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*IFC.2025 is an international congress hosted by Işık University, Istanbul, Turkiye. IFC-2025 had participants from 16 different countries, namely; Turkiye, Philippines, Iran, United Arab Emirates, Ethiopia, Bangladesh, Pakistan, Nigeria, Azerbaijan, Poland, Lithuania, United Kingdom, India, Indonesia, Latvia and Tunisia.*
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# 14th ISTANBUL FINANCE CONGRESS | December 25, 2025 | ISTANBUL

# TENTATIVE CONGRESS PROGRAM

**14th Istanbul Finance Congress (IFC.2025) hosted by Işık University has participants from 16 different countries, namely; Philippines, Iran, United Arab Emirates, Tunisia, Ethiopia, Bangladesh, Pakistan, Nigeria, Azerbaijan, Poland, Lithuania, United Kingdom, India, Indonesia, Latvia and Turkiye. Hence, IFC.2025 is defined an "International Congress" qualified by the Higher Education Council of Turkiye.**

**ZOOM LINK: https://zoom.us/j/94622746393**

| OPENING SPEECHES \| SESSION 1 \| December 25, 2025, Thursday | |
|---|---|
| 10.30-10.40 | Prof. Suat Teker, Congress President, Welcoming Speech |
| 10.40-11.00 | **Keynote Speaker - I:** Assoc. Prof. Caner Ozdurak, MARBAS Chief Economist |
| | ***Breaking Point: How Cognitive Capitalism Reconfigures National Competitiveness and Global Economy*** |

| PRESENTATION SESSIONS | |
|---|---|
| 11.00 - 15.00 | **SESSION 2 \| https://zoom.us/j/94622746393** |
| | **Chair: Assoc. Prof. Cuneyt Dirican, Istanbul Arel University** |
| 11.00 - 11.15 | **The impact of ESG performance on financial performance: evidence from Turkiye** |
| | Busra Turgut Turan, Istanbul Technical University |
| | Kaya Tokmakcioglu, Istanbul Technical University |
| | Nihan Yildirim, Istanbul Technical University |
| 11.15 - 11.30 | **Modeling the Effects of Bitcoin, Gold, Inflation, and USD/TL Parity on BIST 100 Movements** |
| | Huseyin Cetin, Bursa Technical University |
| 11.30 - 11.45 | **Motivation on employee performance through top leadership commitment in the local water district in Laguna Province** |
| | Emma Africa-Fandino, Batangas State University, Philippines |
| 11.45 - 12.00 | **The interplay of innovation and sustainability: How ESG and R&D intensity impact financial performance in Turkish firms** |
| | Beste Pazarozyurt, Istanbul Technical University |
| 12.00 - 12.15 | **Debt Markets in the 19th Century World Economy and Foreign Borrowing of the Ottoman Empire** |
| | Zelha Altinkaya, Yalova University |
| 12.15 - 12.30 | **Why is bad news priced faster? Negativity bias and loss aversion in Borsa Istanbul** |
| | Semra Demir, Burdur Mehmet Akif Ersoy University |
| 12.30 - 12.45 | **Global vs. continental financial market infrastructures: a cross-jurisdictional pls-sem multi-group analysis of transaction cost economics** |
| | Hannes Laudenbach, University of Latvia |
| 12.45 - 13.00 | **Global financial cycles and the dynamics of private credit in emerging market economies: a panel var analysis** |
| | Alper Ozhan, Yeditepe University |
| | Sema Dube, Yeditepe University |

| | |
|---|---|
| 13.00 - 13.15 | **Structural determinants of productivity: sector-level evidence from Turkiye** |
| | Sinem Sefil Tansever, Istanbul Ticaret University |
| 13.15 - 13.30 | **No country for old loans: the rise in credit risk with geographic diversification** |
| | Caner Gerek, Kirklareli University |
| 13.30 - 13.45 | **Tick size change and institutional ownership: evidence from BIST** |
| | Ahmet Mert Kurumahmutoglu, Istanbul Technical University |
| | Cumhur Ekinci, Istanbul Technical University |
| 13.45 - 14.00 | **Statistical analysis of money laundering risks with public financial data sets** |
| | Tuba Aydin, Altinbas University |
| 14.00 - 14.15 | **The underlying theories of the Indonesian banking sector capital structure policy** |
| | Saiful, Universitas Bengkulu, Indonesia |
| 14.15 - 14.30 | **The impact of AI-powered embedded finance platforms on credit risk management** - Yapay zeka destekli gömülü finans platformlarının kredi riski yönetimine etkisi |
| | Tutku Unkaracalar, Kirklareli University |
| 14.30 - 14.45 | **Assessing the impact of inflation on the premium production and market value of insurance companies -** Enflasyonun sigorta şirketlerinin prim üretimi ve piyasa değeri üzerindeki etkisinin değerlendirilmesi |
| | Ilknur Kulekci, Istanbul Gelisim University |
| | Aysegul Ertugrul, Istanbul Gelisim University |
| 14.45 - 15.00 | **An alternative and scientific perspective against mainstream (Neoclassical, Neoliberal, Orthodox) assumptions in Türkiye in light of heterodox economics -** Heterodoks iktisat ışığında Türkiye'de ana akım (Neoklasik, Neoliberal, Ortodoks) kabullerine karşı alternatif ve bilimsel bakış |
| | Cuneyt Dirican, Istanbul Arel University |

| | |
|---|---|
| **15.00 - 17.30** | **SESSION 3 \| https://zoom.us/j/94622746393** |
| | **Chair: Prof. Dr. Suat Teker** |
| 15.00 - 15.15 | **Beyond linear regression: enhancing predictive accuracy in stock price prediction using machine learning ensemble methods** |
| | Samir Safi, United Arab Emirates University |
| | Mariam Daibam, United Arab Emirates University |
| | Dana Almuraqab, United Arab Emirates University |
| | Dania Awwad, United Arab Emirates University |
| 15.15 - 15.30 | **Does greater banking inclusion enhance or undermine financial stability in Tunisia? A nonlinear investigation** |
| | Meriem Sebai, University of Tunis El-Manar, Tunisia |
| | Omar Talbi, University of Tunis El-Manar, Tunisia |
| 15.30 - 15.45 | **Determinants of participation in off-farm employment among small holder farmers of Jimma Arjo District, East Wollega Zone, Oromia** |
| | Tekle Tamiru Yadeta,Wollega University, Ethiopia |

| | |
|---|---|
| **15.45 - 16.00** | **Do board governance mechanisms influence the intellectual capital–performance relationship? Evidence from an emerging economy** |
| | Raihan Sobhan, University of Dhaka, Bangladesh |
| **16.00 - 16.15** | **The role of tax incentives and refund mechanisms in promoting export growth in developing economies: Evidence from Pakistan** |
| | Khalid Mahmood, Hazara Univerity, Pakistan |
| **16.15 - 16.30** | **Closing doors, closing opportunities: The impact of bank branch coverage on SMEs** |
| | He He, Bangor University, United Kingdom<br>Ayan Orujov , Bangor University, United Kingdom<br>Cem Soner, Bangor University, United Kingdom<br>Binru Zhao, Bangor University, United Kingdom |
| **16.30 - 16.45** | **Financial technology and financial inclusion in Sub-Saharan Africa (SSA) countries** |
| | Olabisi Faseesin, Adekunle Ajasin University, Nigeria |
| | Adeleke Omolade, Federal University, Nigeria |
| | Damilola Olatunde Akinbode, Potential Miners International Research Center, Nigeria |
| | Aina Damilare Ezekiel, Federal University, Nigeria |
| **16.45 - 17.00** | **Sovereign green bonds and monetary stability: A comprehensive Review** |
| | Krish Bhatnagar, Birla Institute of Technology and Sciences, India |
| **17.00 - 17.15** | **Triple entry for holding companies** |
| | Reza Mirzaei, MazMaz Group, Iran |
| **17.15 - 17.30** | **AI in market dynamics and policy: Predicting economic shifts through machine learning** |
| | Goshgar Rasulov, Industrial Technologies, Azerbaijan<br>Nijat Mammadli, Vistula Universitty, Poland<br>Aygun Musayeva, Vytautas Magnus University, Lithuania |

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# ABSTRACTS OF THE CONGRESS

## GLOBAL FINANCIAL CYCLES AND THE DYNAMICS OF PRIVATE CREDIT IN EMERGING MARKET ECONOMIES: A PANEL VAR ANALYSIS

***Alper Ozhan, Yeditepe University,***
***Sema Dube, Yeditepe University***

This study investigates the bidirectional macro-financial dynamics of private domestic credit in emerging market economies (EMEs), examining both the external determinants of credit cycles and the subsequent consequences of credit expansion on the domestic economy. Utilizing a quarterly Panel Vector Autoregression (PVAR) framework for a sample of nine major EMEs (Brazil, Chile, India, Indonesia, the Republic of Korea, Malaysia, Mexico, Thailand, and Türkiye) over the period 2003–2023, the analysis employs Generalized Method of Moments (GMM) estimation to rigorously test the stability and causal relationships among real credit, output, inflation, exchange rates, portfolio flows, and policy rates.Regarding the determinants of credit, the results indicate that domestic lending conditions are overwhelmingly driven by external financial variables rather than internal policy levers. Consistent with the "Global Financial Cycle" hypothesis, portfolio investment inflows emerge as the strongest positive driver of real private domestic credit. Furthermore, the findings support the "Balance Sheet Channel" over the traditional Mundell-Fleming trade channel; exchange rate depreciations lead to a sharp contraction in credit supply, validating the "Contractionary Devaluation" hypothesis associated with currency mismatches in EMEs. In terms of consequences, the empirical evidence reveals a significant positive feedback loop between GDP growth and credit. This pro-cyclicality supports the "Financial Accelerator" theory, suggesting that credit expansion improves borrower net worth, which in turn fuels further lending, thereby amplifying the business cycle. However, the study finds that credit growth is not a primary driver of domestic price instability; instead, inflation dynamics are heavily dominated by exchange rate pass-through rather than demand-pull forces generated by lending. Finally, the Central Bank Policy Rate demonstrates a "disconnect" in the direct monetary transmission mechanism but functions as a "Pull Factor" for capital flows, suggesting that EMEs face a "Policy Trilemma" where macroprudential measures may be more effective than interest rates in managing the real effects of credit cycles

**Keywords**: Emerging markets, credit cycle, panel VAR, global financial cycle, balance sheet effect.
**JEL Codes:** C23, G21, E44

## THE IMPACT OF ESG PERFORMANCE ON FINANCIAL PERFORMANCE: EVIDENCE FROM TÜRKİYE

***Busra Turgut Turan, Istanbul Technical University,***
***Kaya Tokmakçıoğlu, Istanbul Technical University,***
***Nihan Yıldırım, Istanbul Technical University***

Corporate sustainability is an essential component of sustainability performance, focusing on the environmental and social impacts of firms while achieving business objectives and respecting the ability of future generations to meet their needs. It requires transparent disclosure of firms' impacts and mitigation efforts, emphasizing the relevance of Environmental, Social and Governance (ESG) concept. ESG is widely used to evaluate firms' corporate sustainability performance, and its relevance has increased significantly due to the rising stakeholder awareness and expectations on accountability and transparency. Meeting these expectations and improving ESG performance can also deliver financial benefits to firms by building trust and strengthening relationships with stakeholders. However, it requires additional investment and may result in varying impacts on financial/economic performance depending on the industrial and national context. The impact of ESG performance on financial performance has been examined by several studies, which have mostly found it to be positive. Yet, some studies reporting negative, neutral or mixed results leave the research area inconclusive, leaving a research gap for in depth studies on the relationship between ESG and financial performance. In this context, the purpose of this research is to investigate the impact of aggregate ESG performance, along with its individual Environmental, Social, and Governance pillars, on the financial performance of non-financial firms in Türkiye. By providing empirical evidence from Türkiye, an important emerging market, the study aims to contribute to the limited literature on the ESG-financial performance nexus in developing economies. The analysis focused on the firms listed on Borsa Istanbul, using a panel dataset comprising 240 firm-year observations from 40 non-financial firms over the period 2019–2024. ESG ratings are obtained from LSEG (formerly Refinitiv/Thomson Reuters), one of the most widely used global ESG rating providers. Financial performance is measured using return on assets (ROA). The empirical approach includes descriptive statistics, pairwise correlations, and multiple regression analyses to evaluate both the aggregate ESG score and the distinct Environmental, Social, and Governance pillars. The regression results indicate that the overall ESG score does not exhibit a statistically significant effect on the firms' ROA in Türkiye. When the individual pillars are examined, the analysis reveals that the Social pillar has a significant negative effect on ROA, suggesting that social-related activities or disclosures may impose short-term costs that outweigh their immediate financial benefits. In contrast, both the Environmental and Governance pillars exert positive but statistically insignificant effects on

should not be treated as a uniform construct; instead, firms should develop pillar-specific and context-sensitive ESG strategies. Particularly in emerging markets such as Türkiye, where institutional structures, regulatory frameworks, and stakeholder expectations differ from those in developed economies, the differentiated impacts of ESG components become even more pronounced. The study underscores the importance for managers and policymakers to assess how each ESG dimension aligns with strategic priorities and financial outcomes.
**Keywords:** ESG performance, corporate sustainability, financial performance, regression analysis, emerging markets
**JEL Codes:** G30, M14, Q56

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## MOTIVATION ON EMPLOYEE PERFORMANCE THROUGH TOP LEADERSHIP COMMITMENT IN THE LOCAL WATER DISTRICT IN LAGUNA PROVINCE

***Emma Africa Fandiño, Batangas State University-Pablo Barbon, Philippines***

This study investigates the impact of employee motivation and leadership commitment on employee performance within the Local Water Districts in Laguna Province, Philippines. It explores how intrinsic and extrinsic motivations, along with leadership commitment, influence employee performance, and examines whether leadership commitment mediates the effect of motivation on performance. A quantitative research design with a descriptive approach was used. Data were collected via a structured questionnaire administered to 256 respondents selected through stratified random sampling. Statistical tools such as descriptive statistics, t-tests, ANOVA, and regression analysis were employed to analyze the data. The study found that intrinsic motivation significantly influences employee performance, particularly in task and contextual performance. Leadership commitment plays a critical mediating role in translating motivation into improved performance, especially for intrinsic motivation. Significant differences in performance and motivation were observed based on demographic factors like age, gender, and income. This research emphasizes the importance of leadership commitment in fostering a motivated workforce. It suggests that intrinsic motivation is a stronger driver of performance than extrinsic factors. Based on the findings, a comprehensive Human Resource Intervention Program is proposed, focusing on leadership development, motivational strategies, and age-based engagement to enhance overall employee performance.
**Keywords:** Employee motivation, employee performance, top leadership commitment, mediation, local water district
**JEL Codes:** 3 JEL codes

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## MODELING THE EFFECTS OF BITCOIN, GOLD, INFLATION, AND USD/TL PARITY ON BIST 100 MOVEMENTS

***Huseyin Cetin, Bursa Technical University***

In this research, the main objective is to analyze the effects of Bitcoin, gold, Turkey's CPI, and USD/TL parity on changes in the BIST 100 between February 2021 and March 2025. The originality of this study lies in comparing the effects of these specific variables on the BIST 100. High inflation, drastic exchange rate variations, and growing public interest in cryptocurrencies were all factors in Turkey between 2021 and 2025 that had a significant impact on financial market asset allocation and investor behavior. Assessing the integration of digital and traditional assets in developing markets such as Turkey requires an understanding of these relationships. Since Bitcoin is a key component of the cryptocurrency market and is considered by many investors an alternative investment tool, changes in its price may influence the performance of the BIST 100. Including Bitcoin adds another aspect of originality to this research. According to the E-GARCH analysis, Bitcoin and gold prices do not have a significant effect on the performance of the BIST 100. However, it was found that Turkey's CPI and the USD/TL parity have significant positive effects on changes in the index. In the second stage of the analysis, a Markov regime-switching regression was applied to observe the regime-dependent effects of the variables. In the first regime, none of the variables were statistically significant. In the second regime, Bitcoin had a significant negative effect, while the USD/TL parity, gold, and Turkey's CPI all showed significant positive effects on the BIST 100. These results suggest that, in certain periods, investors may sell their BIST holdings to buy Bitcoin before an anticipated Bitcoin price increase, which could lead to a temporary decline in BIST 100 performance. Conversely, during some periods when the USD appreciates against the Turkish lira and gold prices rise, investors may redirect their profits into the BIST 100. For the third analysis, a Bayesian VAR impulse response analysis was implemented to observe the innovation impact of the variables on BIST 100 performance. It was found that Bitcoin, USD/TL parity, and Turkey's CPI have positive innovation impact, while gold has a negative innovation influence on the BIST 100. Observing the first-period innovation impact reveals that Bitcoin has the most positive influence among the variables. After the first period, the dominance of Bitcoin's innovation declined, while the USD/TL's innovation influence began to rise; in the final period, Turkey's CPI became the dominant factor for innovation impact. The study reveals that digital and traditional financial assets are becoming more connected in Turkey, providing valuable insights for investors, policymakers, and portfolio managers in managing market risks and developing investment strategies.
**Keywords:** Turkey's CPI, bitcoin, gold, bist 100, USD/TL parity
**JEL Codes:** C58, E44, G15

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## THE IMPACT OF AI-POWERED EMBEDDED FINANCE PLATFORMS ON CREDIT RISK MANAGEMENT: NEW PARADIGMS, OPPORTUNITIES, AND CHALLENGES

***Tutku Unkaracalar, Kırklareli University***

The purpose of this study is to examine, from a multidimensional perspective, the structural transformation created by artificial intelligence-supported embedded finance platforms in credit risk management. The invisible integration of financial services into digital ecosystems transforms credit risk assessment processes by moving them away from traditional banking towards a more dynamic, behavioural and data-based structure. Within this framework, the study aims to evaluate the effects of artificial intelligence algorithms on risk prediction performance, forms of data use and levels of transparency by analysing the platforms Stripe, Unit and Weavr in a comparative manner. Adopting a qualitatively oriented exploratory approach, it examines multiple data sources consisting of platform documentations, financial technology reports and the academic literature through content analysis. In addition, an original conceptual model explaining artificial intelligence-based credit risk management in the context of embedded finance has been developed. This methodological approach makes it possible to evaluate both the technological infrastructure and the ethical and regulatory dimensions in a holistic manner. The study shows that the analysed platforms exhibit clear differences in data processing capacity, algorithmic modelling techniques and risk management approaches. While Stripe's processing of behavioural data with deep learning models produces dynamic and highly accurate risk predictions; Unit's transparent analytical structure based on regulatory compliance strengthens auditability in the credit assessment process; and Weavr's modular risk engine allows flexible, sector-based credit assessments. However, it has been determined that critical problems such as data privacy, algorithmic bias and model explainability persist in all platforms.This study reveals that artificial intelligence-supported embedded finance platforms go beyond technical innovation in credit risk management and create a new financial architecture, and it offers original contributions to the literature both at the level of comparative platform analysis and at the level of a conceptual framework explaining the data–impact relationship. The findings constitute an important basis for future research on algorithmic transparency, regulatory compliance and the ethical boundaries of the use of alternative data

**Keywords:** Embedded finance, artificial ıntelligence, credit risk management, fintech, algorithmic bias
**JEL Codes:** G20, G24, O33

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## ASSESSING THE IMPACT OF INFLATION ON THE PREMIUM PRODUCTION AND MARKET VALUE OF INSURANCE COMPANIES

***Ilknur Kulekci, Istanbul Gelisim University***
***Aysegul Ertugrul, Istanbul Gelisim University***

The purpose of this study is to analyze the relationship between inflation, premium production, and market value of insurance companies operating in the insurance sector listed on Borsa Istanbul, and to determine the direction of causality among these variables..In this study, quarterly data of six insurance companies operating on Borsa Istanbul for the period between December 2014 and June 2025 were utilized. In the analysis, the variables used were the inflation rate (INF), total premium production (LNPP), and the market-to-book value ratio (PB). Unit root tests were applied to examine the stationarity of the variables, and the Granger causality analysis was subsequently conducted to determine the causal relationships among them. The analysis results indicate a statistically significant bidirectional causal relationship between the inflation rate and premium production. This finding reveals that both variables mutually influence each other. In contrast, no statistically significant effect of inflation on the market-to-book value ratio of insurance companies has been identified. Findings are consistent with the direction of the relationship predicted by the theoretical framework and align with the general trend observed in the existing literature. In this context, it can be stated that an increase in inflation weakens premium production and indirectly reduces market value, whereas lower inflation enhances premium production and strengthens the financial performance of the sector. The results emphasize the importance of maintaining price stability to ensure sustainable growth in the insurance industry. Therefore, policymakers and industry managers should take inflation dynamics into account when developing pricing strategies and long-term risk management policies.

**Keywords:** Inflation, premium production, market value, ınsurance companies, Granger Causality
**JEL Codes:** G22, E31, C32

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## DEBT MARKETS IN THE 19TH CENTURY WORLD ECONOMY AND FOREIGN BORROWING OF THE OTTOMAN EMPIRE

***Zelha Altınkaya, Yalova University***

Foreign debt has long been one of the central themes in international economics. It is widely argued that, when used productively, external borrowing to finance infrastructure, healthcare, education, and industrial investment—particularly in countries with insufficient domestic savings and capital—can foster long-term economic growth by enhancing productive capacity and efficiency. Throughout the last century, international loans have served not only as instruments for financing development and growth but also as mechanisms for managing current account deficits when export revenues proved inadequate to finance imports. By contrast, in the 19th century, the predominant motive for borrowing was the financing of wars among states. Foreign debt often functions as a signal of confidence for international investors, indicating the credibility of the borrowing country. Furthermore, it integrates economies into global capital markets, thereby facilitating investment,

trade, and financial cooperation. Nonetheless, access to international credit and the accumulation of excessive external debt entail significant economic and political risks. Creditors, in certain circumstances, may employ debt as a means of exerting influence. The challenges faced by heavily indebted poor countries (HIPCs) under unsustainable debt burdens have thus become a major issue in international governance. Moreover, a debt crisis in one country can generate contagion effects, undermining regional or global financial stability. Consequently, foreign debt has retained its relevance and importance within both national and international economic systems throughout history. Comparable dynamics were evident in the 19th century, when capital flows originated from the industrialized nations of the era and were directed toward less industrialized economies. The Ottoman Empire's borrowing practices constitute a significant case in this regard. Initially, the Empire contracted foreign loans to finance the costs of the Crimean War; however, within two decades, it became unable to meet its repayment obligations. Despite this, further borrowing ensued—particularly to fund railway construction—leading to a deepening of the debt burden. The establishment of the Ottoman Public Debt Administration effectively deprived the Empire of control over its fiscal sovereignty and its standing within international credit markets. This development was not merely a technical default; rather, the Ottoman Empire's foreign indebtedness evolved into a profound threat to its political autonomy and national independence. Although extensive research has examined this topic, the present study seeks to contribute to the literature through a comparative analysis of the international order, focusing on the borrowing conditions prevailing in global financial markets during the 19th century—especially the interest rates and lending terms applied to Latin American countries at a time when the Ottoman Empire was similarly indebted. The study employs a historical case study methodology to contextualize these dynamics within broader patterns of global financial relations.

**Keywords:** International economics, foreign capital, foreign debt, Ottoman, world economy, 19th century.
**JEL Codes:** F00, F 30, F34

## WHY IS BAD NEWS PRICED FASTER? NEGATIVITY BIAS AND LOSS AVERSION IN BORSA ISTANBUL

***Semra Demir, Burdur Mehmet Akif Ersoy University***

Irrational investor tendencies supporting behavioral finance theories highlight the crucial role of investor psychology in financial markets. The aim of this study is to identify the tendencies of investors in Türkiye regarding risk management and uncertainty. In this context, the study utilizes the Geopolitical Risk Index (GPR) developed by Caldara and Iacoviello (2022) and the Borsa Istanbul 100 (XU100) index as variables. The analysis covers monthly data from January 2013 to November 2025. To determine the stationarity of the variables, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests are employed. Given the mixed integration levels of the variables, the non-linear autoregressive distributed lag (NARDL) model is estimated to investigate the non-linear relationship and asymmetric effects between the variables. The calculated F-statistic (5.78) exceeds the upper critical value (5.15) at the 5% significance level; thus, the null hypothesis is rejected, confirming a long-term cointegration relationship. The coefficient for positive shocks related to GPR is found to be positive and statistically significant, whereas the coefficient for negative shocks is insignificant. The findings reveal that the XU100 index responds asymmetrically to geopolitical risks. Positive shocks—representing increases in geopolitical risk—have a statistically significant (at the 5% level) and positive effect on the stock market. Conversely, negative shocks—representing decreases in geopolitical risk—do not exhibit a statistically significant impact. These findings indicate that investors in the Turkish stock market price in bad news (increased risk) by rallying, yet they disregard good news. In behavioral finance, this tendency is known as "negativity bias." The results suggest that investors focus more on bad news (Negativity Bias) precisely because they fear loss (Loss Aversion). Consequently, they react faster and more strongly to increased geopolitical risk—perceiving it as a threat that often signals a currency shock—and take immediate action. Ultimately, investors utilize the stock market as a "Hedge Against Inflation" to protect their capital from erosion.

**Keywords:** Behavioral Finance, Negativity Bias, Loss Aversion, NARDL Approach
**JEL Codes:** G41, G14, C22, D81

## THE INTERPLAY OF INNOVATION AND SUSTAINABILITY: HOW ESG AND R&D INTENSITY IMPACT FINANCIAL PERFORMANCE IN TURKISH

***Beste Pazarozyurt, Istanbul Technical University***

In the contemporary global landscape, relying solely on cost leadership is no longer sufficient for maintaining a competitive advantage. Firms are now compelled to navigate a dual challenge: adhering to rigorous sustainability standards while simultaneously driving technological advancement. For emerging economies like Turkey, which shares deep economic ties with the European Union, this pressure is intensified by regulatory frameworks such as the European Green Deal. Consequently, companies must innovate through Research and Development (R&D) to survive, while also improving Environmental, Social, and Governance (ESG) performance to maintain legitimacy.

However, the simultaneous pursuit of these strategies presents a significant financial challenge. Both innovation and sustainability initiatives are capital-intensive and compete for the same finite pool of corporate resources. This forces managers into a "resource constraint dilemma," where they must balance the immediate costs of compliance and development against uncertain future returns. This research empirically investigates the complex interrelationships among R&D intensity, ESG performance, and firm financial performance—measured by Return on Assets (ROA)—within the specific context of the Turkish market.

The study analyzes a dataset of companies listed on Borsa İstanbul (BIST) over the period of 2020 to 2024. Financial and ESG data were sourced from the Refinitiv database, while R&D expenditure data was manually collected from Turkishtime. The empirical analysis employs two distinct statistical approaches to test the hypotheses. The results from the static model indicate a positive association between both ESG scores, R&D

intensity, and firm profitability. However, the dynamic model, which accounts for profit persistence (the influence of past success), reveals that the most significant determinant of current performance is prior financial performance. These findings suggest that while R&D and ESG are value-enhancing strategies, their impact is not instantaneous. Instead, they function as long-term investments where financial benefits lag behind the initial expenditure. The study concludes that managers and investors should not expect an immediate surge in profits within the same year of investment, but rather view these strategies as essential for long-term viability.

**Keywords:** ESG, R&D Intensity, Corporate Governance, Firm Financial Performance, Turkey
**JEL Codes:** O32, M14, L25

## GLOBAL VS. CONTINENTAL FINANCIAL MARKET INFRASTRUCTURES: A CROSS-JURISDICTIONAL PLS-SEM MULTI-GROUP ANALYSIS OF TRANSACTION COST ECONOMICS

***Hannes Laudenbach, University of Latvia***

This study examines how transaction costs arise and differ across Global and Continental financial market infrastructures (FMIs) by applying a cross-jurisdictional Transaction Cost Economics (TCE) framework. Motivated by regulatory and technological transformation following MiFID II/MiFIR, the research analyzes whether the structural determinants of transaction costs vary between internationally integrated stock exchange groups and regionally focused market operators. The study employs Partial Least Squares Structural Equation Modeling (PLS-SEM) combined with permutation-based Multi-Group Analysis (MGA) to evaluate how infrastructure transactions, market economics, and infrastructure operations interact in shaping transaction cost outcomes. Two anonymized datasets were constructed from audited financial statements, trading statistics, historical listing archives, and industry factbooks covering 2012–2023. All variables were transformed using natural logarithms to ensure statistical comparability. The PLS-SEM results reveal consistently high explanatory power for both institutional clusters (Global FMIs: $R^2$= 0.995; Continental FMIs: $R^2$= 0.975), confirming that the TCE-FMI model effectively captures structural cost dynamics across jurisdictions. The MGA findings identify significant cross-group differences in four of the five hypothesized relationships. Global FMIs exhibit markedly lower sensitivity of transaction costs to trading activity and stronger dependence on market economics, indicating greater scalability and stronger integration into international capital flows. Conversely, Continental FMIs remain more volume-driven, with operational structures that are more sensitive to fluctuations in trading intensity. Only the relationship between infrastructure operations and transaction costs shows no significant difference, suggesting a convergent operational cost architecture for personnel, technology, and overhead resources across jurisdictions. Overall, the study demonstrates that regulatory frameworks and institutional scope materially shape the cost architecture of financial markets. Global infrastructures appear to benefit from broader market reach, automation, and technological maturity, while Continental infrastructures retain a more traditional, activity-dependent cost structure. These results extend Transaction Cost Economics to the context of modern digitalized FMIs and provide a replicable methodological design for future cross-jurisdictional research on regulatory transformation and market infrastructure governance.

**Keywords:** Transaction Cost Economics, Financial Market Infrastructures, PLS-SEM, Multi-Group Analysis, MiFID II / MiFIR Regulation
**JEL Codes:** G18, G28, D23

## STRUCTURAL DETERMINANTS OF PRODUCTIVITY: SECTOR-LEVEL EVIDENCE FROM TÜRKİYE

***Sinem Sefil-Tansever, Istanbul Ticaret University***

The purpose of this study is to investigate how market concentration, capital intensity, labour share, and macroeconomic conditions shape sectoral productivity in Türkiye. Although substantial research highlights the link between market structure and productivity, empirical evidence from emerging economies, particularly at the sector level, remains limited. Türkiye represents an important case due to its structural heterogeneity, frequent macroeconomic fluctuations, and the coexistence of highly concentrated and highly competitive industries. This study aims to fill this gap by providing sector-level evidence based on the Annual Industry and Service Statistics (AISS) for the period 2009–2022. The analysis employs fixed-effects panel regressions. Labour productivity (lnprod) is modelled as a function of market concentration (HHI), capital–equipment ratio (lncer), employment scale (lnemployment), and the adjusted labour share (adj_ls). Additional models include exchange rate, interest rate, year fixed effects, and a linear time trend. Robust standard errors are clustered at the industry level. The results consistently indicate that increases in market concentration are associated with higher sectoral productivity across all model specifications. Although the magnitude of the HHI coefficient declines when macroeconomic controls or time effects are added, the positive and statistically significant relationship remains highly robust. Capital intensity is another strong and stable predictor of productivity, indicating that sectors employing more capital-intensive production technologies tend to achieve higher efficiency levels. In contrast, the effect of employment size becomes statistically insignificant when macroeconomic shocks are controlled for, suggesting that sector size alone does not drive productivity. The adjusted labour share has a persistent adverse impact on productivity, consistent with the idea that higher-productivity sectors allocate a smaller share of value added to labour. Finally, exchange rate and interest rate dynamics affect productivity in expected directions. The study concludes that productivity differences across sectors in Türkiye are shaped by both structural characteristics, particularly concentration and capital intensity, and macroeconomic conditions. The persistence of the concentration–productivity relationship suggests that market structure plays a significant role in sectoral performance.

**Keywords:** Market concentration, productivity, capital intensity, labour share, panel data analysis
**JEL Codes:** L11, O47, C23

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## NO COUNTRY FOR OLD LOANS: THE RISE IN CREDIT RISK WITH GEOGRAPHIC DIVERSIFICATION

***Caner Gerek, Kirklareli University***

This paper investigates the impact of geographic income diversification of large European banks on credit risk. Using a hand-collected dataset on geographic income shares, this study shows that greater geographic diversification increases the non-performing loans (NPL), a finding that challenges the traditional view that diversification is a stabilizing force. When foreign activities are disaggregated by region, the increase in credit risk is found to stem only from European operations, whereas activities in the rest of the world are statistically insignificant. Furthermore, the analysis identifies regulatory conditions in the home market as the driver of the positive relationship. The results also indicate that the positive association between geographic diversification and credit risk is stronger for banks that rely more on deposit-based funding. Overall, the findings, which remain robust across alternative diversification measures and econometric methods, highlight that diversification within integrated European markets can intensify, rather than mitigate, credit risk, questioning its conventional role as a stabilizing mechanism in the European banking sector.

**Keywords:** Bank business model, income diversification, European banking
**JEL Codes:** G20, G21

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## TICK SIZE CHANGE AND INSTITUTIONAL OWNERSHIP: EVIDENCE FROM BIST

***Ahmet Mert Kurumahmutoğlu, Istanbul Technical University,***
***Cumhur Ekinci, Istanbul Technical University***

Tick size changes generally do not provide Pareto improvements as they impact investors differently. Conventionally, smaller ticks reduce spreads and transaction costs, though they also reduce market depth since liquidity provision is harmed by smaller profit margin and cheaper undercutting. The reduction in depth leads to higher price impact cost since large order liquidity is affected. Therefore, how institutional investors are affected by tick change has always been a subject of interest. Literature shows that even though investors generally benefit from smaller tick sizes, institutional investors might prefer larger tick sizes. Existing studies mostly examine institutional investors' reaction to tick size changes by focusing on trading activity (volume or turnover). However, investment activity (ownership) represents another dimension of response. Among others, how institutional investors would respond to tick size changes and whether they would change their portfolio preferences remain relatively unexplored questions. Moreover, the ownership of foreign institutional investors who have influence on emerging markets has never been studied. The purpose of this study is to investigate the effects of tick size change on institutional ownership with a special focus on foreign investors. In this context, exploiting the tick size increase on BIST, we examine the ownership of institutional investors through mutual funds, pension funds and foreign investors. Using a difference-in-differences (DiD) model in an event window of 90 working days, we analyze ownership ratios in liquid and illiquid stocks. We take intermediaries as a proxy for ownership and calculate ownership ratios on a daily basis. Excluding the stocks that underwent stock split, capital increase through a rights issue or tick size change through price movements, the treatment and control groups consist of 16 (12) and 29 (114) liquid (illiquid) stocks respectively. The results show that, for liquid stocks, the treatment group experienced a decrease on institutional ownership ex-post across all groups. In other words, all the three types of institutional investors (i.e. mutual funds, pension funds, foreign investors) are inclined to hold smaller tick stocks in their inventory, suggesting that they benefit more from smaller tick when they are investing. This might indicate that they prefer immediacy to large order liquidity, potentially compensating price impact cost through order splitting. The lack of significant change in illiquid stocks may be market-specific as they likely disregarded illiquid stocks. Results could also imply that they have different tick preferences for trading and investing. Further research addressing the trading activity would likely provide more comprehensive evidence.

**Keywords:** Tick size, ownership, institutional investors
**JEL Codes:** G11, G14, G18

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## STATISTICAL ANALYSIS OF MONEY LAUNDERING RISKS WITH PUBLIC FINANCIAL DATA SETS

***Tuba Aydin, Altinbas University***

This study statistically examines money laundering (ML) risk in Türkiye over 2015-2024 using public financial datasets. We conceptualize ML not only as a criminal phenomenon but also as a structural threat to macroeconomic stability, fiscal discipline, and the integrity of financial intermediation. The analysis integrates official data from the Central Bank of the Republic of Türkiye (CBRT), Ministry of Treasury and Finance, Banking Regulation and Supervision Agency (BRSA), Financial Crimes Investigation Board (MASAK), Turkish Statistical Institute (TurkStat), and the Financial Action Task Force (FATF). Two dependent measures are employed: (i) a Money Laundering Index (MLI) constructed from shadow economy, cash intensity, tax revenue shortfall, financial depth, and FATF alignment; and (ii) Suspicious Transaction Reports (STRs) as a system-level signal of risk perception and supervisory capacity. Explanatory variables include FATF Compliance Score, cash density, tax collection gap, GDP growth, inflation, interest rate, financial-institution size, and compliance cost. We estimate correlations and regression models (time-series/panel formulations as permitted by data), supported by robustness checks, to assess directional associations between ML proxies and macro-financial indicators. Results indicate that higher ML intensity is negatively associated with financial stability and fiscal control: greater cash intensity and a wider tax gap co-move with higher STR volumes and MLI values; ML pressures complicate monetary control and are consistent with heightened volatility in interest and inflation dynamics. Conversely, improvements in FATF compliance are associated with lower ML risk proxies and reduced STR intensity after controlling for business-cycle conditions-albeit with non-trivial compliance costs borne

macro-fiscal and sectoral signals; and (3) sustain FATF-aligned reforms while optimizing the distribution of compliance burdens. Limitations stem from proxy measurement (no direct ML dataset), external shocks (e.g., COVID-19), and annual granularity for select variables; hence, results support analytical rather than statistical generalization. Overall, the paper translates public finance data into actionable AML intelligence and a scalable evidence base for policy design.
**Keywords:** Anti-Money Laundering (AML), Illicit Financial Flows (IFFs), Shadow/Informal Economy, Suspicious Transaction Reports (STRs), Public Data Analytics
**JEL Codes:** O17, H26, G28

## AN ALTERNATIVE AND SCIENTIFIC PERSPECTIVE AGAINST MAINSTREAM (NEOCLASSICAL, NEOLIBERAL, ORTHODOX) ASSUMPTIONS IN TURKIYE IN LIGHT OF HETERODOX ECONOMICS

***Cuneyt Dirican, Istanbul Arel University***

Neoclassical theories and neoliberal approaches, as well as orthodox monetary economics, are generally accepted as mainstream economics. Latest global (and local) economic and financial developments cannot be well explained by mainstream economic understanding, which does not help to cope with the problems created by itself as well. In Türkiye, especially after the pandemic, many unorthodox economic policies were under criticism by mainstream economists and commentators. Negative real interest rate (interest rate can be the cause of inflation based on Gibson Paradox, Neofisherian, Wicksell-Keynes Model, MMT, etc.), exchange rate protected deposit, macro prudential measures have been told as experimental economics and have no place in economic science, besides it was claimed strongly that returning to orthodox monetary policies by increasing central bank policy rate and tightening monetary policy will attract foreign investments, will solve foreign trade deficit, budget deficit and Turkish Lira depreciation as well as will lead to disinflation. As time passes and those claims have been proven as nonsense and invalid by looking at the macro figures, it was claimed that without tightening fiscal policies, those aims could not be achieved. Historical misconceptions of the mainstream economist can be explained by heterodox economics realities as well as their lack of orthodox and neoclassical knowledge. Bernanke et al. (2004) found that the policy rate has no impact on inflation in supply and energy inflation; hence reminds there are types of inflation. Inflation is not always and everywhere a monetary phenomenon, as Friedman suggested, surprisingly (for newcomers) admitted by him in his FT interview that central banks cannot control money supply. Because money is created by commercial banks when they open loans, which means loans are not provided after deposit taking, instead, vice versa has been proved, even Keynes in his book of 1930. Hence, claiming that wages, credit cards, or consumer loans (i.e. money supply) are the cause of inflation every time is not valid. Besides, government spending can be disinflationary under supply-side economic policies, and if productivity is achieved. Such arguments of mainstream economists, in general, are based on their confusion about correlation and causality. Many articles also show that the causality is two-way in these variables. On the other hand, an exchange rate protected deposit is a Turkish Lira option (DCD) product with one-way foreign currency, which should not be calculated among dollarization and the losses created by it in the central bank balance sheet are transitory until profit happens and does not affect its policies, as well as those losses are not paid by citizens' taxes. Heterodox new theories admit that any government borrowing with its local currency will not default (Kelton, 2020). Optimal foreign exchange reserves of central banks, as per Guidotti and Greenspan (1999), are problematic if government debts cannot be rolled over; otherwise, only interest rate cost will happen. Central bank swaps could be accepted under this rule, and since FX reserves excluding swaps are not valid under the IMF IRFCL Guidelines (2013), such an argument of the mainstream is also not scientific. Finally, experimental and neoliberal economics are under B5 Heterodox Approaches Jel Codes in AEA, which again mainstream economists in Türkiye failed to be aware of in general, as they failed to be aware of the existence of Mises's "Epistemological Problems of Economics" book (1933) because they also made fun of the word "epistemology". As the main conclusion, those assumptions on the economy and its impacts should be investigated in detail.
**Keywords**: Heterodox, Mainstream, Orthodox, Neoliberal, Neoclassical, Economics, Finance, Swap, Central Bank, Inflation
**JEL Codes:** B13, B25, B52, E12, E13, E42, E44, E51, E58, E62

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## ABSTRACT

**Purpose-** This study examines how transaction costs arise and differ across Global and Continental financial market infrastructures (FMIs) by applying a cross-jurisdictional Transaction Cost Economics (TCE) framework. Motivated by regulatory and technological transformation following MiFID II/MiFIR, the research analyzes whether the structural determinants of transaction costs vary between internationally integrated stock exchange groups and regionally focused market operators. The study employs Partial Least Squares Structural Equation Modeling (PLS-SEM) combined with permutation-based Multi-Group Analysis (MGA) to evaluate how infrastructure transactions, market economics, and infrastructure operations interact in shaping transaction cost outcomes.

**Methodology-** Two anonymized datasets were constructed from audited financial statements, trading statistics, historical listing archives, and industry factbooks covering 2012–2023. All variables were transformed using natural logarithms to ensure statistical comparability. The PLS-SEM results reveal consistently high explanatory power for both institutional clusters (Global FMIs: $R^2$= 0.995; Continental FMIs: $R^2$= 0.975), confirming that the TCE-FMI model effectively captures structural cost dynamics across jurisdictions.

**Findings-** The MGA findings identify significant cross-group differences in four of the five hypothesized relationships. Global FMIs exhibit markedly lower sensitivity of transaction costs to trading activity and stronger dependence on market economics, indicating greater scalability and stronger integration into international capital flows. Conversely, Continental FMIs remain more volume-driven, with operational structures that are more sensitive to fluctuations in trading intensity. Only the relationship between infrastructure operations and transaction costs shows no significant difference, suggesting a convergent operational cost architecture for personnel, technology, and overhead resources across jurisdictions.

**Conclusion-** Overall, the study demonstrates that regulatory frameworks and institutional scope materially shape the cost architecture of financial markets. Global infrastructures appear to benefit from broader market reach, automation, and technological maturity, while Continental infrastructures retain a more traditional, activity-dependent cost structure. These results extend Transaction Cost Economics to the context of modern digitalized FMIs and provide a replicable methodological design for future cross-jurisdictional research on regulatory transformation and market infrastructure governance.

**Keywords:** transaction cost economics, financial market infrastructures, PLS-SEM, multi-group analysis, MiFID II / MiFIR regulation
**JEL Codes:** G18, G28, D23

## 1. INTRODUCTION

In the years following the global financial crisis, regulatory reforms across major jurisdictions sought to reinforce market stability, increase transparency, and strengthen investor protection.[1] Within the European Union, MiFID I, MiFID II, and MiFIR emerged as central regulatory pillars, reshaping both the structural configuration and operational practices of financial market infrastructures.[2] These regulatory shifts influence not only the functioning of stock exchange organizations but also the economic mechanisms underlying transaction costs, infrastructure investments, and competitive dynamics.

At the same time, financial market infrastructures have become embedded in increasingly technology-intensive environments. Modern exchanges rely on digital process automation, cloud-based systems[3], and advanced data architectures utilized for artificial intelligence

[1] Francioni, Freis and Hachmeister (2017), pp. 239-259
[2] Francioni (2017), p. 11; Geranio (2018), pp. 15, 22-23, 27-28, 35-51
[3] Kun (2024), pp. 14-15

solutions[4], which alter the cost structure of pre- and post-trading services. As a result, regulatory compliance and technological capability increasingly act as intertwined drivers of operational efficiency and institutional competitiveness rather than external constraints.

Against this backdrop, the present study examines how infrastructure transactions, market economics, and infrastructure operations shape transaction cost formation within two distinct jurisdictional groups – Global and Continental financial market infrastructures. Using Partial Least Squares Structural Equation Modeling (PLS-SEM) combined with permutation-based Multi-Group Analysis (MGA), the study evaluates whether these structural relationships differ systematically across jurisdictions and regulatory conditions. This approach enables a nuanced assessment of how MiFID II/MiFIR[5] has transformed operational dependencies and transaction cost dynamics in technologically advanced financial market infrastructures operated by stock exchange organizations.[6] Based on the conceptual framework, five sub-hypotheses are formulated for empirical testing within the MGA design.

## 2. LITERATURE REVIEW

The literature foundations of this study were developed through a structured, multi-phase review of research on transaction cost economics, financial market infrastructures, and the organizational characteristics of stock exchanges. A systematic search strategy was employed to identify relevant theoretical and empirical work, resulting in an initial dataset of 52,180 academic records. Following screening based on predefined inclusion criteria, 77 peer-reviewed publications published between 1998 and 2023 were retained.[7] This body of literature provides a comprehensive overview of how transaction costs emerge within institutional settings and how financial market infrastructures evolve under changing technological and regulatory conditions.[8]

A significant portion of the reviewed literature examines the regulatory transformation of financial markets, particularly within the European Union. Studies focusing on MiFID I, MiFID II, and MiFIR highlight how transparency requirements, market structure reforms, and data-driven supervision influence trading behavior, operational processes, and cost formation within exchange groups. These regulatory analyses are complemented by supervisory assessments that document structural shifts in trading volumes, information products use, and cross-border market competitiveness.[9]

Guided by insights from the literature, the study develops the Transaction Cost Economics in Financial Market Infrastructures (TCE-FMI)[10] framework, which conceptualizes the interplay among transaction costs, infrastructure transactions, market economics, and infrastructure operations. This framework supports a systematic investigation of how these constructs behave across different institutional contexts – here operationalized as Global versus Continental financial market infrastructures.

To operationalize the model, an extensive dataset was compiled drawing on audited financial statements, historical trading statistics, and factbooks published by stock exchange groups and industry associations. The dataset also incorporates archival sources such as historical listing records, secondary market documents, and corporate disclosures, covering the period from 2012 to 2023. These materials form the empirical basis for the cross-jurisdictional comparison conducted through PLS-SEM[11] and permutation-based Multi-Group Analysis (MGA).

## 3. DATA AND METHODOLOGY

This study applies the Transaction Cost Economics in Financial Market Infrastructures (TCE-FMI) framework to examine how transaction costs arise from the interaction of three latent constructs: Infrastructure Transactions ($X_1$), Market Economics ($X_2$), and Infrastructure Operations ($X_3$). These constructs jointly determine Transaction Costs (Y) and allow a structured comparison between Global and Continental financial market infrastructures in the post-MiFID II environment.

Infrastructure Transactions ($X_1$) capture the intensity of trading activity, measured through electronic order book (EOB) trading days, processed trades, and turnover across on- and off-order-book segments. Market Economics ($X_2$) reflects the economic scale and market scope of an exchange group, operationalized through market capitalization and the number of domestic, foreign, and total listings. Infrastructure Operations ($X_3$) represent internal cost structures, including personnel expenses, other operating costs, depreciation, and amortization, which together capture the operational capacity required to support trading, clearing, and settlement functions.

Transaction Costs (Y) are operationalized through revenue components linked to listing, trading, clearing, settlement, information services, indices, and connectivity solutions, providing a standardized proxy for the transaction costs faced by market participants.

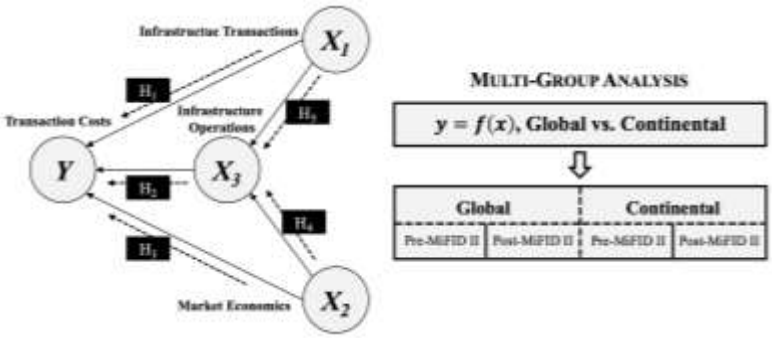
To test the structural relationships among these constructs, the study applies Partial Least Squares Structural Equation Modeling (PLS-SEM). Given the observational nature of financial data, PLS-SEM identifies theoretically consistent associations rather than strict causal effects, and all variables are transformed using natural logarithms to improve scaling and distributional properties.

A Permutation Multi-Group Analysis (MGA) is then conducted to compare structural relationships between two anonymized institutional clusters – Global versus Continental FMIs – selected for their distinct market reach, technological maturity, and operational models. This

[4] Tchuente, Lonlac and Kamsu-Foguem (2024), p. 9; Ghosh, Chaudhuri, Alfaro-Cortés, Gámez and García (2022).
[5] COMMISSION-DELEGATED-REGULATION-(EU)-2017/567 (2017)
[6] Bitz (2007), pp. 7-28; Williamson (1981), pp. 1537-1538; 1543-1551; Schmidt (1983), p. 187; Francioni (2017), pp. 15-70
[7] Laudenbach (2025b)
[8] Francioni (2017), p. 64; Benston and Smith (1976), pp. 228-229; Geranio (2018), p. 99
[9] ESMA-50-165-1355 (2020)
[10] Laudenbach (2025d); Laudenbach (2025c); Laudenbach (2025a)
[11] Hair Jr., Hult, Ringle, Sarstedt, Danks and Ray (2021)

cross-jurisdictional comparison enables the assessment of heterogeneous regulatory and strategic effects in European and international market infrastructures. Figure 1 represents the conceptual design of the TCE-FMI-Model.

**Figure 1: The Theoretical Research – TCE-FMI-Model[12]**




Based on the theoretical model and expected regulatory and technological differences between Global and Continental infrastructures, the following hypotheses are formulated:

- $H_1$: The impact of infrastructure transactions on transaction costs is significantly lower in Global financial market infrastructures than in Continental infrastructures, reflecting higher scalability and greater automation among globally oriented FMIs.
- $H_2$: The influence of infrastructure operations on transaction costs does not differ significantly between Global and Continental FMIs, indicating a convergent cost structure for personnel, technology, and operating expenditures across jurisdictions.
- $H_3$: Market economics exert a stronger influence on transaction costs in Global FMIs compared to Continental FMIs, reflecting the broader scale, higher international listings, and cross-border capital flows in globalized markets.
- $H_4$: Market economics have a significantly stronger effect on infrastructure operations in Global FMIs compared to Continental FMIs, driven by higher operational complexity, regulatory obligations, and data-related processing requirements.
- $H_5$: Infrastructure transactions exert a stronger influence on infrastructure operations in Continental FMIs compared to Global FMIs, reflecting greater operational sensitivity to trading activity among regionally focused exchanges.

## 4. FINDINGS: GLOBAL VERSUS CONTINENTAL

### 4.1. Explanatory Power of the Structural Model ($R^2$)

The structural model demonstrates very high explanatory power in both groups. For the Global FMIs, the $R^2$ for Transaction Costs is 0.995, while for Infrastructure Operations value is 0.798. Similarly, the Continental FMIs show strong explanatory power with $R^2$ values of 0.975 for Transaction Costs and 0.862 for Infrastructure Operations. These consistently high $R^2$ values indicate that the TCE-FMI model captures the structural cost and economic mechanisms in FMIs with substantial accuracy across jurisdictions.

### 4.2 Relationship Between Variable Construct (β)

Across both groups, the estimated path coefficients reveal meaningful differences in how trading activity, operational load, and market structure influence transaction costs. Global FMIs exhibit a weak link between Infrastructure Transactions and Transaction Costs (β = 0.013), whereas this relationship is much stronger for Continental FMIs (β = 0.362). Conversely, Market Economics exert a substantially stronger effect on Transaction Costs in Global FMIs (β = 0.744) than in Continental FMIs (β = 0.378). These differences indicate that globalized infrastructures rely more heavily on market scale and listing breadth, whereas continental infrastructures remain more sensitive to trading intensity.

### 4.3 Measurement Model: Indicator Loadings

All indicators across both groups exhibit loadings well above the conventional 0.70 threshold, confirming strong indicator reliability. The constructs Infrastructure Transactions, Infrastructure Operations, Market Economics, and Transaction Costs consistently demonstrate high internal cohesion. This supports the robustness of the measurement model and confirms that the indicators appropriately reflect the underlying conceptual dimensions of the TCE-FMI framework.

### 4.4. Permutation Multi-Group-Analysis (MGA) with Permutation P-Value (PP) and Summary of Sub Hypotheses-Test Conclusion

The MGA results reveal statistically significant structural differences between Global and Continental FMIs for four of the five relationships. Significance is determined using the Permutation p-value (PP) at a 5% level. Table 1 and Table 2 summarizing the results.

[12] Authors own figure based on Laudenbach (2025d); Laudenbach (2025c)

**Table 1: Permutation Multi-Group Analysis (MGA): Path Coefficients and Permutation Statistics[13]**

| Permutation Multi-Group-Analysis (MGA) Path coefficients with Permutation P-Value | Original Global | Original Contiental | Original Difference | Permutation Mean Difference | 2.50% | 97.50% | Permutation P Value |
|---|---|---|---|---|---|---|---|
| $H_1$: Infrastructure Transactions → Transaction Costs | 0.013 | 0.362 | -0.349 | 0.000 | -0.160 | 0.160 | 0.000 |
| $H_2$: Infrastructure Operations → Transaction Costs | 0.277 | 0.294 | -0.018 | 0.001 | -0.182 | 0.178 | 0.853 |
| $H_3$: Market Economics → Transaction Costs | 0.744 | 0.378 | 0.366 | -0.001 | -0.127 | 0.123 | 0.000 |
| $H_4$: Market Economics → Infrastructure Operations | 0.472 | 0.252 | 0.220 | 0.000 | -0.128 | 0.125 | 0.001 |
| $H_5$: Infrastructure Transactions → Infrastructure Operations | 0.482 | 0.707 | -0.224 | 0.000 | -0.123 | 0.124 | 0.000 |

**Table 2: Hypotheses ($H_1$–$H_5$) – Global versus Continental[14]**

| Hypotheses ($H_{1-5}$) - Global vs. Continental | Permu. P-value (PP) | Result (PP-value) | Original Difference | Null Hypothesis | H-Test Conclusion |
|---|---|---|---|---|---|
| $H_1$: Infrastructure Transactions → Transaction Costs | 0.000 | Significant | -0.349 | Rejected | Preliminary confirmed |
| $H_2$: Infrastructure Operations → Transaction Costs | 0.853 | Not significant | -0.018 | Failed to reject | Not confirmed |
| $H_3$: Market Economics → Transaction Costs | 0.000 | Significant | 0.366 | Rejected | Preliminary confirmed |
| $H_4$: Market Economics → Infrastructure Operations | 0.001 | Significant | 0.220 | Rejected | Preliminary confirmed |
| $H_5$: Infrastructure Transactions → Infrastructure Operations | 0.000 | Significant | -0.224 | Rejected | Preliminary confirmed |

$H_1$: Infrastructure Transactions → Transaction Costs: Global FMIs show a significantly lower dependence of transaction costs on trading activity than Continental FMIs, indicating higher scalability and automation in global infrastructures.

- $H_2$: Infrastructure Operations → Transaction Costs: No significant difference exists between Global and Continental FMIs, meaning both groups share a similar operational cost structure for personnel, technology, and overhead.
- $H_3$: Market Economics → Transaction Costs: Market economics exert a significantly stronger influence on transaction costs in Global FMIs, reflecting their higher international integration and broader listing base.
- $H_4$: Market Economics → Infrastructure Operations: Global FMIs experience a significantly stronger operational impact from market size and listings, indicating greater complexity in managing large-scale, cross-border market structures.
- $H_5$: Infrastructure Transactions → Infrastructure Operations: Continental FMIs show a significantly stronger operational sensitivity to trading activity than Global FMIs, suggesting a less scalable operational framework.

The MGA findings reveal substantial structural differences between Global and Continental financial market infrastructures, with four out of five hypotheses supported. Global FMIs are more strongly shaped by market size and international listing dynamics, whereas Continental FMIs remain more sensitive to trading activity and operational load. Overall, the results demonstrate that globalized infrastructures benefit from greater scalability and automation, while continental infrastructures retain a more volume-dependent operational structure.

## 4.5. Limitations

A key limitation of this study arises from the required anonymization of institutional data, which, while necessary for ethical and confidentiality reasons, reduces contextual specificity and restricts direct comparisons across individual market operators or national environments. Moreover, potential endogeneity is inherent in observational financial data and cannot be fully resolved within a PLS-SEM framework; consequently, the identified relationships should be interpreted as associative rather than causal. Finally, the analysis includes only two institutional groups, limiting broader generalizability.

## 5. CONCLUSION

This study provides a cross-jurisdictional assessment of how transaction costs arise within Global and Continental financial market infrastructures by applying the TCE-FMI framework through PLS-SEM and permutation-based Multi-Group Analysis. The results demonstrate that while both groups exhibit consistently strong explanatory power, their structural cost drivers differ markedly. Global FMIs show a reduced dependence on trading volume and a stronger linkage between market economics and both transaction costs and infrastructure operations, reflecting higher scalability, broader market integration, and more advanced technological infrastructures. In contrast, Continental FMIs remain more sensitive to trading intensity and operational load, indicating a more volume-dependent cost structure.

Overall, the findings highlight that institutional scope, technological maturity, and market breadth materially shape transaction cost dynamics. The study extends TCE by illustrating how regulatory and technological environments condition the relationships among trading activity, operational complexity, and market scale. These results contribute to academic understanding of FMI cost structures while providing a replicable methodological template for future cross-jurisdictional research on regulatory transformation and digitalization in financial markets.

## DISCLAIMER: Data Usage and Research Intent, Financial Instrument Projections, and Artificial Intelligence

Data Usage and Research Intent: This study relies exclusively on publicly available data and serves purely academic purposes. No business, strategic, or institution-specific conclusions are intended. The accuracy of external data sources cannot be guaranteed.

[13] Authors own figure
[14] Authors own figure

Financial Instrument Projections: Any references to financial developments are illustrative and based solely on historical information. Past performance does not predict future outcomes, and no responsibility is assumed for future market conditions.

Artificial Intelligence: Generative AI (ChatGPT-5.1, OpenAI) was used solely for linguistic refinement and clarity. All conceptual, analytical, and empirical components of the research were developed independently by the author.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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# STATISTICAL ANALYSIS OF MONEY LAUNDERING RISKS WITH PUBLIC FINANCIAL DATA SETS

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## ABSTRACT

**Purpose-** This study statistically examines money laundering (ML) risk in Türkiye over 2015-2024 using public financial datasets. We conceptualize ML not only as a criminal phenomenon but also as a structural threat to macroeconomic stability, fiscal discipline, and the integrity of financial intermediation. The analysis integrates official data from the Central Bank of the Republic of Türkiye (CBRT), Ministry of Treasury and Finance, Banking Regulation and Supervision Agency (BRSA), Financial Crimes Investigation Board (MASAK), Turkish Statistical Institute (TurkStat), and the Financial Action Task Force (FATF).

**Methodology-** Two dependent measures are employed: (i) a Money Laundering Index (MLI) constructed from shadow economy, cash intensity, tax revenue shortfall, financial depth, and FATF alignment; and (ii) Suspicious Transaction Reports (STRs) as a system-level signal of risk perception and supervisory capacity. Explanatory variables include FATF Compliance Score, cash density, tax collection gap, GDP growth, inflation, interest rate, financial-institution size, and compliance cost. We estimate correlations and regression models (time-series/panel formulations as permitted by data), supported by robustness checks, to assess directional associations between ML proxies and macro-financial indicators.

**Findings-** Results indicate that higher ML intensity is negatively associated with financial stability and fiscal control: greater cash intensity and a wider tax gap co-move with higher STR volumes and MLI values; ML pressures complicate monetary control and are consistent with heightened volatility in interest and inflation dynamics. Conversely, improvements in FATF compliance are associated with lower ML risk proxies and reduced STR intensity after controlling for business-cycle conditions-albeit with non-trivial compliance costs borne by financial institutions (e.g., KYC, reporting, internal audit). The findings highlight the strategic value of public-data analytics for early risk detection, scenario monitoring, and the calibration of risk-based supervision.

**Conclusion-** Policy implications are threefold: (1) strengthen data governance and routine publication of high-frequency AML-relevant indicators; (2) advance risk-based oversight using composite indices (MLI) that fuse macro-fiscal and sectoral signals; and (3) sustain FATF-aligned reforms while optimizing the distribution of compliance burdens. Limitations stem from proxy measurement (no direct ML dataset), external shocks (e.g., COVID-19), and annual granularity for select variables; hence, results support analytical rather than statistical generalization. Overall, the paper translates public finance data into actionable AML intelligence and a scalable evidence base for policy design.

**Keywords:** Anti-Money Laundering (AML); Illicit Financial Flows (IFFs); Shadow/Informal Economy; Suspicious Transaction Reports (STRs); Public Data Analytics
**JEL Codes:** O17, H26, G28

## 1. INTRODUCTION

The internationalization of finance, computerization of payments and high capital mobility have entwined the macroeconomic consequences of money laundering (ML) with domestic economies. ML-the concealment of illicit proceeds through formal financial systems-affects not only the internal operations of financial institutions but also macro-stability, public finance, income distribution, investment climate and overall financial soundness (Abuabdin & Shuaibu, 2024). In developing economies these effects cumulate with structural frictions such as a sizeable informal sector, tax losses, corruption and capital flight, making data-driven ML risk analysis a policy imperative. Injecting illegitimate funds complicates monetary control, destabilizes liquidity and is associated with volatility in interest, exchange and inflation indicators; on the fiscal side, it narrows the tax base and widens revenue gaps (Akkaynak, 2022). Unrecorded outflows weaken bank balance sheets and elevate systemic risk. Concurrently, algorithmic audit systems and risk-based controls have begun to improve anomaly detection and reduce false positives in financial supervision, yet they also raise compliance costs (Akkaya, 2025). FATF standards require countries to measure and monitor ML risks; FATF compliance scores thus provide a salient external benchmark.

Against this backdrop, Türkiye experienced 2015-2024 as a decade of macro-financial volatility, rapid digitalization and expanding use of e-money, mobile payments and crypto assets-factors that reshape ML typologies (Akkaynak, 2022). Quantitative studies linking ML proxies to macro-fiscal indicators for Türkiye remain scarce (Akyürek, 2022). This paper addresses that gap by constructing a Money Laundering Index

(MLI), examining Suspicious Transaction Reports (STRs) and estimating their relationships with FATF compliance, cash intensity, tax collection gap, GDP growth, inflation, interest rates, financial-institution size and compliance cost. Using official public datasets (CBRT, TurkStat, Ministry of Treasury and Finance, BRSA, MASAK, FATF), the study offers an integrated, evidence-based view of how ML pressures interact with macro-financial dynamics and derives policy-relevant implications for risk-based supervision, data governance and fiscal transparency.

## 2. LITERATURE REVIEW

**Conceptual Framework: Illicit Proceeds and Money Laundering -** Illicit proceeds arise from crimes such as narcotics, arms trafficking, tax evasion, corruption, and terrorism financing (Akyürek, 2022). "Money laundering" denotes concealing the criminal origin of funds and integrating them into the formal economy via three stages-placement, layering, and integration-aimed at disguising source, ownership, and control. Laundering distorts financial data and macro indicators, weakening fiscal policy effectiveness (Arnone & Padoan, 2008). Risk-based methods and data analytics are central to detection (Castelao-López et al., 2025).

**Historical Evolution -** Modern AML practice builds on cases from Prohibition-era organized crime; subsequent pillars include the U.S. BSA (1970), the 1988 Vienna Convention, FATF's 40 Recommendations, and KYC/STR regimes. Since the 2010s, crypto-assets and darknet markets have introduced new typologies (Aytaç & Bilge, 2020).

**Economic, Social, and Political Effects -** Laundering misallocates resources, enlarges the shadow economy, erodes the tax base, and heightens financial instability; gray-list exposure can dampen capital inflows (Castelao-López et al., 2025; Akyürek, 2022). Socially, it undermines fairness and exacerbates inequality; politically, it fuels corruption and institutional erosion (Ercan, 2016; Çakmak, 2025; Mayernik, 2017).

**Process and Stages -** Placement: cash-intensive sectors, structuring/smurfing, fictitious or inflated invoicing (Çakmak, 2025). Layering: rapid multi-jurisdiction transfers, offshore shells, TBML; in crypto, mixing and chain-hopping (Doğan & Yıldız, 2021). Integration**:** real estate and portfolio investments, back-to-back loans, round-tripping with macro-level distortions (Egmont Group et al., 2025).

**Linkages with Other Financial Crimes -** Money laundering both results from and sustains corruption, tax evasion, market abuse, and payment/banking fraud schemes; high-velocity, algorithmic transactions complicate monitoring (Ekmen, 2024; Ercan, 2016).

**Terrorist Financing (TF) Nexus -** While objectives differ, AML and CFT share channels and risk environments; small-value, seemingly legitimate flows are operationally significant. VASPs, blockchain analytics, and the Travel Rule remain regulatory focal points (Erylmaz & Biricikoğlu, 2011; Çakmak, 2025; IMF, 2009).

**Role of Financial Intelligence -** FIUs (e.g., MASAK) transform STRs into strategic and operational intelligence via anomaly detection, network analytics, and data mining; outputs inform policy and international assessments (Erdinç, 2010; Arnone & Padoan, 2008).

**Public Financial Data Sets: Definition and Value -** Budget, debt, tax, SOE, local government, and financial stability indicators underpin fiscal transparency and accountability. Open-data initiatives strengthen analytical capacity and oversight (FATF & APG, 2015; Erdinç, 2010).

**Components and Principles -** Revenue-expenditure, debt-assets, budget performance, audit reports, and digital reporting modules gain meaning through **transparency, accountability, and open-data** principles (Altun et al., 2017).

**Analytical Use -** Standardization, time-series construction, regression/correlation, clustering-network methods, and anomaly detection support early identification of AML risks (Georgieva, 2020; Udeh et al., 2024).

**Roles and Obligations of Financial Institutions -** KYC/EDD, STR filing, record-keeping, and robust compliance-internal audit systems are core; for emerging channels (fintech, crypto), real-time algorithmic monitoring is critical. Coordination among BRSA, CMB, and MASAK, and alignment with FATF/Basel/EU standards shape the framework (Hyland-Wood, 2022; Jiang, 2024).

**MASAK and National FIUs -** Within a prevention-analysis-coordination axis, risk-based supervision, National Risk Assessments, and Egmont-network information exchange enhance effectiveness. Electronic analytics platforms (including blockchain and network tools) expand technical capacity (Işık, 2022; Irving Fisher Committee, 2021).

**International Architecture -** FATF mutual evaluations and listing policies; World Bank/IMF technical assistance and FSAP; OECD transparency (CRS/BEPS); and UNODC conventions together constitute the global AML/CFT regime (Jensen & Iosifidis, 2023).

**FATF Focus -** Risk-based approach, beneficial ownership transparency, virtual-asset coverage (Rec. 15/Travel Rule), and cross-border cooperation are central; non-compliance can impair investment climates (Jiang, 2024; Jiao, 2023).

**Egmont Group -** Secure FIU-to-FIU exchange (Egmont Secure Web), standards, and capacity building enable rapid tracing of cross-border flows (Karaca, 2008).

**EU Directives -** AMLD1-6 establish KYC/STR, PEP, and UBO registers; extend to VASPs; require enhanced measures for high-risk countries; and, prospectively, empower the EU AMLA as a central supervisor (Kuzmenko et al., 2020; Kurban, 2023).

**Turkey's Legal Framework -** Article 282 of the Turkish Penal Code criminalizes laundering; Law No. 5549 and the "Measures Regulation" set CDD/STR/record-keeping duties; MASAK's role and administrative sanctions are defined. Law No. 6415 addresses CFT obligations (Lin, 2019; Lokanan, 2019).

**Risk Analysis and Measurement-** Within the Risk-Based Approach (RBA), threat-vulnerability-impact triad informs customer/product/transaction/geographic risk scoring. National and institutional assessments increasingly leverage AI-enabled early-warning systems (OECD, 2013; Rekunenko et al., 2025).

**Indicators and Models -** Macro indicators (shadow economy size, capital flows) and micro markers (account cycles, TBML price gaps, UBO opacity, blockchain metrics) combine with time-series, clustering, network, anomaly detection, and supervised learning (OSAA, 2022; Ramanujam, 2025).

**Descriptive and Econometric Toolkit -** Descriptive statistics (distribution/volatility/outliers), correlation-regression, panel methods, and cointegration tests support policy evaluation and forecasting (Szołno-Koguc, 2018; Towett et al., 2019).

## 3. DATA AND METHODOLOGY

**Method and Research Design -** This study examines how the Basel risk score relates to price level, monetary composition, and expectations indicators using an annual, single-country panel (2015–2024). A multi-method quantitative design is employed, including descriptive statistics; linear (Pearson) and ordinal/monotonic (Spearman) association tests; dimensionality reduction via PCA; and predictive models-OLS, ARIMAX, and logistic classification. Internal validity is supported through diagnostics (assumption checks, residual tests), multicollinearity control via PCA/VIF, and small-sample safeguards (stationarity and causality tests). The analytic sequence proceeds from distributional summaries and confidence intervals, followed by correlation screening, then PCA-based component construction, and finally regression, time-series, and logistic modeling.

**Universe and Sample -** The population comprises annual country-level indicators of risk, prices, real efficiency, monetary structure, and expectations. The sample (N=10 for most series; up to N=11 for monetary ratios) includes: Basel score and ranking; MASAK STR totals and STR per capita; ln(Net Errors & Omissions) in the balance of payments; CPI inflation; real GDP growth; cash/GDP and cash/M2; and economic and consumer confidence indices.

**Data Collection Process -** Data are compiled from official statistics, regulator reports, and public index databases on a calendar-year basis. Definitions and scope are validated against metadata; primary sources are tracked end-to-end. Price/growth/confidence indicators come from official statistical tables; monetary ratios from central bank balance sheets/statistics; STR series from FIU publications; Basel indicators from annual index releases. When methodology updates occur, retrospective revisions are reviewed and harmonized.

**Data Collection Tools -** Spreadsheets and scripted workflows are used for ingestion, alignment, missing-value screening, and outlier checks. A data dictionary records each variable's definition, unit, transformations, source, and revision history. PCA, regression, time-series, and classification routines run in the same scripted environment with versioned, reproducible outputs.

**Data Analysis**

1. Descriptives: mean, SD, min-max, and 95% CIs; distributional features assessed.
2. Associations: Pearson (linear) and Spearman (monotonic), including blockwise comovement across price, monetary composition, and confidence sets.
3. PCA: two high-eigenvalue components interpreted as "price-monetary composition" and "real efficiency-sentiment."
4. OLS: Basel score on PCA scores; report coefficients, CIs, p-values; monitor multicollinearity (VIF) and test residual normality, autocorrelation, and heteroskedasticity.
5. ARIMAX: short-horizon dynamics for Basel with differencing, autoregressive terms, and exogenous PCA components; select by information criteria; verify white-noise residuals.
6. Logistic classification: binary "high-risk year" outcome; evaluate with ROC-AUC and accuracy; assess sensitivity-specificity via confusion matrix; add a shallow decision tree for interpretability and policy-oriented thresholds.

## 4. FINDINGS

The Basel risk score averages 5.922 with a narrow 95% CI (5.706-6.138), indicating strong clustering; Basel rank is dispersed (33k-71k), implying material year-to-year shifts. MASAK per-capita STR averages 0.603 (0.423-0.988) and is volatile yet more stable than total STR volume (avg 313.8M; high heterogeneity). ln(BOP net errors & omissions) centers at 23.015 (SD 0.594), signaling imbalances without dominance of extremes. CPI inflation averages 28.5% (95% CI: 14.7-42.4%) with a post-2020 upward drift; real GDP growth averages 4.81% (0.9-11.4%). Monetary composition varies strongly (cash/M2 3.00-7.94; mean 5.71), consistent with liquidity preference/substitution, while economic (≈98) and consumer (≈82.8) confidence move largely in sync.

Correlation evidence shows the Basel score is positively associated with per-capita STR (≈0.45) and inversely with confidence (economic ≈ −0.46/−0.49; consumer ≈ −0.37). Inflation co-moves tightly with liquidity measures (cash/M2 ≈ 0.71-0.75; cash/GDP ≈ 0.60-0.63), economic vs consumer confidence are near-collinear (≈0.91), and growth has a near-zero link to Basel. PCA reveals a dominant "price-money composition" axis (PC1; 60.25% variance) loading positively on inflation, cash/GDP and cash/M2 and negatively on confidence, and a "real activity-sentiment" axis (PC2; 26.90%) loading positively on growth and negatively on confidence. PC1 rises from −1.231 (2015) to +1.418 (2023), turning positive after 2020-evidence of a regime shift toward stronger price-liquidity pressures-while PC2 turns positive from 2019, indicating intermittent sentiment/activity rebounds. In OLS (basel_score ~ PC1 + PC2 + year_trend), PC1 has a significant positive effect (β=0.110, p=0.024) whereas PC2 and trend are insignificant; diagnostics support specification quality ($R^2$=0.566; DW≈2.34; no

autocorrelation/heteroskedasticity; low VIFs). Short-run ARIMAX on differenced Basel (best (1,1,0)) yields white-noise residuals but insignificant AR and PC terms, consistent with limited short-horizon power in a small annual sample. A high-risk-year classifier shows insignificant coefficients yet solid discrimination (AUC=0.833; accuracy=0.70; sensitivity≈67%, specificity≈75%), suggesting threshold tuning or cost-sensitive calibration for operational use; decision-tree rules (depth ≤3) highlight low confidence and weak cash/GDP (or high inflation with low liquidity share) as high-risk leaves, with economic confidence (~89.5) the most discriminatory splitter.

Stationarity tests indicate non-stationarity for Basel, ln(BOP NEO), inflation and growth in levels, encouraging differencing/cointegration or structural-break treatments; an alternative ADF panel finds STR total stationary (p=0.002) while Basel remains non-stationary, implying persistence or breaks. A partial correlation of Basel with CPI (controlling for others) is 0.294, consistent with price effects mediated by confidence and liquidity. Comparing 2015-19 to 2020-24, the Basel score declines from 6.213 to 5.632 (−0.581), STR surges by ~303.7M, inflation rises (+0.325) and economic confidence falls (−3.934), aligning with the PCA/correlation narrative. Granger tests (lags ≤2) show no directional predictability between ln(BOP NEO) and Basel. Overall, the price-liquidity complex (inflation + cash share) emerges as the dominant linear driver of Basel risk, confidence moves inversely and provides the most policy-readable threshold splits, short-run dynamics are weak at annual frequency, and the post-2020 regime shift on PC1 coincides with higher inflation, stronger cash preference and lower confidence alongside the observed decline in the Basel score.

## 5. CONCLUSION

This study examined how the Basel AML/CFT risk score co-moves with the price level, monetary composition, and expectations indicators within a compact multivariate design. Even with a short annual sample, a coherent narrative emerges. Descriptives show the Basel score tightly clustered around its mean (5.922; 95% CI: 5.706-6.138), while inflation and cash ratios display wide swings-evidence of regime rupture after 2020. Cash/M2 varies strongly (3.003-7.944; SD 1.835), consistent with shifts in liquidity preference and currency substitution as prices accelerate.

Correlation patterns reinforce a “price-money” block. Inflation correlates strongly with cash/M2 (≈0.71) and cash/GDP (≈0.60), indicating that higher prices tilt portfolios toward cash and reshape monetary composition. Economic and consumer confidence are near-collinear (≈0.91), implying a shared information set. Basel’s positive association with per-capita STR (Pearson 0.449; Spearman 0.418) suggests that oversight/compliance intensity and the pressure to surface informality rise with perceived risk-consistent with AML/CFT work on capacity, openness, and supervision (Arnone & Padoan, 2008; Ferwerda & Reuter, 2024; Egmont Group et al., 2025; Doğan & Yıldız, 2021).

Dimensionality reduction shows that co-volatility is well summarized on two axes. PC1 loads positively on inflation, cash/GDP, and cash/M2 and negatively on confidence, capturing a “price-money composition” force; PC2 loads positively on growth and negatively on confidence, reflecting a “real activity-sentiment” dimension. Together they explain 87.147% of variance. PC1’s score turns decisively positive after 2020, evidencing a post-shock regime dominated by price-liquidity pressures, in line with policy-surveillance studies on the coordination of money-credit and price regimes (FATF & APG, 2015; Irving Fisher Committee, 2021; Usta & Akıncı, 2020).

Regression and diagnostics indicate that PC1 is the main linear driver of Basel risk. In OLS (basel_score ~ PC1 + PC2 + trend), PC1 is positive and significant (β=0.110, p=0.024), while PC2 and trend are insignificant. Model quality is supported by $R^2$=0.566 (Adj. 0.362), DW≈2.34, normal residuals, homoskedasticity, no autocorrelation, and low VIFs. On the time-series side, a parsimonious ARIMAX(1,1,0) yields white-noise residuals but no short-run significance for exogenous PCs-unsurprising at annual frequency and small N. Classification results echo this: coefficients are imprecise, yet the model separates classes well (AUC=0.833; accuracy=0.70). The complexity matrix (≈67% sensitivity) argues for threshold recalibration to manage false-negative risk, and shallow decision-tree rules provide policy-readable splits where low confidence and weak cash/GDP (or high inflation at low liquidity share) define high-risk leaves-evidence that simple, explainable early-warning rules can aid supervision (Fronzetti Colladon & Remondi, 2017; Jensen et al., 2023; Jacsó & Vámosi, 2023).

Methodological checks highlight the limits of short samples. ADF tests show level non-stationarity for Basel, inflation, growth, and ln(NEO); STR total appears stationary. Granger tests do not reveal directional predictability between ln(NEO) and Basel at short lags, pointing to the need for longer horizons, richer frequencies, and structural-break analysis. A period comparison (2015-19 vs 2020-24) confirms a regime shift: the Basel score declines (6.213 - 5.632), inflation rises (0.123 - 0.448), and aggregate STR surges, consistent with intensified surveillance/reporting and greater transactional volatility. This composite picture aligns with recommendations on institutional harmonization, data sharing, and stronger financial-control mechanisms (IMF, 2009; FATF & APG, 2015; OECD, 2013; United Nations OSAA, 2022; Akyürek, 2022) and with evidence that openness, accountability, and audit capacity reduce AML risk when supported by robust data architectures (Karaca & Özsalmanlı, 2022; Erylmaz & Biricikoğlu, 2011; Szołno-Koguc, 2018).

The main limitations are the small number of observations and integrity issues in some variables. PCA-based summaries help mitigate multicollinearity and overfitting, but short horizons widen coefficient CIs and complicate stationarity assessment; reporting-regime shifts blur distinctions between true intensity and disclosure behavior in STR metrics; survey-based confidence indicators may introduce measurement error; PC interpretations assume stable loadings, which can drift across regimes; differencing in ARIMAX can mask short-run exogenous effects; and class imbalance in binary models inflates AUC-accuracy tensions. Excluding granular institutional indicators (e.g., sanction intensity, cross-border information-sharing depth, financial openness) risks omitted-variable bias. Single-country, narrow-period focus also constrains external validity.

Future work should expand coverage horizontally and vertically. Longer spans and higher-frequency series would support stationarity transformations and cointegration (Johansen/ARDL), while regime-shift tools (Bai-Perron, Markov switching) can detect breaks. Cross-country or regional panels with the same variable set would strengthen causal claims via fixed effects/IV and isolate institutional heterogeneity. PCA summaries should be stress-tested with factor-number cross-validation, rotations, and rolling windows to track regime-sensitive meanings. For early warning, cost-sensitive learning, resampling, and calibration-evaluated with AUC, Brier scores, and retention

curves-should be paired with explainable methods (e.g., SHAP over gradient-boosted trees) for accountable decisioning. From a time-series angle, state-space/Kalman models, nonlinear TAR/STAR, and Bayesian VARs can better represent shock transmission and uncertainty. Strengthening data governance-source cross-validation (e.g., cash/GDP), metadata standards, and version control-will reduce measurement error and improve reproducibility. Decomposing STR into sub-channels (e.g., letter-money, POS, trade-based patterns) will clarify the roles of shadow-banking and trade-based mechanisms and align metrics to policy targets. Open-science sharing of versioned data/code/reporting will enhance auditability and foster comparative analysis.

**Policy implications-**Monitoring the price-liquidity complex (inflation plus cash share) alongside confidence erosion offers the most informative early-warning bundle for Basel risk in this horizon. Calibrated thresholds-grounded in explainable splits and adjusted for class imbalance-can turn these statistical signals into actionable supervisory triggers.

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# STRUCTURAL DETERMINANTS OF PRODUCTIVITY: SECTOR-LEVEL EVIDENCE FROM TURKIYE

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## ABSTRACT

**Purpose-** The purpose of this study is to investigate how market concentration, capital intensity, labour share, and macroeconomic conditions shape sectoral productivity in Türkiye. Although substantial research highlights the link between market structure and productivity, empirical evidence from emerging economies, particularly at the sector level, remains limited. Türkiye represents an important case due to its structural heterogeneity, frequent macroeconomic fluctuations, and the coexistence of highly concentrated and highly competitive industries. This study aims to fill this gap by providing sector-level evidence based on the Annual Industry and Service Statistics (AISS) for the period 2009–2022.

**Methodology-** The analysis employs fixed-effects panel regressions. Labour productivity (lnprod) is modelled as a function of market concentration (HHI), capital–equipment ratio (lncer), employment scale (lnemployment), and the adjusted labour share (adj_ls). Additional models include exchange rate, interest rate, year fixed effects, and a linear time trend. Robust standard errors are clustered at the industry level.

**Findings-** The results consistently indicate that increases in market concentration are associated with higher sectoral productivity across all model specifications. Although the magnitude of the HHI coefficient declines when macroeconomic controls or time effects are added, the positive and statistically significant relationship remains highly robust. Capital intensity is another strong and stable predictor of productivity, indicating that sectors employing more capital-intensive production technologies tend to achieve higher efficiency levels. In contrast, the effect of employment size becomes statistically insignificant when macroeconomic shocks are controlled for, suggesting that sector size alone does not drive productivity. The adjusted labour share has a persistent adverse impact on productivity, consistent with the idea that higher-productivity sectors allocate a smaller share of value added to labour. Finally, exchange rate and interest rate dynamics affect productivity in expected directions.

**Conclusion-** The study concludes that productivity differences across sectors in Türkiye are shaped by both structural characteristics, particularly concentration and capital intensity, and macroeconomic conditions. The persistence of the concentration–productivity relationship suggests that market structure plays a significant role in sectoral performance.

**Keywords:** Market concentration, productivity, capital intensity, labour share, panel data analysis
**JEL Codes:** L11, O47, C23

## 1. INTRODUCTION

Labor productivity is a complex phenomenon shaped by numerous macro and micro-level determinants. Explaining the industry-level differences in labor productivity, especially in developing countries undergoing structural transformations, has been a central issue in empirical economics. Sectoral productivity varies widely in Türkiye, a pattern attributable to differences in technological intensity, market structure, input composition, and vulnerability to exogenous shocks. Although productivity in Türkiye has been studied extensively, the role of market concentration, along with structural sectoral characteristics such as labor intensity, labor share, and sector size, particularly at the industry level, has not been examined. This study aims to fill this gap in the literature by employing a fixed-effects estimation framework with industry-level data from 2009 to 2022 to examine the impacts of market concentration, capital intensity, sector size, and macroeconomic variables on productivity across Turkish industries.

## 2. LITERATURE REVIEW

A vast body of literature examines the mechanisms by which market structure influences productivity. Syverson (2004, 2011) shows that high competitiveness improves sectoral efficiency by increasing the share of productive firms while forcing low-productivity firms to exit the industry. Supporting this finding, Foster et al. (2008) show that increases in sectoral productivity primarily derive from reallocation across firms within industries rather than from within-firm productivity gains. A broader structural trend is demonstrated by De Loecker and

Eeckhout (2017), Calligaris et al. (2018), and Autor et al. (2020). They show the link among rising global markups, increasing productivity, and the declining labor share.

Evidence from developed and developing countries supports the importance of market concentration for productivity. Rodríguez-Castelán, López-Calva, and Barriga Cabanillas (2020) show that a decrease in market concentration amplifies firm-level productivity, while Savagar (2024) also reports a strong link between rising market concentration and rising productivity in the UK. By contrast, Suyanto et al. (2022) demonstrate the negative impact of high market concentration on productivity in Indonesia's manufacturing sector, owing to substantial cross-country heterogeneity in market concentration and its implications for firm behaviour. Another focus of the labor productivity literature is the role of capital intensity, both in capital deepening (Olley & Pakes, 1996; Melitz, 2003) and in the structure and quality of capital equipment (Ahmad & Peters, 2018).

Studies on Türkiye report high heterogeneity in productivity and market structure across industries. Unver & Sunal (2015) show that high price mark-ups explain Turkiye's relatively low labor share rather than low productivity. They also emphasize the role of market concentration in determining the income distribution. The Central Bank of Türkiye (2021) finds that increases in the labor share since the mid-2000s can be explained by both within- and between-industry dynamics, indicating a substantial structural transformation in Türkiye. Sector-level studies exhibit diverse concentration patterns. Sarıdoğan (2021) finds medium market concentration in the information technology sector. Karaçayır (2021) shows that market concentration positively affects export intensity in the manufacturing sector. Polat (2007) and Öngel (2022) report high market concentration in the cement manufacturing industry. Ünsal & Akbıyık (2019) report a decline in market concentration in the beverage industry. These strong heterogeneities in both productivity and concentration levels across industries make Türkiye an important case for examining the dynamics between the two.

## 3. DATA AND METHODOLOGY

This study employs industry-level panel data from Türkiye's Annual Industry and Service Statistics (AISS), covering the period 2009-2022. The AISS survey, compiled by TURKSTAT, provides firm-level data on turnover, production value, and value added at factor cost, personnel costs, and other demographic variables across NACE Rev. 2 industries. From AISS, sectoral aggregates are calculated on labor productivity (lnprod), market concentration (HHI), capital intensity (lncer), size (lnemployment), and adjusted labor share (adj_ls). Labor productivity is defined as gross value added per employee. The choice of the HHI (Herfindahl–Hirschman Index), based on sectoral turnover shares as the measure of market concentration, is motivated by its ability to yield more reliable results at the NACE2 level. Other concentration measures, such as CR3 and CR4, are better suited to a finer industrial classification (e.g., NACE3, NACE4) because they are more sensitive to missing observations and annual fluctuations. To calculate the capital intensity variable, the ratio of the fixed assets to employment is used. Fixed asset values at the NACE2 level are obtained from the Sector Balance Sheets Statistics (SBSS) compiled by TURKSTAT. The total employment-to-employee ratio adjusts the labor share at the sectoral annual level. To control for time-varying macroeconomic shocks, annual exchange-rate and interest-rate variables are also included in the analysis. The final balanced industrial level panel dataset comprises 16 NACE2 sectors over 14 years.

The appropriate empirical approach for this analysis is fixed-effect panel regression. This framework enables control for unobserved, sector-specific characteristics that may jointly affect productivity and market concentration. The following model is employed as the baseline specification:

$$lnprod_{\{it\}} = \beta_0 + \beta_1 hhi_{\{it\}} + \beta_2 lncer_{\{it\}} + \beta_3 lnemployment_{\{it\}} + \beta_4 adj\_ls_{\{it\}} + \gamma_t + u_i + \varepsilon_{\{it\}} \quad (1)$$

This model estimates the effect of HHI, capital intensity, employment size, and adjusted labor share on productivity, while controlling for unobserved, time-invariant sectoral heterogeneity. The following models include year fixed effects to capture standard macroeconomic shocks, followed by specifications that include explicit macroeconomic controls (exchange and interest rates). A linear time trend is also added to account for gradual structural change. All regression models are estimated using robust, clustered standard errors at the industry level to address serial correlation and heteroskedasticity. This stepwise modelling strategy enables us to see how the concentration–productivity relationship evolves as additional sources of variation are incorporated.

## 4. FINDINGS

Table 1 shows the high variation across Turkish NACE2 industries in productivity and other structural characteristics. A substantial variation is observed in labor productivity. Descriptive statistics on HHI reveal that a few industries exhibit much higher concentration levels than the average in a competitive environment. These patterns indicate the significant impact of market concentration on labor productivity, which can be modelled using a fixed-effects framework.

**Table 1: Summary Statistics of Main Variable**

| Variable | Mean | SD | Min | Max | P25 | P50 | P75 |
|---|---|---|---|---|---|---|---|
| lnprod | 11.584 | 1.045 | 9.687 | 15.150 | 10.801 | 11.461 | 12.221 |
| hhi | 0.034 | 0.083 | 0.001 | 0.633 | 0.002 | 0.006 | 0.027 |
| lncer | 4.696 | 1.373 | 1.958 | 8.957 | 3.801 | 4.487 | 5.343 |
| lnemployment | 12.441 | 1.379 | 9.876 | 15.254 | 11.309 | 12.240 | 13.527 |
| adj_ls | 0.456 | 0.223 | 0.041 | 1.000 | 0.266 | 0.451 | 0.639 |
| exchange_rate | 4.495 | 4.007 | 1.500 | 16.564 | 1.792 | 2.871 | 5.671 |
| interest_rate | 15.559 | 4.471 | 8.908 | 24.078 | 12.758 | 14.093 | 20.787 |

Capital intensity and the labour share also differ considerably across sectors, as evident in the regression results. The fluctuations in exchange rates and interest rates during the sample period are substantial, supporting their inclusion in analyses of productivity over time. Therefore, the descriptive patterns and the econometric findings are mutually supportive. Productivity outcomes across sectors are associated with variations in market structure, input composition, and broader macroeconomic conditions.

**Table 2: Sector Level Summary Statistics**

| Sector Name | lnprod | HHI | lncer | lnemployment | adj_ls |
|---|---|---|---|---|---|
| Mining and Quarrying | 12.050 | 0.022 | 5.533 | 11.466 | 0.286 |
| Manufacturing | 11.451 | 0.003 | 4.728 | 14.948 | 0.427 |
| Electricity, Gas, Steam and Air Conditioning Supply | 13.083 | 0.032 | 7.651 | 11.249 | 0.142 |
| Water Supply; Sewerage, Waste Management and Remediation | 11.801 | 0.055 | 3.790 | 11.027 | 0.401 |
| Construction | 11.652 | 0.002 | 4.821 | 13.820 | 0.227 |
| Wholesale and Retail Trade | 11.256 | 0.001 | 4.227 | 14.584 | 0.457 |
| Transportation and Storage | 11.419 | 0.035 | 5.035 | 13.418 | 0.494 |
| Accommodation and Food Service Activities | 10.725 | 0.002 | 4.701 | 13.344 | 0.631 |
| Information and Communication | 12.276 | 0.051 | 5.218 | 11.893 | 0.389 |
| Real Estate Activities | 12.130 | 0.010 | 7.136 | 10.628 | 0.259 |
| Professional, Scientific and Technical Activities | 11.258 | 0.001 | 3.973 | 12.913 | 0.527 |
| Administrative and Support Service Activities | 10.569 | 0.003 | 3.486 | 13.577 | 0.776 |
| Education | 10.871 | 0.006 | 3.824 | 12.072 | 0.734 |
| Human Health and Social Work Activities | 11.011 | 0.009 | 3.949 | 12.384 | 0.631 |
| Arts, Entertainment and Recreation | 13.416 | 0.308 | 4.430 | 10.374 | 0.083 |
| Other Service Activities | 10.371 | 0.002 | 2.633 | 11.361 | 0.832 |

The sector-level statistics in Table 2 reveal the clear variation in the structures of Turkish industries. While we observe higher productivity in energy related industries and in art and entertainment, service activities such as water services and other service activities categories exhibit a low level of productivity. Arts and entertainment sector also stands out with its high concentration level relative to the other industries with lower concentration degrees. Capital intensity and employment size exhibit high variation across industries while labor share seems higher in service related sectors and lower in capital intensive ones. Overall, these descriptive statistics show that industries in Turkish economy have different technological and market conditions.

Table 3 presents four fixed-effects models in a stepwise framework. Across all four fixed-effects models, the coefficient on HHI remains positive and statistically significant, indicating that productivity tends to rise in years when a sector becomes more concentrated. The effect is most pronounced in the simplest specification and diminishes as year effects, macroeconomic variables, and a linear trend are added. This pattern suggests that the link between concentration and productivity is explained by shifts within sectors, as well as by long-run movements. Capital intensity shows a similarly stable and positive relationship with productivity. In contrast, the employment size effect becomes insignificant when aggregate shocks are included, suggesting that sector size does not play a central role once macroeconomic conditions are accounted for. The adjusted labour share consistently harms productivity, indicating that higher productivity is associated with less labour-intensive value added. The exchange rate and interest rate are also significant, capturing movements that appear to influence measured productivity through price and cost channels rather than through structural change.

**Table 3: Fixed-Effects Estimates of the Determinants of Sectoral Productivity**

| Variable | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| hhi | 2.717*** | 1.789*** | 2.282*** | 1.795*** |
| | (0.226) | (0.127) | (0.180) | (0.121) |
| lncer | 0.760*** | 0.144** | 0.484*** | 0.141*** |
| | (0.044) | (0.060) | (0.042) | (0.046) |
| lnemployment | 0.746*** | 0.025 | 0.524*** | 0.003 |
| | (0.118) | (0.152) | (0.064) | (0.090) |
| adj_ls | -2.696*** | -2.116*** | -1.822*** | -2.073*** |
| | (0.570) | (0.457) | (0.503) | (0.419) |
| exchange_rate | | | 0.0497*** | 0.0539*** |
| | | | (0.0065) | (0.0056) |
| interest_rate | | | 0.0100*** | 0.00529*** |
| | | | (0.0021) | (0.00173) |
| trend (t) | | | | 0.0699*** |
| | | | | (0.0082) |
| _cons | -0.129 | 10.883*** | 3.165*** | 10.919*** |
| | (1.601) | (2.149) | (0.842) | (1.310) |
| Year FE | No | Yes | No | No |
| Industry FE | Yes | Yes | Yes | Yes |
| Observations | 224 | 224 | 224 | 224 |
| R2_within | 0.9490 | 0.9816 | 0.9696 | 0.9797 |

Clustered standard errors are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

## 5. CONCLUSION

This study analyzes sectoral productivity dynamics in Türkiye using a panel of 16 industries from 2009 to 2022, employing fixed-effects estimation. The descriptive analysis exhibits substantial structural variation across sectors in productivity, concentration, capital intensity, and labour share. The econometric results show that higher market concentration is consistently associated with higher labour productivity, even after controlling for sector-specific characteristics, macroeconomic shocks, and long-term trends. Capital intensity also plays a positive and robust role, whereas the adjusted labour share is negatively associated with productivity. Overall, the findings suggest that both market structure and input composition are central to explaining productivity differences across Turkish industries.

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# THE IMPACT OF AI-POWERED EMBEDDED FINANCE PLATFORMS ON CREDIT RISK MANAGEMENT: NEW PARADIGMS, OPPORTUNITIES, AND CHALLENGES

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## ABSTRACT

**Purpose-** The purpose of this study is to examine, from a multidimensional perspective, the structural transformation created by artificial intelligence-supported embedded finance platforms in credit risk management. The invisible integration of financial services into digital ecosystems transforms credit risk assessment processes by moving them away from traditional banking towards a more dynamic, behavioural and data-based structure. Within this framework, the study aims to evaluate the effects of artificial intelligence algorithms on risk prediction performance, forms of data use and levels of transparency by analysing the platforms Stripe, Unit and Weavr in a comparative manner.

**Methodology-** Adopting a qualitatively oriented exploratory approach, it examines multiple data sources consisting of platform documentations, financial technology reports and the academic literature through content analysis. In addition, an original conceptual model explaining artificial intelligence-based credit risk management in the context of embedded finance has been developed. This methodological approach makes it possible to evaluate both the technological infrastructure and the ethical and regulatory dimensions in a holistic manner.

**Findings-** The study shows that the analysed platforms exhibit clear differences in data processing capacity, algorithmic modelling techniques and risk management approaches. While Stripe's processing of behavioural data with deep learning models produces dynamic and highly accurate risk predictions; Unit's transparent analytical structure based on regulatory compliance strengthens auditability in the credit assessment process; and Weavr's modular risk engine allows flexible, sector-based credit assessments. However, it has been determined that critical problems such as data privacy, algorithmic bias and model explainability persist in all platforms.

**Conclusion-** This study reveals that artificial intelligence-supported embedded finance platforms go beyond technical innovation in credit risk management and create a new financial architecture, and it offers original contributions to the literature both at the level of comparative platform analysis and at the level of a conceptual framework explaining the data–impact relationship. The findings constitute an important basis for future research on algorithmic transparency, regulatory compliance and the ethical boundaries of the use of alternative data.

**Keywords:** Embedded finance, artificial intelligence, credit risk management, fintech, algorithmic bias
**JEL Codes:** G20, G24, O33

# YAPAY ZEKA DESTEKLİ GÖMÜLÜ FİNANS PLATFORMLARININ KREDİ RİSKİ YÖNETİMİNE ETKİSİ: YENİ PARADİGMALAR, FIRSATLAR VE ZORLUKLAR

## ÖZET

**Amaç-** Yapay zeka destekli gömülü finans platformlarının kredi riski yönetiminde yarattığı yapısal dönüşümü çok boyutlu bir bakış açısıyla incelemektir. Dijital ekosistemlerde finansal hizmetlerin görünmez biçimde entegre edilmesi, kredi riski değerlendirme süreçlerini geleneksel bankacılıktan uzaklaştırarak daha dinamik, davranışsal ve veri temelli bir yapıya dönüştürmektedir. Bu çerçevede çalışma, Stripe, Unit ve Weavr platformlarını karşılaştırmalı olarak analiz ederek yapay zeka algoritmalarının risk tahmini performansına, veri kullanım biçimlerine ve şeffaflık düzeylerine etkisini değerlendirmeyi amaçlamaktadır.

**Yöntem-** Nitel ağırlıklı keşifsel bir yaklaşım benimseyerek platform dokümantasyonları, finansal teknoloji raporları ve akademik literatürden oluşan çoklu veri kaynaklarını içerik analizi yoluyla incelemiştir. Ayrıca gömülü finans bağlamında yapay zeka temelli kredi riski yönetimini açıklayan özgün bir kavramsal model geliştirilmiştir. Bu yöntemsel yaklaşım, hem teknolojik altyapıyı hem de etik ve düzenleyici boyutları bütüncül şekilde değerlendirmeye olanak tanımaktadır.

**Bulgular-** Analiz edilen platformların veri işleme kapasitesi, algoritmik modelleme teknikleri ve risk yönetimi yaklaşımlarında belirgin farklılıklar sergilediğini göstermektedir. Stripe'ın davranışsal verileri derin öğrenme modelleriyle işlemesi dinamik ve yüksek doğruluklu risk tahminleri üretirken; Unit'in regülasyon uyumuna dayalı şeffaf analitik yapısı, kredi değerlendirme sürecinde denetlenebilirliği güçlendirmekte; Weavr'ın modüler risk motoru ise sektör bazlı esnek kredi değerlendirmelerine imkan vermektedir. Bununla birlikte tüm platformlarda veri gizliliği, algoritmik önyargı ve model açıklanabilirliği gibi kritik sorunların devam ettiği tespit edilmiştir.

**Sonuç-** Bu çalışma, yapay zeka destekli gömülü finans platformlarının kredi riski yönetiminde teknik inovasyonun ötesine geçerek yeni bir finansal mimari oluşturduğunu ortaya koymakta; literatüre hem karşılaştırmalı platform analizi hem de veri-etki ilişkisini açıklayan kavramsal

çerçeve düzeyinde özgün katkılar sunmaktadır. Bulgular, gelecekte algoritmik şeffaflık, regülasyon uyumu ve alternatif veri kullanımının etik sınırları üzerine yapılacak araştırmalar için önemli bir temel oluşturmaktadır.

**Anahtar Kelimeler :** Gömülü finans, yapay zeka, kredi riski yönetimi, fintech, algoritmik önyargı
**JEL Kodları :** G20, G24, O33

## 1. GİRİŞ

Dijital platform ekonomilerinin hızla yaygınlaşması, finansal hizmetlerin üretim, dağıtım ve tüketim biçimlerinde köklü bir dönüşüme yol açmıştır. Bu dönüşümün merkezinde, finansal ürün ve hizmetlerin finans dışı dijital ortamlara görünmez biçimde entegre edilmesine imkan tanıyan gömülü finans yapıları yer almaktadır. Gömülü finans; kredi, ödeme, sigorta ve yatırım gibi temel finansal işlevlerin e-ticaret siteleri, mobil uygulamalar, lojistik ve sosyal medya platformları gibi günlük kullanım alanlarının altyapısına gömülmesiyle, finansal hizmetleri geleneksel banka şubeleri ve bankacılık arayüzlerinden kısmen bağımsızlaştırmakta ve kullanıcı deneyiminin doğal bir bileşeni haline getirmektedir.

Bu yeni yapının ölçeklenmesinin en önemli itici gücü, yapay zeka ve veri analitiği teknolojilerinin gömülü finans ekosistemine entegrasyonudur. Yapay zeka tabanlı analitik modeller, kredi riski değerlendirmesinde geleneksel istatistiksel tekniklerin ötesine geçerek, kullanıcıların finansal geçmişinin yanı sıra davranışsal göstergeleri, işlem örüntülerini ve dijital ayak izlerini de içeren geniş veri kümelerini analiz edebilmektedir. Böylece kredi riski tahmini gerçek zamanlı, dinamik ve kişiselleştirilmiş bir yapıya kavuşmakta; finansal kapsayıcılık açısından geleneksel sistemin dışında kalan kullanıcı grupları için yeni olanaklar ortaya çıkmaktadır.

Bununla birlikte, yoğun veri işleme süreçleri ve algoritmik karar alma mekanizmaları önemli etik ve hukuksal tartışmaları da beraberinde getirmektedir. Veri gizliliği ve güvenliği, algoritmik önyargı, model açıklanabilirliği ve çoklu aktör yapısına sahip platformların regülasyon kapsamındaki konumu, gömülü finansın sürdürülebilirliği açısından kritik konular olarak öne çıkmaktadır. Bu çerçevede çalışmanın temel amacı, yapay zeka ile güçlendirilmiş gömülü finans platformlarının kredi riski yönetimine etkilerini, Stripe, Unit ve Weavr örnekleri üzerinden çok boyutlu bir akademik perspektifle incelemek ve ortaya çıkan fırsat ve zorlukları sistematik bir biçimde tartışmaktır.

## 2. LİTERATÜR

Finansal teknolojiler alanında yapılan çalışmalar, gömülü finans ve yapay zeka tabanlı kredi riski yönetimi alanlarının her birinde önemli ilerlemeler ortaya koymakla birlikte, bu iki alanın kesişiminde yer alan yeni finansal yapıyı bütüncül biçimde analiz eden çalışmaların sınırlı olduğunu göstermektedir. Gömülü finans üzerine yapılan çalışmalar, finansal hizmetlerin finans dışı dijital platformlara Uygulama Programlama Arayüzü(API) temelli entegrasyonu aracılığıyla "arka plan finansallaşması" olarak nitelenebilecek yeni bir yapının ortaya çıktığını vurgulamaktadır (Dahlberg ve Öörni, 2021). Bu yapı, kullanıcıların platformlar arası geçiş ihtiyacını azaltmakta, işlem süreçlerini sadeleştirmekte ve finansal ürünleri, deneyimin görünmez bir bileşeni haline getirmektedir.

Yapay zeka tabanlı kredi riski modellerine ilişkin yapılan çalışmalar ise makine öğrenmesi ve derin öğrenme tekniklerinin geleneksel kredi skorlamasına kıyasla daha yüksek tahmin doğruluğu sunduğunu göstermektedir. Khandani, Kim ve Lo (2010), tüketici kredi riskinin makine öğrenmesi algoritmalarıyla modellenmesi sonucu doğrusal olmayan örüntülerin daha etkin biçimde yakalanabildiğini ve tahmin performansının belirgin biçimde arttığını ortaya koymaktadır. Moro, Cortez ve Rita (2020) ise alternatif veri kaynaklarını işleyebilen algoritmaların, özellikle finansal geçmişi sınırlı kullanıcıların risk profillerinin belirlenmesinde önemli avantajlar sağladığını vurgulamaktadır.

Diğer yandan algoritmik önyargı, veri gizliliği ve açıklanabilir yapay zeka ekseninde yoğunlaşan etik tartışmalar, büyük veri temelli karar mekanizmalarının sosyal sonuçlarına dikkat çekmektedir. Barocas ve Selbst (2016), büyük veri uygulamalarının belirli gruplar üzerinde sistematik dezavantajlar doğurabileceğini, özellikle krediye erişimde ayrımcılık risklerinin arttığını belirtmektedir. Avrupa Birliği Genel Veri Koruma Tüzüğü (GDPR) gibi düzenleyici çerçeveler üzerine yapılan çalışmalar, finansal platformların kişisel verileri işlerken yüksek düzeyde şeffaflık ve hesap verebilirlik sorumluluğu taşıdığını ortaya koymaktadır.

Gömülü finans platformlarını doğrudan inceleyen akademik çalışmaların sayısı ise sınırlıdır. Mevcut bilgi birikimi büyük ölçüde sektör raporlarına ve teknik dokümantasyonlara dayanmaktadır. Stripe, Unit ve Weavr gibi platformlar çoğunlukla altyapı, Uygulama Programlama Arayüzü yapısı ve iş modeli düzeyinde tanımlanmakta; ancak yapay zeka tabanlı kredi risk modellerinin veri yapıları, performans özellikleri, şeffaflık düzeyleri ve regülasyonla ilişkileri sistematik biçimde karşılaştırılmamaktadır. Bu çalışma, söz konusu literatürdeki boşluğu doldurmayı hedefleyerek gömülü finans-yapay zeka kesişiminde hem kavramsal bir çerçeve sunmakta hem de üç platformu kredi riski yönetimi perspektifinden karşılaştırmalı olarak ele almaktadır.

## 3. VERİ VE METODOLOJİ

Çalışmada, yapay zeka destekli gömülü finans platformlarının kredi riski yönetimi üzerindeki etkilerini açıklamak amacıyla nitel ağırlıklı keşfedici bir yöntem benimsenmiştir. Gömülü finans ekosisteminin çok aktörlü yapısı, tescilli algoritmaların kapalı doğası ve veri şeffaflığındaki sınırlılıklar dikkate alındığında, tam anlamıyla nicel bir performans analizinden ziyade, yapıların ve süreçlerin kavramsal ve analitik düzeyde çözümlenmesini mümkün kılan bir yaklaşım tercih edilmiştir.

Veri seti, üç temel kaynaktan oluşmaktadır:

(i) Stripe, Unit ve Weavr platformlarının geliştirici dokümantasyonları, Uygulama Programlama Arayüzü kullanım kılavuzları ve risk yönetimi ile veri işleme politikalarını içeren teknik belgeler;

(ii) uluslararası danışmanlık kuruluşları ve sektör örgütleri tarafından hazırlanan gömülü finans ve fintech raporları;

(iii) gömülü finans, yapay zeka tabanlı kredi riski, algoritmik önyargı, açıklanabilir yapay zeka ve finansal regülasyon konularına odaklanan akademik çalışmalar.

Bu kaynaklar içerik analizi yöntemiyle sistematik olarak incelenmiş; platformların veri yapısı, kullandıkları algoritma türleri, kredi riski değerlendirme süreçleri, açıklanabilirlik ve regülasyon uyumu politikaları tematik kodlama yoluyla sınıflandırılmıştır. Analiz sürecinde platformlar mikro (algoritmik süreçler ve veri akışı), mezo (iş modeli, müşteri etkileşimi ve veri politikaları) ve makro (regülasyon, etik ve finansal sistem etkisi) düzeyde değerlendirilmiştir.

Çalışma kapsamında ayrıca, gömülü finans platformlarında yapay zeka destekli kredi riski tahmininin nasıl kurgulandığını açıklayan kavramsal bir veri akış modeli geliştirilmiştir. Model; kullanıcı davranış verileri, finansal işlem verileri ve platform içi etkileşim verilerinin veri toplama, veri hazırlama, algoritmik modelleme, risk sınıflandırması ve karar motoru katmanlarından geçerek nihai kredi kararı çıktısına dönüştüğü çok katmanlı bir yapıyı ortaya koymaktadır.

Metodolojik çerçeve bazı sınırlılıklar içermektedir. Yapılan incelemeler, kamuya açık dokümantasyon ve raporlarla sınırlı olduğundan, platformların tescilli algoritmalarına, model parametrelerine ve gerçek zamanlı performans metriklerine doğrudan erişim mümkün olmamıştır. Dolayısıyla bu çalışma, model performansını ampirik olarak test etmekten çok yapısal ve politik yönelimleri görünür kılan nitel bir analiz sunmaktadır.

## 4. BULGULAR

Karşılaştırmalı analiz, incelenen üç platformun kredi riski yönetiminde kullandıkları veri altyapısı, algoritmik yaklaşım ve regülasyon uyumu bakımından belirgin biçimde farklılaştığını göstermektedir. Stripe, yüksek hacimli davranışsal ve işlem verisini derin öğrenme modelleriyle işleyen, performans odaklı bir mimariye sahiptir. Kullanıcıların harcama davranışları, platform içi etkileşimleri ve işlem sıklığı gibi göstergeler, kredi riski tahmini için sürekli güncellenen dinamik skorlar üretmekte; bu durum özellikle hızlı ve yüksek hacimli dijital işlem ortamlarında önemli bir rekabet avantajı sağlamaktadır. Ancak bu karmaşık model yapısı, açıklanabilirlik ve denetlenebilirlik bakımından sınırlılıklar yaratmakta; risk sınıflandırmalarının hangi değişken ve ağırlıklarla üretildiğinin dış paydaşlar tarafından anlaşılmasını güçleştirmektedir.

Unit, gömülü finans bağlamında kredi riski yönetimini regülasyon uyumu ve şeffaflık ekseninde konumlandırmaktadır. Platformun altyapısı, daha sade ve açıklanabilir makine öğrenmesi algoritmalarına dayanmaktadır. Veri seti Stripe'a kıyasla daha sınırlı olmakla birlikte, model çıktılarının izlenebilir ve denetlenebilir olması, özellikle regülatörler ve kurumsal müşteriler açısından önemli bir güven unsuru oluşturmaktadır. Bu durum, performans ile şeffaflık arasında klasik literatürde tartışılan "trade-off"un gömülü finans alanındaki somut yansıması olarak değerlendirilebilir.

Weavr ise modüler bir risk motoru aracılığıyla sektörel uyarlamayı önceleyen esnek bir yapı sunmaktadır. Farklı sektörlere (örneğin SaaS, pazar yeri platformları, KOBİ finansmanı) özgü veri akışları ve risk göstergeleri, modüller aracılığıyla modele entegre edilmekte; bu sayede sektörel bağlama göre uyarlanmış risk sınıflandırmaları üretilebilmektedir. Ancak veri kalitesinin ve modelleme derinliğinin sektörler arasında homojen olmaması, kredi riski tahmin performansının ve açıklanabilirliğin tüm kullanım senaryolarında aynı düzeyde sağlanmasını zorlaştırmaktadır.

**Tablo 1: Gömülü Finans Platformlarında Kredi Riski Yönetimine İlişkin Karşılaştırmalı Özellikler**

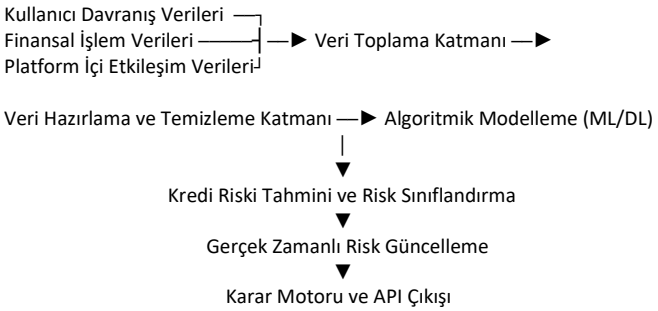
| Boyut | Stripe | Unit | Weavr |
|---|---|---|---|
| **Veri ve model yapısı** | Yüksek hacimli davranışsal/işlem verisi, derin öğrenme | Daha kısıtlı veri seti, ancak izlenebilir ve yorumlanabilir modelleme yaklaşımı | Sektöre özgü veri akışlarını kullanan modüler risk motoru |
| **Performans** | Yüksek performans ve ölçeklenebilirlik | Görece ihtiyatlı; performans ve şeffaflık arasında dengeli bir profil | Sektör ve veri kalitesine göre değişken |
| **Açıklanabilirlik/ Denetim** | Düşük; modelin işleyişine ilişkin açıklık düzeyi dış paydaşlar açısından kısıtlıdır | Yüksek; izlenebilir ve denetlenebilir çıktılar | Orta düzey; senaryolar arasında tutarlılık sınırlı |
| **Regülasyon uyumu** | Performans odaklı; düzenleyici uyum boyutu ikincil planda | Regülasyon uyumu ve şeffaflık ekseninde konumlanmış | Çok paydaşlı ve sektörel bağlama duyarlı, uyum düzeyi değişken |
| **Esneklik/Sektörel uyarlama** | Hızlı ve yüksek hacimli dijital işlem ortamlarına uygun | Kurumsal ve regülatif beklentilere uyumlu, daha standart yapı | Farklı sektörlere uyarlanabilen esnek ve modüler yapı |
| **Yapay zeka kullanımı** | Derin öğrenme modelleri, davranış tahmin algoritmaları | Makine öğrenmesi tabanlı kredi skorlama modülleri | Modüler risk motorları, tahmine dayalı modeller |

Çalışmada geliştirilen kavramsal veri akış modeli, gömülü finans platformlarında kredi riski yönetiminin yalnızca klasik finansal verilere değil, davranışsal ve etkileşim temelli çok boyutlu veri kümelerine dayandığını göstermektedir. Kullanıcı davranış verileri, finansal işlem verileri ve platform içi etkileşim verileri, veri toplama ve hazırlama katmanında bütünleştirilmekte; ardından makine öğrenmesi/derin öğrenme algoritmaları ile işlenerek kredi riski skorları ve risk sınıfları üretilmektedir. Elde edilen çıktılar, uygulama programlama arayüzü (API) temelli

karar motorları aracılığıyla üçüncü taraf platformlarda kredi tahsisi, limit güncelleme veya işlem onayı gibi sonuçlara dönüştürülmektedir. Bu durum, çalışmanın temel bulgularından biri olarak, gömülü finans platformlarında yapay zeka destekli kredi riski yönetiminin çok boyutlu veri yapısına dayalı olduğunu ve platformların rekabet avantajını doğrudan etkilediğini ortaya koymaktadır.

Aşağıdaki şekil, platformların kredi risk tahmini süreçlerinde kullandığı veri akışının kavramsal bir modelini sunmakta ve bulguların görsel olarak bütünleşik biçimde anlaşılmasını sağlamaktadır.

**Şekil 1: Gömülü Finans Platformlarında Yapay Zeka Destekli Kredi Riski Tahmini İçin Kavramsal Veri Akış Modeli**




Elde edilen bulgular, bu yapıların önemli fırsatlarla birlikte ciddi riskler de barındırdığını ortaya koymaktadır. Fırsatlar; kredi riski tahmin doğruluğunun artması, gerçek zamanlı risk güncellemesi, yeni kullanıcı segmentlerinin sisteme dahil edilmesi ve finansal kapsayıcılığın güçlenmesi şeklinde özetlenebilir. Buna karşılık veri gizliliği ve güvenliği, algoritmik önyargı, model açıklanabilirliğinin sınırlılığı ve gömülü finansın çok aktörlü yapısına uygun regülasyon çerçevesinin henüz tam biçimde oluşmamış olması, ekosistemin temel zorlukları olarak öne çıkmaktadır. Özellikle davranışsal verilerin kredi kararlarında yoğun biçimde kullanılması, veri temelli finansal gözetim ve ayrımcılık risklerine ilişkin tartışmaları güçlendirmektedir.

## 5. SONUÇ

Bu çalışma, yapay zeka destekli gömülü finans platformlarının kredi riski yönetimini hem teknik hem de kurumsal ve etik boyutlarıyla ele alarak, literatürde görece sınırlı olan bir alanı kapsamlı biçimde incelemiştir. Elde edilen bulgular; gömülü finans ekosisteminin klasik bankacılık çerçevesinde tasarlanmış statik kredi skorlaması yaklaşımlarından uzaklaşarak, çok boyutlu veri setlerine dayanan, dinamik ve davranışsal bir risk değerlendirme paradigmasına yöneldiğini göstermektedir. Stripe, Unit ve Weavr örnekleri, bu paradigmanın platform düzeyinde farklı stratejik yönelimler altında nasıl somutlaştığını ortaya koymaktadır.

Stripe, yüksek performanslı ama şeffaflık açısından sınırlı; Unit, regülasyon uyumlu ve açıklanabilir fakat göreli olarak daha temkinli; Weavr ise esnek ve sektörel bağlamı dikkate alan, ancak veri tutarlılığı ve açıklanabilirlik açısından orta düzeyde bir altyapı sunmaktadır. Bu karşılaştırmalı analiz; gömülü finans platformlarında kredi riski yönetiminin tek bir "en iyi" model etrafında değil, performans, şeffaflık, esneklik ve uyumluluk boyutları arasındaki tercihlere göre şekillenen çoğul stratejiler üzerinden geliştiğini göstermektedir.

Bu çalışmanın literatüre başlıca katkıları üç başlıkta özetlenebilir. Birincisi; gömülü finans ve yapay zeka temelli kredi riski literatürlerini birleştirerek, platform temelli yeni bir finansal altyapıyı kavramsal düzeyde çerçevelemektedir. İkincisi; Stripe, Unit ve Weavr örnekleri üzerinden gerçekleştirilen karşılaştırmalı analiz, gömülü finans platformlarında veri mimarisi, algoritmik kapasite, şeffaflık ve regülasyon uyumunun birlikte değerlendirilmesine imkan tanıyan analitik bir bakış açısı sunmaktadır. Son olarak; çalışma, veri gizliliği, algoritmik önyargı ve açıklanabilirlik gibi etik ve hukuksal boyutları doğrudan yapay zeka tabanlı kredi riski modelleriyle ilişkilendirerek, gömülü finansı sadece teknik değil aynı zamanda toplumsal ve hukuksal bir dönüşüm alanı olarak konumlandırmaktadır.

Gelecekte yapılacak araştırmalar açısından, yapay zeka modellerinin açıklanabilirlik düzeylerinin ampirik olarak ölçülmesi, alternatif veri kaynaklarının kredi riski tahmini üzerindeki etkilerinin nicel yöntemlerle test edilmesi ve gömülü finans platformlarının farklı ülke regülasyonları ile etkileşiminin karşılaştırmalı politika çalışmaları kapsamında ele alınması önem taşımaktadır. Ayrıca, kullanıcı deneyimlerini ve finansal kapsayıcılık sonuçlarını merkeze alan saha araştırmaları, algoritmik önyargı ve finansal dışlanma risklerinin somut etkilerini daha net biçimde ortaya koyabilir.

Düzenleyici otoriter ve uygulayıcı kuruluşlar açısından ise sürdürülebilir bir gömülü finans ekosistemi için üç temel öneri öne çıkmaktadır. Veri kullanım politikalarının şeffaflaştırılması ve güçlü veri gizliliği ile kişisel verilerin korunmasına yönelik mekanizmaların kurumsallaştırılması; model temelli yanlılık ve algoritmik ayrımcılık risklerini azaltmaya yönelik model denetimi ve açıklanabilir yapay zeka yaklaşımlarının yaygınlaştırılması ve çok paydaşlı platform yapısını dikkate alan, yapay zeka tabanlı kredi risk modellerini düzenli ve bağımsız denetime tabi tutan esnek ancak etkin bir regülasyon çerçevesinin geliştirilmesidir. Bu koşullar sağlandığında yapay zeka, yalnızca kredi riski hesaplama aracı olmanın ötesine geçerek, daha adil, şeffaf ve kapsayıcı bir finansal ekosistemin temel bileşenlerinden biri haline gelebilecektir.

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# ASSESSING THE IMPACT OF INFLATION ON THE PREMIUM PRODUCTION AND MARKET VALUE OF INSURANCE COMPANIES

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## ABSTRACT

**Purpose-**The purpose of this study is to analyze the relationship between inflation, premium production, and market value of insurance companies operating in the insurance sector listed on Borsa Istanbul, and to determine the direction of causality among these variables..
**Methodology-**In this study, quarterly data of six insurance companies operating on Borsa Istanbul for the period between December 2014 and June 2025 were utilized. In the analysis, the variables used were the inflation rate (INF), total premium production (LNPP), and the market-to-book value ratio (PB). Unit root tests were applied to examine the stationarity of the variables, and the Granger causality analysis was subsequently conducted to determine the causal relationships among them.
**Findings-**The analysis results indicate a statistically significant bidirectional causal relationship between the inflation rate and premium production. This finding reveals that both variables mutually influence each other. In contrast, no statistically significant effect of inflation on the market-to-book value ratio of insurance companies has been identified.
**Conclusion-**These findings are consistent with the direction of the relationship predicted by the theoretical framework and align with the general trend observed in the existing literature. In this context, it can be stated that an increase in inflation weakens premium production and indirectly reduces market value, whereas lower inflation enhances premium production and strengthens the financial performance of the sector. The results emphasize the importance of maintaining price stability to ensure sustainable growth in the insurance industry. Therefore, policymakers and industry managers should take inflation dynamics into account when developing pricing strategies and long-term risk management policies.

**Keywords:** Inflation, premium production, market value, ınsurance companies, Granger Causality
**JEL Codes:** G22, E31, C32

# ENFLASYONUN SİGORTA ŞİRKETLERİNİN PRİM ÜRETİMİ VE PİYASA DEĞERİ ÜZERİNDEKİ ETKİSİNİN DEĞERLENDİRİLMESİ

## ÖZET

**Amaç-** Türkiye'de sigorta sekötründe Borsa İstanbul'da faaliyet gösteren sigorta şirketlerinin enflasyon, prim üretimi ve piyasa değeri arasındaki ilişkiyi analiz etmek ve bu değişkenler arasındaki nedensellik yönünü ortaya koymaktır.
**Yöntem-** Bu çalışmada, Türkiye'de Borsa İstanbul'da faaliyet gösteren altı sigorta şirketinin 2014 Aralık – 2025 Haziran dönemine ait çeyrek dönemlik verileri kullanılmıştır. Analizde, enflasyon oranı (ENF), toplam prim üretimi (LNPP) ve piyasa değeri/defter değeri oranı (PD) değişkenleri kullanılmıştır. Değişkenlerin durağanlığını test etmek birim kök testleri uygulanmış, ardından değişkenler arasındaki nedensellik ilişkisini belirlemek için Granger nedensellik analizi yapılmıştır.
**Bulgular-** Analiz bulguları, enflasyon oranı ile prim üretimi arasında istatistiksel olarak anlamlı ve çift yönlü bir nedensellik ilişkisi bulunduğunu göstermektedir. Bu sonuç, her iki değişkenin birbirini karşılıklı olarak etkilediğini ortaya koymaktadır. Buna karşılık, enflasyonun sigorta şirketlerinin piyasa değeri/defter değeri oranı üzerinde istatistiksel olarak anlamlı bir etkisi tespit edilmemiştir.
**Sonuç-** Elde edilen bu bulgular, teorik çerçevede öngörülen ilişkinin yönüyle ve literatürdeki mevcut çalışmaların genel eğilimiyle uyumludur. Bu kapsamda, enflasyondaki artışın prim üretimini zayıflatarak dolaylı biçimde piyasa değerini düşürdüğü; düşük enflasyonun ise prim üretimini artırarak sektörün finansal performansını güçlendirdiği söylenebilir. Bu bulgular, sigorta sektöründe sürdürülebilir büyümenin sağlanabilmesi için fiyat istikrarının korunmasının önemini vurgulamaktadır.

**Anahtar Kelimeler:** Enflasyon, prim üretimi, piyasa değeri, sigorta şirketleri, Granger Nedenselliği
**JEL Kodları:** G22, E31, C32

## 1. GİRİŞ

Sigorta sistemi, ekonomik istikrarın korunması ve finansal piyasaların derinleşmesi açısından önemli bir aracılık mekanizmasıdır. Risk yönetimi işlevi sayesinde ekonomide belirsizlikleri azaltır, kaynakların etkin dağılımını destekler ve sürdürülebilir büyümeye katkı sağlar. Bu yönüyle sigorta şirketlerinin piyasa değeri, yalnızca sektörün iç dinamiklerini değil, aynı zamanda makroekonomik göstergelerle olan etkileşimlerini de yansıtır.

Sigorta sektörünün büyümesinde temel belirleyici unsur olan prim üretimi, şirketlerin faaliyet hacmini, risk üstlenme kapasitesini ve finansal sağlamlığını gösteren önemli bir göstergedir. Prim üretimindeki artış, hem sigorta bilincinin hem de ekonomik güven ortamının güçlendiğini ifade eder. Ancak prim üretiminde yaşanan dalgalanmalar, özellikle ekonomik istikrarsızlık ve yüksek enflasyon dönemlerinde, sigorta şirketlerinin piyasa değerini doğrudan etkilemektedir. Bu durum, makroekonomik değişkenlerin sigorta sektörünün performansı üzerindeki etkisini anlamayı gerekli kılmaktadır.

Bu bağlamda enflasyonun yükselmesi sigorta şirketlerinin maliyetlerini yükselterek kârlılığı azaltmakta ve aynı zamanda prim fiyatlandırmasında etkili olmaktadır. Yüksek enflasyon, ekonomik istikrarı zayıflatarak üretim, tasarruf ve yatırım kararlarını olumsuz yönde etkilemektedir. Paranın değer kaybı beklentisi, bireylerin uzun vadeli ve sabit primli sigorta poliçelerine olan ilgisini azaltmaktadır. Teorik çerçeveye göre enflasyondaki artış, prim üretimini azaltarak sigorta şirketlerinin piyasa değerini düşürmekte; enflasyonun düşmesi ise prim üretimini artırarak piyasa değerinin yükselmesine katkı sağlamaktadır.

## 2. LİTERATÜR ARAŞTIRMASI

Sigorta şirketlerinin piyasa değeri, yatırımcıların geleceğe yönelik beklentilerini ve risk-getiri algılarını yansıtan bir göstergedir. Bu nedenle enflasyonun prim üretimi ve piyasa değeri üzerindeki etkilerinin analizi, hem sektörel performansın hem de makroekonomik istikrarın anlaşılması açısından önem taşımaktadır.

Enflasyonun sigorta sektörü üzerindeki etkisine yönelik ilk çalışmalar, hayat sigortası poliçelerinin reel değer kaybı ve yatırım getirilerindeki düşüş üzerinde yoğunlaşmıştır. Linton (1933) enflasyonun sigorta sektöründeki yatırım gelirlerini azalttığını ve poliçe satışlarını düşürdüğünü ortaya koymuştur. Hofflander ve Duvall (1967) artan enflasyonun maliyetleri artırarak primleri yükselttiğini ve hayat sigortası talebini azalttığını vurgulamıştır. Neumann (1969), beklenmeyen enflasyonun sigorta portföy dengesini bozduğunu ve poliçe sahiplerinin uzun vadeli sözleşmelere olan ilgisini azalttığını tespit etmiştir.

Babbel (1979, 1980) enflasyonun hayat sigortası maliyetleri üzerindeki etkisini analiz etmiş ve artan enflasyonun primleri yükselterek poliçe satışlarını azalttığını göstermiştir. Babbel'in (1981) Brezilya örneği üzerine yaptığı bir diğer çalışmada ise, enflasyona endeksli poliçelerin dahi satış düşüşlerini tam olarak engelleyemediği, yüksek enflasyon ortamının sigorta talebini azaltmaya devam ettiği sonucuna ulaşılmıştır.

Karl, Holzheu ve Laster (2010), Swiss Re Sigma raporunda, enflasyonun hayat sigortalarına yatırım getirilerini düşürdüğünü; buna karşılık hayat dışı sigortaların fiyat ayarlamalarıyla daha hızlı tepki verebildiğini göstermiştir. Han ve Hung (2017) de faiz ve enflasyon risklerinin bireylerin hayat sigortası tercihleri üzerindeki etkilerini analiz ederek, artan enflasyonun sigorta talebini azaltıcı yönde etkili olduğunu ortaya koymuştur.

Enflasyonun sağlık sistemi üzerindeki dolaylı etkilerini inceleyen çalışmalar da sigorta talebi açısından önemlidir. Sharif vd. (2018) ve Bourne (2009), enflasyonun sağlık hizmetlerini olumsuz etkilediğini, bu durumun ise bireyleri özel sağlık sigortalarına yönlendirdiğini ortaya koymuştur.

Türkiye'de yapılan çalışmalar da benzer biçimde makroekonomik değişkenlerle sigorta göstergeleri arasındaki ilişkileri incelemiştir. Şener ve Behdioğlu (2014), 1990-2010 döneminde nüfus ve sigorta şirketi sayısının prim üretimini artırdığını, ancak enflasyonun etkisinin istatistiksel olarak anlamlı olmadığını belirtmiştir. Tunay, Çamlıbel ve Tunay (2020) ise 30 ülke için 1995–2014 döneminde yaptıkları analizde, ekonomik dalgalanmaların özellikle hayat dışı sigorta primleri üzerinde daha güçlü bir etki yarattığını göstermiştir.

Eren ve Çütcü (2021), Türkiye'de 1983–2019 döneminde sigorta sektörü ile makroekonomik değişkenler arasındaki ilişkiyi analiz etmiş; ekonomik büyümeden sigorta primlerine doğru tek yönlü bir nedensellik tespit etmiştir. Gençer-Çelik ve Öngel (2021), 2009–2019 döneminde hayat dışı sigortacılık sektöründe kârlılığı etkileyen faktörleri panel veri analiziyle incelemiş ve enflasyonun kârlılığı artırıcı etkisini saptamıştır. Tunay ve Tunay (2023), enflasyonun sigorta şirketlerinin performansı ve prim üretimi üzerinde kısa ve uzun dönemde tek yönlü nedensellik ilişkileri yarattığını ancak kısa dönemde enflasyondan prim üretimine doğru bir ilişki bulunduğunu ortaya koymuştur.

Makroekonomik göstergelerle sigorta sektörü arasındaki ilişkiyi ele alan Şamiloğlu, Eser ve Bağcı (2019), işsizlik oranı, istihdam oranı, ÜFE ve TÜFE göstergeleri ile sigortacılık değişkenleri arasında uzun dönemli ilişkiler bulmuş, enflasyonun ise poliçe sayısı ve katkı payı gibi göstergeler üzerinde pozitif yönlü bir etki yarattığını ortaya koymuştur. Kara (2024) ise Türkiye'de özel sağlık sigortası şirketlerinin prim toplama başarısı üzerinde enflasyonun etkisini incelemiş ve TÜFE ile reel prim üretimi arasında uzun dönemli bir ilişki tespit etmiştir.

Bu çalışmalar, genel olarak enflasyonun sigorta sektöründeki etkilerinin hem ülke koşullarına hem de sigorta türüne göre farklılaştığını göstermektedir. Ayrıca Türkiye örneklerinde, enflasyonun prim üretimi üzerindeki etkisinin yönü, makroekonomik istikrarın düzeyine ve sigorta bilincinin gelişmişliğine bağlı olarak değişmektedir.

## 3. VERİ VE METODOLOJİ

Bu çalışma Türkiye'de faaliyette bulunan ve Pazar payı en yüksek olan altı adet sigorta şirketinin prim üretim düzeyleri, piyasa değeriş/defter değeri oranı ve enflasyon arasındaki ilişkinin değerlendirilmesi amacı ile oluşturulmuştur. Çalışmada Agesa Hayat Emeklilik, Ak Sigorta,

Anadolu Hayat Emeklilik, Anadolu Sigorta, Ray Sigorta ve Türkiye Sigorta sigorta şirketlerinin 2014 Aralık ayı ile 2025 Haziran ayları çeyrek dönemlik verileri ile yine aynı dönemlerin enflasyon oranları veri olarak alınmıştır. Veriler TC Merkez Bankası EVDS sistemi ve Türkiye Sigorta Birliği (TSB) ve Kamuyu Aydınlatma Platformu (KAP)'tan elde edilmiştir. Araştırmanın ana amacını belirleyen hipotezler ise aşağıdaki gibi oluşturulmuştur.

H1a: Enflasyon Prim Üretiminin Granger nedenidir.

H1b: Enflasyon Piyasa Değeri/Defter Değerinin Granger nedenidir.

Araştırmada değişkenler arasındaki ilişkinin tespit edilmesi amacıyla Granger nedensellik analizi (Granger, 1969; Granger, 1981). uygulanmış ve öncesinde Birim Kök testi yapılarak değişkenlerin durağanlıkları test edilmiştir. Durağanlık testi için ise birinci nesil birim kök testlerinden olan Augmented Dickey Fuller- ADF ile Phillips Perron- PP testleri yapılmıştır.

Araştırmada kullanılan değişkenler ve kısaltlamalar ise, çeyrek dönemlik enflasyon oranı "ENF" kısaltması ile, Piyasa Değeri/Defter Değeri oranı "PD" kısaltması ile belirtilmişken, prim üretimi toplamları ise tutarsal değer olması dolayısıyla ln değerleri alınarak "LNPP" kısaltması ile belirtilmektedir. Araştırmada kullanılan değişkenler ve bu değişkenlere ait tanımlayıcı istatistik değerleri Tablo 1'de sunulmuştur.

**Tablo 1: Değişkenlerin Tanımlayıcı İstatistikleri**

| **İstatistikler/Değişkenler** | **Enflasyon Oranı - ENF** | **Toplam Prim Üretimi- LNPP** | **Piyasa Değeri/Defter Değeri- PD** |
|---|---|---|---|
| **Ortalama** | 6.266 | 23.550 | 19.459 |
| **Medyan** | 4.230 | 23.300 | 17.950 |
| **Maksimum** | 25.110 | 26.300 | 44.500 |
| **Minimum** | 0.780 | 21.340 | 10.610 |
| **Standart Sapma** | 5.880 | 1.322 | 7.619 |
| **Gözlem Sayısı** | 43 | 43 | 43 |

## 4. BULGULAR

Çalışmada kullanılan değişkenlere birim kök testi uygulanmış ve elde edilen sonuçlar Tbalo 2'de belirtilmiştir. Tablo 2 incelendiğinde yapısal kırılmasız birinci nesil test sonuçlarına göre tüm değişkenlerin %5 anlam düzeyinde seviyede durağan olmadığı ancak birinci farkta durağanlaştıkarı görülmüştür. Bu verilere göre değişkenlerin tümünün aynı düzeyde durağan olması dolayısıyla Granger nedenselllik analizinin uygulanabileceği görülmüştür. Granger nedenselllik analizi uygulanmadan önce uygun gecikme uzunluğu belirlenmiş ve uygun gecikme uzunluğuna dair veriler Tbalo 3'de sunulmuştur.

**Tablo 2: Birim Kök Testi Sonuçları**

| | ADF- Seviyede | | | | | |
|---|---|---|---|---|---|---|
| İstatistik Değerleri | T istatistiği | | | Olasılık | | |
| Değişkenler | ENF | LNPP | PD | ENF | LNPP | PD |
| Sabitli+Trendli | -4.471 | -1.514 | -3.122 | ***0.0048***** | ***0.8063*** | ***0.1151*** |
| | ADF-Birinci Fark | | | | | |
| İstatistik Değerleri | T istatistiği | | | Olasılık | | |
| Değişkenler | ENF | LNPP | PD | ENF | LNPP | PD |
| Sabitli+Trendli | -9.720 | -5.575 | -4.933 | ***0.0000***** | ***0.0029***** | ***0.0014***** |
| | PP-Seviyede | | | | | |
| İstatistik Değerleri | T istatistiği | | | Olasılık | | |
| Değişkenler | ENF | LNPP | PD | ENF | LNPP | PD |
| Sabitli+Trendli | -4.489 | -5.947 | -2.265 | ***0.0046***** | ***0.0001***** | ***0.4428*** |
| | PP-Birinci Fark | | | | | |
| İstatistik Değerleri | T istatistiği | | | Olasılık | | |

| Değişkenler | ENF | LNPP | PD | ENF | LNPP | PD |
|---|---|---|---|---|---|---|
| Sabitli+Trendli | -24.555 | -18.843 | -4.922 | ***0.0000**** | ***0.0000**** | ***0.0014**** |

**Tablo 3: Uygun Gecikme Uzunluğu**

| Lag (Gecikme) | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -320.010 | NA | 2073.380 | 16.150 | 16.277 | 16.196 |
| 1 | -267.656 | 94.237* | 237.746* | 13.982* | 14.489* | 14.166* |
| 2 | -261.216 | 10.626 | 272.624 | 14.110 | 14.997 | 14.431 |
| 3 | -250.619 | 15.895 | 257.185 | 14.030 | 15.297 | 14.488 |

Tablo 3'e göre uygun gecikme uzunluğunun bir (1) olduğu görülmüş ve bu gecikme uzunluğunda otokorelasyon ve eşvaryanslık testleri yapılmıştır. Modelde otokorelasyon (0.928>0.05) ve farklı varyanslık (0.524>0.05) sorunu olmadığı yapılan testler sonucunda bulunmuştur. Aynı zamanda AR ters kök poligonuna göre ise tüm değişkenlerin çember içinde kaldığı görülmüştür. Bir gecikmede otokorelasyon sorunu olmaması dolayısıyla Granger nedensellik analizi yapılmış ve elde edilen sonuçlar Tablo 4'te belirtilmiştir.

**Tablo 4: Granger Nedensellik Analizi: Bir gecikmeli**

| Null Hipotezleri | Gözlem Sayısı | F-İstatistiği | Olasılık |
|---|---|---|---|
| ENF, LNPP'nin Granger nedeni değildir. | 42 | 5.00080 | 0.0411* |
| LNPP, ENF'in Granger nedeni değildir. | | 6.09810 | 0.0180* |
| ENF, PD'nin Granger nedeni değildir. | 42 | 1.19252 | 0.2815 |
| PD, ENF'in Granger nedeni değildir. | | 0.01109 | 0.9167 |

Tablo 4'e göre enflasyon oranının prim üretiminin gecikmeli değeri üzerinde etkili olduğu görülürken, prim üretiminin de enflasyon oranının nedeni olduğu sonucuna varılmıştır. Bu verilere göre H1a hipotezi Kabul edilirken, enflasyon oranının sigorta şirketlerinin Piyasa Değeri/Defter değeri oranları üzerinde etkili olmadığı görülmüş ve H1b hipotezi rededilmiştir.

## 5. SONUÇ

Sigorta sektörü, finansal istikrarın korunması ve ekonomik sistemin sürdürülebilirliği açısından temel bir aracılık mekanizmasıdır. Ancak bu sektör, makroekonomik değişkenlerdeki dalgalanmalardan etkilenmekte ve Türkiye'de yüksek enflasyon oranı seyretmektedir.

Bu çalışma, Türkiye'de Borsa İstanbul'da faaliyet gösteren altı sigorta şirketinin 2014–2025 dönemine ait çeyrek dönemlik verileri kullanılarak enflasyon, prim üretimi ve piyasa değeri arasındaki ilişkinin incelenmesini amaçlamaktadır. Çalışmada değişkenler arasındaki nedensellik ilişkileri Granger nedensellik analizi ile test edilmiştir.

Analiz sonuçlarına göre, enflasyon oranı ile prim üretimi arasında çift yönlü bir nedensellik ilişkisi tespit edilmiştir. Bu bulgu, enflasyonun prim gelirlerini etkilediği gibi prim üretiminde meydana gelen değişimlerin de enflasyon üzerinde belirli bir etki yarattığını göstermektedir. Buna karşılık, enflasyonun sigorta şirketlerinin piyasa değeri/defter değeri oranı üzerinde anlamlı bir etkisi bulunmamıştır. Dolayısıyla, enflasyonun sektördeki etkisinin doğrudan piyasa değerinden ziyade prim gelirleri üzerinden gerçekleştiği söylenebilir. Sonuç olarak, çalışma bulguları teorik çerçeveyi destekler niteliktedir: enflasyondaki artış, prim üretimini azaltarak dolaylı biçimde piyasa değerini zayıflatmakta; enflasyonun düşmesi ise prim üretimini artırarak sektörün piyasa performansını güçlendirmektedir.

Bu sonuç, literatürde yer alan çalışmalarla genel olarak uyumludur. Linton (1933), Babbel (1979, 1980) ve Han ve Hung (2017) çalışmalarında olduğu gibi, enflasyonun artışı sigorta talebini ve prim üretimini zayıflatmaktadır. Benzer şekilde, Tunay ve Tunay (2023), Türkiye'de enflasyonun prim üretimi üzerinde kısa dönemde etkili olduğunu ve uzun dönemde bu etkinin sınırlı kaldığını belirtmiştir. Benzer şekilde Eren ve Çütçü (2021) de enflasyonun sigorta primleri üzerindeki etkisinin zayıf olduğunu, ancak ekonomik büyümenin sigorta primlerini artırdığını ortaya koymuştur. Öte yandan, Şener ve Behdioğlu (2014) enflasyonun istatistiksel olarak anlamlı bir etkisinin bulunmadığını saptamış, bu bulgu da enflasyonun piyasa değeri üzerindeki etkisizlik sonucu ile örtüşmektedir.

Bulgular, Türkiye sigorta sektöründe fiyatlama stratejilerinin enflasyon koşullarına uyumlu biçimde geliştirilmesi ve prim gelirlerinin değer kaybına karşı korunması önemi ortaya konulmuştur. Ayrıca, düşük ve öngörülebilir enflasyon ortamı, sektörün finansal istikrarını ve piyasa performansını güçlendirecektir.

Bu çerçevede, sigorta sektörünün sürdürülebilir büyümesini desteklemek için fiyatlama stratejilerinde enflasyonist dönemlerin dikkate alınması ve prim gelirlerinin değer kaybına karşı korunmasına yönelik politika araçlarının geliştirilmesi önem taşımaktadır. Ayrıca, finansal istikrarın korunması açısından, enflasyonun uzun vadede düşük ve öngörülebilir seviyelerde tutulması, sektörün piyasa performansını güçlendirecek bir unsur olarak değerlendirilebilir.

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