can be used in different analyses as alternative leading indicators in addition to econometric models and expert judgements.

Conflict of Interest

All authors declare that they have no conflicts of interest.

Final Note

All views and opinions expressed here are of the authors and do not necessarily represent the official views of the Central Bank of Republic of Türkiye and its staff.

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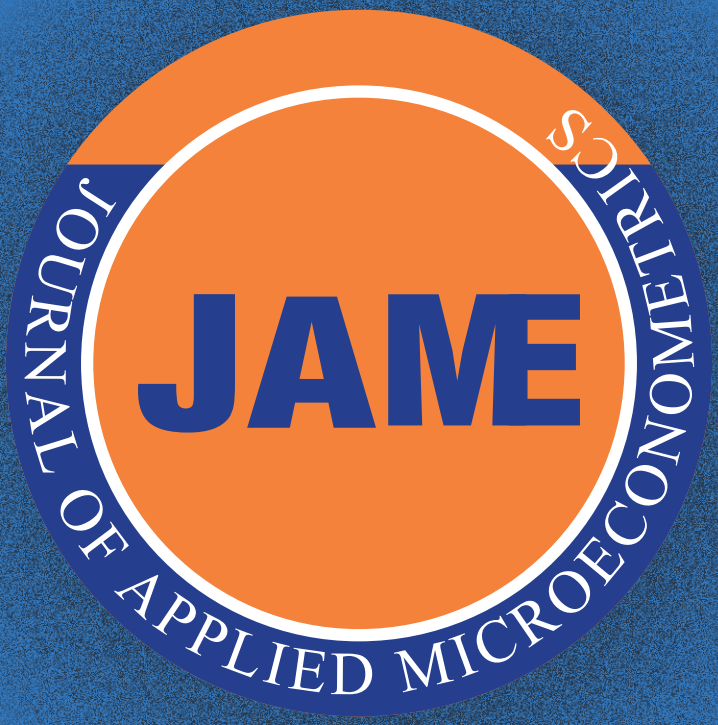

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