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Research Article

Embedded Finance as a Long-Run Value Driver: ARDL Evidence from a Leading Telecommunication Operator in Turkey

Uzun Dönem Değer Sürücüsü Olarak Gömülü Finans: Türkiye'de Önde Gelen Bir Telekomünikasyon Operatöründen ARDL Kanıtı

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Abstract

The telecommunications industry is undergoing a paradigm shift, evolving from traditional connectivity providers into digital ecosystem players, with Embedded Finance (EmFi) emerging as a critical growth engine. There is a notable lack of empirical research on embedded finance on micro-level performance metrics, particularly in non-bank sectors. This study empirically investigates the long-run impact of embedded finance revenue streams on Turkcell's corporate market value, a leading telecommunications operator in Turkey. Drawing on multiple theoretical frameworks, the research posits that embedded finance fosters firm value by reducing transaction friction and creating lock-in effects. Using quarterly financial data from 2016Q4 to 2025Q3, the study employs the Autoregressive Distributed Lag (ARDL) bounds testing approach to analyze the cointegration dynamics between the company's embedded finance integration and its market capitalization. The empirical results confirm the existence of a cointegration relationship, demonstrating that embedded finance revenues are a positive and significant determinant of the firm's long-run market value. These findings imply that investing in digital financial services is not merely a diversification strategy but a fundamental driver of shareholder value. The study contributes to the limited literature on non-bank financial providers by offering empirical evidence from an emerging market context.

Keywords: *Embedded Finance, Telecommunications, Market Value, ARDL Bounds Test, Turkcell*

Özet

Telekomünikasyon sektörü, geleneksel bağlantı sağlayıcısı konumundan dijital ekosistem oyuncusuna dönüşerek bir paradigma değişimi geçirmekte ve bu süreçte Gömülü Finans (EmFi) önemli bir araç olarak öne çıkmaktadır. Gömülü finans üzerine yapılan araştırmalar, özellikle de banka dışı sektörlere odaklanan ampirik araştırmaların eksikliği dikkat çekmektedir. Bu çalışma, Türkiye'nin önde gelen telekomünikasyon operatörü Turkcell'in piyasa değeri üzerinde, gömülü finans gelir akışlarının uzun dönemli etkisini ampirik olarak incelemektedir. Çoklu teorik çerçevelerden yararlanan bu araştırma, gömülü finansın, işlem maliyetlerini düşürerek, kilitlenme etkisi yaratarak ve sermaye piyasalarına teknolojik çeviklik sinyalleri göndererek, firma değerini desteklediğini ileri sürmektedir. 2016Ç4 ile 2025Ç3 dönemini kapsayan çeyreklik finansal verilerin kullanıldığı çalışmada, şirketin gömülü finans

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yoğunluğu ile piyasa değeri arasındaki eş bütünleşme dinamiklerini analiz etmek için ARDL sınır testi yaklaşımı kullanılmıştır. Ampirik sonuçlar, istatistiksel olarak anlamlı bir eş bütünleşme ilişkisinin varlığını doğrulamakta; gömülü finans gelirlerinin uzun vadede firma piyasa değerinin pozitif ve anlamlı bir belirleyicisi olduğunu göstermektedir. Bu bulgular,telekomünikasyon şirketleri için dijital finansal hizmetlere yatırım yapmanın yalnızca bir çeşitlendirme stratejisi değil, aynı zamanda hissedar değerinin temel bir belirleyicisi olduğunu ortaya koymaktadır. Çalışma, Türkiye gibi önemli bir gelişmekte olan piyasa bağlamından ampirik kanıtlar sunarak banka dışı finansal sağlayıcılar üzerine sınırlı olan literatüre katkıda bulunmaktadır.

Anahtar Kelimeler: *Gömülü Finans, Telekomünikasyon, Piyasa Değeri, ARDL Sınır Testi, Turkcell*

1. Introduction

The global telecommunications industry is currently navigating a critical inflection point. For decades, the traditional business model relied heavily on voice and connectivity revenues. However, as mobile penetration reaches saturation and data services commoditize, Mobile Network Operators (MNOs) risk becoming mere utility providers, with shrinking margins and limited differentiation (Gilder, 2000). As famously predicted by Isenberg (1997) in his paper, the intelligent network has been replaced by dumb pipes, forcing operators to seek value beyond simple data transport. To escape this commoditization trap, leading operators are pivoting toward a digital ecosystem strategy, transforming into "Techcos." At the heart of this transformation lies Embedded Finance (EmFi)—a model in which financial services such as payments, lending, and insurance are seamlessly integrated into non-financial platforms. While the broader *Fintech* ecosystem provides the technological tools for this evolution, EmFi represents the specific strategic integration of these tools in the company's value-creating chain. Embedded finance offers telecommunication operators a dual advantage. First, it unlocks high-margin revenue streams that are independent of connectivity cycles, and second, it significantly enhances customer retention. By leveraging vast datasets on user behavior and existing billing relationships, telcos can offer seamless financial solutions to millions of unbanked or underbanked subscribers, effectively competing with traditional banks (GSMA, 2023). In this study, the term fintech is utilized to reflect the overall technological investments, whereas EmFi specifically denotes the strategic outcome of embedding these financial capabilities into the core mobile ecosystem. However, despite the strategic importance of this shift, academic literature has predominantly focused on fintech's technological architecture or its impact mainly on the banking sector. Empirical evidence regarding how embedded finance strategies influence the corporate market value of non-bank entities, particularly in emerging markets, remains scarce. Existing research on financial innovation has concentrated mainly on the immediate market reactions to fintech announcements. A notable exception and a precursor to this study is the work by Turkmen Muldur (2024), which utilized structural break analysis on Turkcell—Turkey's leading telecommunications operator. That study found that the intensity of embedded finance investments led to a statistically significant structural shift in the company's stock price volatility. While this finding confirmed that the market reacts to such strategic pivots, it left a critical question unanswered, which is "is this market reaction a temporary speculative anomaly, or does it represent a sustainable, long-run appreciation in firm value?. Therefore, this study aims to bridge this gap by shifting the analytical focus from short-term structural breaks to long-run cointegration dynamics. Using quarterly financial data from 2016Q4 to 2025Q3, this research investigates the impact of embedded finance-driven revenue streams on Turkcell's market capitalization using the Autoregressive Distributed Lag (ARDL) bounds testing approach. Unlike previous studies that treat fintech adoption as a binary event, this research quantifies the intensity of embedded finance operations and measures its elasticity with respect to firm value over a decade-long horizon. To provide a robust explanation for the empirical results, this study grounds its analysis in two complementary theoretical frameworks: Transaction Cost Theory and Network Effects. This study posits that Turkcell's embedded finance operations create value not merely through diversification, but by minimizing the friction and transaction costs associated with financial access (Williamson, 1981) and by generating powerful network effects that lock customers into the ecosystem (Katz & Shapiro, 1985). By operationalizing these theories, the study argues that the positive relationship between embedded finance and market value is driven by reductions in marginal costs and the creation of recurring, sticky revenue streams.

The contributions of this paper are threefold. First, it provides rare empirical evidence on the long-term value creation of embedded finance in the telecommunications sector, moving beyond the bank-centric fintech literature. Second, it complements the existing structural break literature by proving that the

value impact is sustained and cointegrated in the long run. Third, it offers a theoretical mechanism—combining transaction costs and network effects—to explain why investors reward the *Telco-to-Techco* transformation in emerging markets.

1.1. Theoretical Background

As a dynamic Fintech model, EmFi enhances accessibility to financial services, placing the end-user at the center of the financial experience. It strengthens financial democratization and inclusion while altering the traditional structure of financial intermediation, thereby reducing costs for all parties involved through novel business models (Harris et al., 2022). The World Bank (2022) defines embedded finance as the seamless and invisible integration of financial products or services into non-financial platforms. Academic literature and industry practitioners offer various definitions of this phenomenon. Bugvi and Endress (2023) categorize these definitions into four groups according to their primary focus. The first group focuses on non-bank third parties providing financial services; the second on fintech entities offering services in partnership with banks; the third on technological advancements focused on enhancing the user experience; and, lastly, the invisible nature of financial services is presented within a natural workflow.

Although consumers appear to be the primary beneficiaries of EmFi, this financial innovation is equally critical for small businesses (SMEs). The World Bank (2022) highlights embedded finance as a pivotal model for post-pandemic economic recovery, particularly for SMEs, helping them overcome liquidity bottlenecks through technological adoption. The rapid expansion of e-commerce has fundamentally transformed how goods and services are purchased, driven by advancements in API protocols, blockchain, and artificial intelligence (AI). While APIs enable real-time data sharing and rapid credit approvals, AI automates risk assessment for faster funding, facilitating B2B "Buy Now, Pay Later" (BNPL) services and easing access to finance (Wright, 2025).

Embedded finance fundamentally disrupts the traditional agency structure across three primary domains. These are payments, lending, and banking-as-a-service (BaaS). Payments account for over 60% of embedded finance applications. This category acts as a catalyst integrated into retail and e-commerce software, enabling SMEs to accept customer payments seamlessly. In the lending domain, BNPL applications offer interest-free installment options on e-commerce platforms, while Point of Sale (PoS) Lending supports high-value purchases with longer-term options. Additionally, B2B Lending focuses on SMEs that traditional banks often overlook due to collateral constraints, providing liquidity through direct online lending platforms. Lastly, BaaS, in embedded banking, allows end-users to create card and payment accounts directly through non-bank providers without interacting with a traditional banking interface (Harris et al., 2022).

Embedded finance is not limited to retail; it is increasingly prevalent in traditional sectors such as health, media, and telecommunications. Telecommunication operators are uniquely positioned to embed mobile payments, credit, and insurance services into their ecosystems, thanks to their vast and loyal customer bases, reliable billing infrastructure, and rich customer data. This strategic positioning allows them to convert sporadic connectivity revenues into recurring, high-margin financial revenue streams. Furthermore, by utilizing mobile billing history as a proxy for creditworthiness, telcos play a critical role in fostering financial inclusion for unbanked populations (Sieber & Guibaud, 2022). Turkcell, the leading operator in the Turkish market, recognized this potential early and aimed to reconcile users' lifestyle experiences with their financial needs through its subsidiary, Paycell. Turkcell's embedded finance strategy spans the three core areas mentioned above:

Payments: Paycell offers an "embedded banking" experience, allowing users to make essential transactions such as bill payments, money transfers, and prepaid card use seamlessly through a mobile app.

Lending: Through its subsidiary Financell, the company provides microloans and BNPL solutions linked directly to mobile line limits, facilitating device or in-app purchases.

Insurance: The company also offers personalized embedded insurance products, making financial services an integral part of its core ecosystem (Turkcell, 2025).

The expectation that embedded finance (EmFi) applications enhance corporate value—specifically for

Turkcell—can be explained through a multi-dimensional theoretical framework that integrates efficiency, ecosystem loyalty, resource exclusivity, and market communication. Transaction Cost Theory (TCT), introduced by Coase (1937) and expanded by Williamson (1985), posits that firms exist to minimize the costs of market exchanges. By embedding payment and lending services directly into its billing infrastructure, Turkcell reduces customer friction, bringing search and bargaining costs near zero, while its proprietary customer data minimizes monitoring and enforcement costs. This operational efficiency is further amplified by Network Effects (Katz & Shapiro, 1985), which suggests that the utility of a platform increases as more users join. In Turkcell's case, integrating financial services creates a critical lock-in effect, where customers using the platform for both connectivity and credit become significantly less likely to churn, thereby stabilizing long-term cash flows. Beyond these efficiencies, the Resource-Based View (RBV) (Barney, 1991) highlights that Turkcell's vast, inimitable customer data and established digital infrastructure serve as rare and valuable resources that provide a sustainable competitive advantage over traditional financial incumbents. Finally, Signaling Theory (Spence, 1973) explains how this strategic transformation acts as a high-quality signal to capital markets. In an environment of information asymmetry, Turkcell's successful scaling of EmFi services signals technological agility and a shift toward a high-growth *techco* model, encouraging rational investors to upwardly revise the firm's future valuation based on its diversified and innovative revenue potential.

This research employed these frameworks as the primary explanatory mechanisms for the observed empirical results. Specifically, the long-run cointegration relationship identified by the ARDL model is grounded in the two theories explained above as economic realities. From the perspective of the reduction in transaction costs, unlike traditional banking, Turkcell's embedded finance operations minimize the marginal cost of revenue generation. Moreover, a network-effect-driven perspective on Turkcell's super-app strategy creates a self-reinforcing loop in which financial services increase user stickiness, transforming volatile connectivity revenues into predictable, long-term cash flows. Consequently, this combination of cost advantage and revenue growth signals to rational market participants that they should revise their expectations of the firm's future cash flows upward, creating a substantial positive impact on the company's market value.

Consequently, this combination of cost advantage and revenue growth signals to rational market participants that they should revise their expectations of the firm's future cash flows upward, creating a substantial positive impact on the company's market value. In light of these theoretical underpinnings, the following hypotheses are formulated to be tested through the ARDL framework:

H1: Embedded Finance adoption has a statistically significant and positive impact on Turkcell's market value in the long run.

H2: The structural reduction in transaction friction and the presence of network-driven lock-in effects result in a stable long-run cointegration relationship between EmFi integration and corporate performance.

Having established the theoretical foundations and the corresponding hypotheses, the next section provides a comprehensive review of the existing literature. This review contextualizes the research within the broader academic discourse on financial innovation and highlights the specific gaps in non-bank embedded finance studies that this paper aims to address.

1.2. Literature review

Despite the rapid transformation the EmFi model has triggered within the financial ecosystem, empirical studies examining the impact of this innovation on corporate value, particularly within emerging markets and specific sub-sectors, remain limited. This section first reviews studies investigating the effects of financial innovations on corporate performance in a broader context, followed by an analysis of conceptual and applied research specifically related to embedded finance. In doing so, it aims to delineate the existing gap in the literature and demonstrate how this study addresses that void.

1.2.1. Financial Innovations and Corporate Performance

Embedded finance is a financial innovation with the potential to fundamentally transform the financial services ecosystem, particularly in digital banking and retail sectors. Financial innovations generally encompass product innovations, such as new securities or pooled investment products, or process innovations, such as the distribution of securities or pricing mechanisms (Lerner & Tufano, 2011). In a broad perspective, these innovations aim to enhance the efficiency of financial markets, covering developments ranging from derivatives and crowdfunding platforms to securitization, blockchain technology, and algorithmic trading.

The impact of financial innovations on corporate financial performance appears to be dual-natured. On one hand, they positively influence performance by enhancing operational efficiency, facilitating access to capital, and improving risk management. On the other hand, they can introduce new risks and challenges, such as cybersecurity threats and complex regulatory requirements, which may negatively affect performance (Petare et al., 2023). Tufano (2018) and Gao & Appiah-Otoo (2022) demonstrated that fintech positively impacts corporate financial performance by increasing efficiency, reducing costs, and improving customer experience. Similarly, Jumah and Karri (2020) conducted a case study analysis on firms holding four major cryptocurrencies (Bitcoin, Ripple, Litecoin, and Ethereum) in their financial reports, finding that significant events related to these currencies had a material impact on firm performance. Lee et al. (2022) suggested that, while the impact of financial innovations arising from M&A Activity varies across developed and emerging markets, the aggregate effect is positive. Kim et al. (2022) provided strong evidence of a robust and positive relationship between Artificial Intelligence (AI) and firm value in US companies. Furthermore, Chen et al. (2022) showed that AI usage helps firms improve performance, gain a competitive advantage, and contribute positively to management practices. In Croatia, Pancić et al. (2023) found that big data analytics and blockchain applications have a direct, significant effect on performance. Wu et al. (2023) observed that in China, the impact of fintech on performance and efficiency is more pronounced in regions with higher financial decentralization. Additionally, Ledi et al. (2023) examined the impact of QR code payments and mobile money on the financial performance of SMEs in Ghana, detecting significant and positive effects.

However, the past literature also acknowledges the potential downsides. The role of financial innovations and fintech in deepening the 2008 global financial crisis was highlighted by former IMF chief economist Simon Johnson, who noted that "financial innovations can sometimes lead to inefficient and even destructive outcomes; every financial innovation is costly, and only those generating benefits exceeding these costs survive" (Coy, 2009). Similarly, former Fed Chairman Bernanke (2009) warned of the dangers, stating that innovations once hailed as solutions—such as high-risk mortgages and CDOs—became symbols of the crisis. From an academic perspective, Lerner and Tufano (2011) highlighted the potential for systemic risks, consumer harm, and rent-seeking behavior as sources of costs in financial innovation. Empirically, Haoliang et al. (2024) revealed that financial innovations negatively affected the profitability of Chinese banks. Song et al. (2023) investigated the "competition effect" versus the "technology spillover effect" of financial innovations on Chinese banks, finding that profitability initially declined due to intense competition before recovering through technology diffusion—a trend more pronounced in smaller banks. This supports the hypothesis proposed by Wu et al. (2024) that the impact of financial innovation on performance follows a "U-shaped" dynamic, causing initial losses before yielding long-term benefits. Another study questioning the positive impact is Tahvildari's (2025) performance analysis of robo-advisors in Germany, which found that they underperformed against the MSCI World Index, exhibiting deeper drawdowns and more extended recovery periods.

1.2.2. Embedded Finance Literature and the Research Gap

While the literature on general financial innovations is extensive and predominantly positive, studies focused explicitly on embedded finance remain nascent and limited in scope. Ozili (2022) defined embedded finance applications, use cases, benefits, and challenges, and later examined the relationships among decentralized finance, embedded finance, and open finance (Ozili, 2023). Al-Gasaymeh et al. (2023) used structural equation modeling to show that embedded finance applications in the UAE banking sector positively and significantly influence non-financial customer experience. Goon et al.

(2024) reviewed the history and implications of embedded finance in banking, while Kumar and Nanduri (2025) analyzed its transformative effect on consumer experience and financial inclusion. Kadam et al. (2024) highlighted the growing role of embedded finance in reshaping industries. Recent bibliometric analyses by Çalışkan (2025) indicated that the literature gained significant momentum post-2020, driven by digital transformation. Furthermore, Galib and Rijal (2025) demonstrated through a systematic literature review that embedded finance integration can increase conversion rates by up to 20% in digital marketing campaigns. Despite these contributions, empirical research examining the direct impact of embedded finance on corporate market performance remains scarce. A notable exception is the work of Turkmen Muldur (2024), which conducted a structural break analysis on Turkcell, the same telecommunications operator analyzed in this study. That study found that the intensification of embedded finance strategies led to a statistically significant structural break in the company's stock price volatility, signaling a market reaction to the strategic shift. However, while her research confirmed the existence of a structural shift, the literature still lacks evidence on the long-run cointegration and the sustained value-creation potential of these strategies. Academic research on embedded finance is currently in a development phase, with comprehensive studies remaining limited. Specifically, there is a notable absence of empirical research examining micro-level performance metrics within non-bank sectors over a long-term horizon. This study aims to fill this gap by moving beyond structural break analysis to empirically test the long-run relationship between embedded finance intensity and firm value using the ARDL approach.

2. Purpose and Methodology

This section outlines the purpose of the study, the dataset used, the definitions of variables, and the econometric framework employed to investigate the relationship between Turkcell's market value and its financial technology activities.

2.1. Purpose of the Study

Based on the theoretical gaps identified in the introduction, the primary objective of this research is to empirically examine the elasticity of corporate market value in response to embedded finance revenue. Specifically, the study seeks to answer whether the strategic transformation from a traditional telecom operator to a digital ecosystem player generates statistically significant long-term shareholder value. Unlike previous studies that use binary variables to measure fintech adoption, this research aims to quantify the magnitude of this relationship using continuous time-series data in an emerging market context.

2.2. Data Description

The study uses quarterly time-series data from the fourth quarter of 2016 (2016Q4) to the third quarter of 2025 (2025Q3), comprising 36 observations. The choice of the starting period coincides with the strategic acceleration of Turkcell's digital business services and the more precise segmentation of embedded finance revenues in financial reports. The variables used in the analysis are defined as follows:

- Market Value (MV): Represents the dependent variable, defined as the quarterly market capitalization of Turkcell. It reflects the total equity value assigned by the capital market, calculated as the closing stock price multiplied by the total number of outstanding shares at the end of each quarter.
- EmFi Revenues (EmFİ): Represents the independent variable, serving as a proxy for the scale and growth of the company's strategic EmFi transformation. This classification underscores the strategic nature of the operator's structural shift toward generating value through financial services. The data is explicitly extracted from the detailed footnotes of the "Sales Revenue" section in Turkcell's consolidated financial statements, as it is often aggregated under broader service categories in the main income statement. Unlike standard metrics that may focus on profitability, this variable captures the gross volume of financial operations, reflecting market demand for the company's digital financial ecosystem. The metric aggregates the digital payment revenues of Paycell, which is the commission income and transaction fees derived from mobile wallet usage and merchant POS solutions, and the consumer financing income of Financell, which

is the interest income and administrative fees generated from micro-loans provided for device financing.

To reduce heteroscedasticity and interpret the coefficients as elasticities, all variables were transformed into their natural logarithmic forms (LN_MV and LN_EMFI). The data was sourced from the Public Disclosure Platform (KAP) and Finnet electronic data delivery system. All econometric estimations, diagnostic tests, and graphical representations were conducted using EViews 14 software.

2.3. Econometric Methodology

Given the potential for structural changes in the Turkish financial market and the telecommunications sector's specific volatility, the econometric strategy follows a two-step procedure.

2.3.1. Unit Root Tests with Structural Breaks

Standard unit root tests, such as the Augmented Dickey-Fuller (ADF), often fail to reject the null hypothesis of non-stationarity in the presence of structural breaks. To address this limitation, the Breakpoint Unit Root Test is employed. This test endogenously determines structural break dates for the intercept and trend, providing a more robust assessment of the variables' integration order (Zivot & Andrews, 1992).

2.3.2. ARDL Bounds Testing Approach

To examine the long-run and short-run relationships between Turkcell's market capitalization and its embedded finance revenues, this study adopts the Autoregressive Distributed Lag (ARDL) bounds testing approach developed by Pesaran et al. (2001). This methodology offers several distinct advantages tailored to the dataset's specific characteristics. First, unlike traditional cointegration techniques, the ARDL approach is flexible regarding the order of integration; it is applicable whether the underlying variables are purely I(0), purely I(1), or a mixture of both, provided that none are integrated of order two, i.e., I(2). Second, the estimator is known to yield robust and consistent results even with small sample sizes. This property is particularly critical for this study, given the limited constraint of 36 quarterly observations. Finally, the ARDL framework allows simultaneous estimation of short-run dynamics and long-run equilibrium parameters via a linear transformation, providing a comprehensive view of the adjustment process without losing long-run information. The Unrestricted Error Correction Model (UECM) specified for the analysis is as follows:

$$\Delta LN\_MV_t = \alpha_0 + \sum_{i=1}^{p} \beta_0 \Delta LN_{MV\,t-i} + \sum_{j=0}^{q} \gamma_j \Delta LN_{FINTECH\,t-j} + \delta_1 \Delta LN_{MV\,t-1} + \delta$$

Where:

Δ is the first difference operator.

α_0 is the constant term.

$\beta_i \; and \; \gamma_j$ represent the short-run dynamic coefficients.

$\delta_1 and\; \delta_2$ represent the long − run multipliers.

t represents the time trend included to capture the variables' secular growth.

The existence of a long-run relationship is tested using the F-statistic to check the joint significance of the lagged level variables ($\Delta\_1 = \Delta\_2 = 0$). If the computed F-statistic exceeds the upper critical bound values provided by Pesaran et al. (2001), the null hypothesis of no cointegration is rejected. Following the dataset description and econometric framework specification, the subsequent section presents the study's empirical findings.

3. Empirical Findings

This section presents empirical findings regarding the impact of Turkcell's strategic transformation into a EmFi provider on its market valuation. The econometric analysis proceeds in a systematic framework to ensure the robustness of the results. First, descriptive statistics and correlation analysis are examined to understand the distributional properties and preliminary associations between the variables. Second,

considering the macroeconomic volatility during the sample period, Breakpoint Unit Root Tests are conducted to determine the order of integration while accounting for structural shifts. Third, the existence of a long-run equilibrium relationship is investigated using the ARDL Bounds Testing approach. Finally, the section concludes by estimating long-run elasticities and the short-run Error Correction Model (ECM) to assess the magnitude of impact and the speed of adjustment towards equilibrium.

3.1. Descriptive Statistics

Table 1 presents the descriptive statistics for the logarithmic series of Market Value (LN_MV) and EmFi Revenues (LN_EMFI) used in the ARDL analysis. The dataset spans the period from the last quarter of 2016 (2016Q4) to the third quarter of 2025 (2025Q3), comprising 36 quarterly observations.

Table 1. Descriptive Statistics

Variables	Unit	Mean	Max.	Min.	Std. Dev.	Skewness	Kurtosis	J-B Prob.
Market Value (MV)	Billion TL	73.90	238.00	17.60	72.90	1.19	2.82	0.0138
EmFi Rev. (EMFI)	Million TL	802.2	3,781.8	115,97	1,014.4	1.73	4.70	0.0000

Note: Market Value is presented in Billions of Turkish Lira (TL). EmFi Revenues (Financial Operations Income) are presented in Millions of TL. The raw data for EmFi Revenues includes initial periods with zero values, reflecting the pre-transformation phase.

Table 1 presents the descriptive statistics for the raw data series. The results indicate that Turkcell's average market capitalization (MV) over the sample period is approximately 73.90 billion TL, exhibiting significant growth with a maximum value of 238.00 billion TL and a minimum of 17.60 billion TL. The high standard deviation suggests substantial volatility in the company's market valuation. Regarding EmFi revenues (EMFI), the average quarterly income is 802.2 million TL. The series demonstrates a remarkable expansion, reaching a peak of 3,781.8 million TL (approx. 3.8 billion TL). The substantial gap between the minimum and maximum values reflects the rapid emergence and scaling of Turkcell's financial operations segment during the observation period. Furthermore, the Jarque-Bera test statistics for both variables ($p < 0.05$) lead to the rejection of the null hypothesis of normal distribution. Both series exhibit positive skewness and high kurtosis. These distributional properties, combined with the high variance, justify the use of natural logarithmic transformations in the subsequent econometric analysis to stabilize the variance and approximate a normal distribution. While the raw data exhibited non-normal characteristics, the logarithmic transformation proved effective in stabilizing the variance and approximating normality. Preliminary tests on the transformed variables (LN_MV and LN_EMFI) yielded Jarque-Bera p-values of 0.089 and 0.073, respectively. Since these values exceed the 5% significance level, the null hypothesis of normality is not rejected. This confirmation is crucial to the study's robustness. Although the sample size is limited to 36 quarterly observations, the normality of the transformed series supports the reliability of the statistical inferences (t-statistics). Furthermore, the ARDL bounds testing approach adopted in this study is chosen for its superior performance with finite sample sizes compared to conventional cointegration techniques.

3.2. Correlation Analysis

Following the descriptive statistics, a correlation analysis was conducted to examine the strength and direction of the linear relationship between Turkcell's market value (LN_MV) and EmFi revenues (LN_EMFI). The correlation analysis covers the period from 2016Q4 to 2025Q3. The results are presented in Table 2.

Table 2: Correlation Matrix

Variables	LN_MV	LN_EMFI
LN_MV	1.0000	
LN_EMFI	**0.9575***	1.0000

*Note: *** indicates statistical significance at the 1% level (p-value < 0.01).*

As detailed in Table 2, the analysis reveals an extremely strong, positive, and statistically significant correlation between the company's market value and embedded finance revenues. This coefficient, being close to 1.00, indicates a high degree of synchronization between the variables (Gujarati, 2009). It is also statistically significant at the 1% level, suggesting that upward movements in market capitalization closely track increases in EmFi revenues. It provides compelling preliminary evidence that Turkcell's strategic shift towards financial technologies is not an isolated operational metric but acts as a primary driver strongly associated with the company's market valuation trends over the sampled period. While a high correlation coefficient might raise concerns about multicollinearity in standard cross-sectional multiple regression models, in this time-series study, it strongly signals a potential long-run equilibrium relationship (cointegration) between the series. Moreover, since the constructed model focuses on the impact of a single independent variable, namely EmFi Revenue, on Market Value, issues of multicollinearity are not inherently applicable to this bivariate framework. Moreover, while correlation does not imply causation, this high coefficient provides preliminary evidence supporting the study's central hypothesis, justifying the subsequent use of the ARDL bounds testing approach to decompose this strong association into short-run dynamics and long-run impacts.

3.3. Unit Root Test Results

Before proceeding with the ARDL bounds testing approach, it is essential to determine the order of integration of the variables to ensure that none are integrated of order two, I(2), which would invalidate the F-statistics of the Bounds Test. Initially, standard unit root tests such as the Augmented Dickey-Fuller were considered. However, financial time series, particularly in emerging markets like Turkey, often exhibit significant structural breaks due to macroeconomic shocks, policy shifts, or rapid inflationary dynamics. As established in the econometric literature by Perron (1989), standard unit root tests suffer from low power in the presence of structural breaks and may erroneously identify a stationary series with a break as non-stationary. Visual inspection of both Turkcell's Market Value (LN_MV) and EmFi Revenues (LN_EMFI) reveals distinct structural shifts occurring between 2022 and 2023, likely driven by the aggressive expansion of digital services and the prevailing inflationary environment. To avoid spurious results and accurately capture these dynamics, the Breakpoint Unit Root Test was employed. The test allows for an innovation outlier break type in both the intercept and trend, selecting the break date by minimizing the Dickey-Fuller t-statistic.

Table 3. Breakpoint Unit Root Test Results

Variable	Method	Break Specification	Break Date	t-Statistic	Critical Value (1%)	Result
D(LN_EMFI)	Innovation Outlier	Intercept Only	2023Q4	-8.77*	-5.35	I(1)
D(LN_MV)	Innovation Outlier	Intercept Only	2022Q4	-10.09*	-5.35	I(1)

**Note: Significance at 1% level. Break selection based on minimizing Dickey-Fuller t-statistic.*

The results presented in Table 3 demonstrate that while the series exhibit non-stationary behavior at their levels, their first differences are strongly stationary. The calculated t-statistics for the first differences of EmFi revenues (-8.77) and market value (-10.09) are significantly greater than the critical values at the 1% significance level in absolute terms. The test successfully identified the structural break dates as 2022Q4 for market value and 2023Q4 for EmFi revenues. Consequently, both variables are confirmed to be integrated of order one, I(1), making them suitable for the ARDL cointegration analysis, which yields robust results for variables integrated of I(0), I(1), or a combination of both (Pesaran et al., 2001).

3.4. Bounds Test Results

To investigate the existence of a long-run equilibrium relationship between Turkcell's EmFi income streams (LN_EMFI) and its market value (LN_MV), the ARDL Bounds Test was employed. The model was estimated using Case 3 -Unrestricted Constant and No Trend based on the nature of the variables. Table 4 displays the results of the Bounds Test.

Table 4. The results of the Bounds Test

Model Specification	F-Statistic	Significance Level	Lower Bound I(0)	Upper Bound I(1)	Result
**F(LN_MV)	(LN_EMFI)**	6.1880*	1%	4.94	5.58
(k=1, Case III)		5%	3.62	4.16	
		10%	3.02	3.51	

Note: Critical values are based on Pesaran et al. (2001), Case III (Unrestricted Constant and No Trend). k denotes the number of independent variables. *** indicates statistical significance at the 1% level, implying the rejection of the null hypothesis of no levels relationship.

As observed in Table 4, the calculated F-statistic is 6.188. This value significantly exceeds the upper critical bounds at the 5% and 1% significance levels, as the standard critical values for k=1 are approximately 4.16 and 5.58, respectively. Consequently, the null hypothesis of *no level relationship* is rejected. This finding empirically confirms the existence of a strong long-run cointegration relationship between the variables, thereby providing direct empirical support for Hypothesis 2 (H2). Next section proceeds with estimating the long-run and short-run coefficients.

3.5. Long-Run Coefficients and Discussion

Following the confirmation of cointegration, the long-run elasticities were estimated. The results, presented in Table 5, provide strong empirical evidence regarding the impact of embedded finance performance on firm value.

Table 5. Estimated Long-Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_EMFI	0.4742	0.1091	4.3466	0.0001*

*Note: The dependent variable is LN_MV. *** indicates statistical significance at the 1% level.*

The estimated coefficient for LN_EMFI is 0.474 and is statistically significant at the 1% level (t=4.34, p<0.01). Since the model is specified in a double-logarithmic form, this coefficient represents the elasticity of market value with respect to EmFi revenues.

This finding implies that a 1% increase in Turkcell's EmFi revenues leads to approximately a 0.47% increase in its market capitalization, *ceteris paribus*. This positive and significant relationship confirms the study's central hypothesis, namely H1. It indicates that the capital markets price the company's EmFi integration strategy positively. The growth in digital payment services from Paycell and financing solutions from Financell is not merely a supplementary revenue stream but a significant driver of the company's long-term shareholder value.

3.6. Short-Run Dynamics and Error Correction Model

The short-run dynamics and the speed of adjustment towards equilibrium are captured by the Error Correction Model (ECM). The results are summarized in Table 6.

Table 6. Short Run Error Correction Model (ECM) Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LN_EMFI)	0.4084	0.1380	2.9590	0.0073***
CointEq (-1)	**-0.6986**	0.1940	-3.6008	0.0016*
Diagnostic Statistics	Value		Statistic	Value
R-squared	0.6110		F-statistic	3.8400
Adjusted R-squared	0.4519		Prob (F-stat)	0.0048
Durbin-Watson stat	2.1479			

*Note: D(LN_EMFI) represents the immediate short-run impact. CointEq(-1) indicates the speed of adjustment towards equilibrium. *** denotes statistical significance at the 1% level.*

The coefficient of the Error Correction Term (COINTEQ) is -0.6986, negative and statistically significant at the 1% level. This confirms the stability of the long-run relationship. The magnitude of the coefficient, -0.69, indicates a rapid speed of adjustment. It suggests that approximately 70% of any

disequilibrium caused by short-term shocks in the previous quarter is corrected in the current period. In other words, while market conditions or external shocks may cause temporary deviations in Turkcell's stock price relative to its EmFi performance, the market efficiently corrects these deviations and quickly returns to the long-run equilibrium path. Having empirically confirmed the significant positive impact of EmFi revenues on market value (H1) and the market's rapid response mechanism (H2), the study now proceeds to interpret these results in a broader context. The concluding section synthesizes these findings to offer strategic recommendations for managers, academics, and regulators, while outlining limitations and directions for future research.

4. Discussion and Conclusion

This study empirically investigated the impact of Turkcell's strategic transformation from a traditional telecommunications operator into a technology-fintech company on its market valuation. Utilizing quarterly data from 2016Q4 to 2025Q3, and employing the ARDL bounds testing approach to account for the dynamic nature of financial time series, the study provides robust evidence supporting the value-enhancing role of financial technology investments. The descriptive and correlation analyses initially revealed a robust synchronization ($r=0.95$) and higher volatility in EmFi revenues compared to market value, signaling a dynamic structural shift in the company's operations. Following the confirmation of stationarity via Breakpoint Unit Root Tests—which successfully accounted for structural breaks in 2022 and 2023—the ARDL Bounds Test confirmed the existence of a stable long-run cointegration relationship between Turkcell's market value and its EmFi revenues. This result successfully validates Hypothesis 2 (H2), demonstrating that integrating financial services into the telecom ecosystem establishes a sustainable,d long-term equilibrium. The most critical finding of this research is the magnitude of the long-run elasticity. The empirical results demonstrate that a 1% increase in fintech-based revenues is associated with approximately a 0.47% increase in Turkcell's market capitalization ($p < 0.01$). This finding provides direct empirical evidence in support of Hypothesis 1 (H1), confirming that EmFi revenue growth is a statistically significant driver of corporate market value. This indicates that the capital markets do not view the company's fintech initiatives, such as Paycell and Financell, merely as auxiliary services, but price them as a core driver of firm value. Furthermore, the Error Correction Model (ECM) revealed a highly efficient market adjustment mechanism. The error correction term was estimated at -0.6986, implying that nearly 70% of any short-term disequilibrium is corrected within a single quarter. This rapid pace of adjustment suggests that investors closely monitor Turkcell's EmFi performance and quickly incorporate new information about its digital transformation into the stock price. Additionally, the statistical insignificance of the COVID dummy variable suggests that the company's value generation through fintech was resilient and driven by structural strategy rather than temporary pandemic-induced anomalies.

5. Concluding Remarks

The findings of this study offer multifaceted implications that extend beyond corporate strategy to regulatory frameworks and academic inquiry. The positive and statistically significant long-run elasticity supports the EmFi business model. It confirms that the strategic pivot towards digital financial services generates tangible shareholder value and is not merely a supplementary revenue stream. Consequently, management is encouraged to continue prioritizing resource allocation towards the fintech ecosystem (Paycell, Financell), as the capital markets reward these high-growth verticals with a premium valuation. Moreover, given the rapid adjustment speed of nearly 70% observed in the error-correction model, the market is highly sensitive to EmFi performance. This necessitates a transparent communication strategy where specific key performance indicators—such as transaction volumes and loan book quality—are reported frequently to reduce information asymmetry and manage the higher volatility inherent in these revenues compared to traditional telecom income. This study also highlights the accelerating convergence between the telecommunications and financial sectors. The strong integration found between Turkcell's market value and its fintech operations suggests that telecom operators are becoming systemically important actors in the financial landscape. This blurring of lines implies that traditional siloed regulation—treating telcos solely under communication laws and fintechs under banking laws—may become insufficient. Therefore, regulators should consider adopting dynamic supervision frameworks to accommodate this hybrid structure. Furthermore, the higher volatility observed in fintech revenues warrants close monitoring to ensure that the aggressive expansion of non-

bank financial intermediation does not introduce new forms of systemic risk or compromise consumer protection, particularly as these digital ecosystems scale rapidly. Finally, for the academic community, this research underscores the need to revisit traditional valuation paradigms for telecommunication firms. The results challenge the conventional view that evaluates telcos primarily based on physical infrastructure (CAPEX) and subscriber growth. Instead, the study advocates for an evolved theoretical framework that incorporates ecosystem value and data monetization capabilities as core determinants of firm value. From a Signaling Theory perspective, the validation of our hypotheses suggests that EmFi operations act as a high-quality signal to investors regarding the firm's future cash-flow stability. Moreover, the long-run relationship supports the Resource-Based View (RBV), indicating that Turkcell's unique digital infrastructure and customer data constitute an inimitable resource that generates a competitive premium. By demonstrating that a telecom company can effectively be priced like a technology-fintech entity, this paper invites researchers to adopt interdisciplinary approaches—combining theories from information and communication technologies, economics, and financial innovation—to better understand the value drivers of the modern *Techco* era.

Theoretically, this study contributes to the valuation literature by demonstrating that, in the digital era, a telecommunications company's value is increasingly derived from its "intangible" service layers rather than from its physical infrastructure alone. It supports the view that successful diversification into high-growth verticals like fintech can lead to a re-rating of traditional incumbent firms. By confirming H1 and H2, this study provides a formal academic bridge between financial innovation and corporate valuation in the non-bank sector. However, the study is subject to certain limitations. First, the analysis is limited to a single-firm case study, namely Turkcell, which, while providing depth, limits the generalizability of the results to the broader telecom sector. Second, although the ARDL method is robust for small samples (N=36), the dataset is constrained by the relatively recent emergence of the EmFi phenomenon.

Future research could expand this framework by conducting a panel data analysis, including other global telecom operators that have ventured into financial services. However, it should be noted that such a comparative study is currently constrained by the lack of standardized reporting and consistent time-series data regarding EmFi-specific revenues across different operators. Once data transparency improves within the sector, cross-country comparisons will become feasible. Furthermore, while this study focuses on market capitalization, future inquiries should investigate the impact of embedded finance on stock return volatility. Applying Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models would provide valuable insights into whether embedded finance revenues act as a volatility absorber, thereby reducing the firm's idiosyncratic risk during turbulent market conditions. Additionally, investigating non-linear effects, such as threshold levels at which profitability might diminish due to regulatory costs, would provide a more nuanced understanding of the "Telco-to-Techco" transformation. In conclusion, the empirical evidence strongly suggests that Turkcell's strategic pivot toward embedded finance is not merely a short-term trend but a fundamental value-accruing mechanism. The full acceptance of both research hypotheses (H1 and H2), validated by the ARDL cointegration results, proves that this transformation leverages network effects to convert connectivity-based relationships into sustainable financial revenue streams and is highly rewarded by capital markets in the long run.

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Araştırma Makalesi

Embedded Finance as a Long-Run Value Driver: ARDL Evidence from a Leading Telecommunication Operator in Turkey

Uzun Dönem Değer Sürücüsü Olarak Gömülü Finans: Türkiye'de Önde Gelen Bir Telekomünikasyon Operatöründen ARDL Kanıtı

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Genişletilmiş Özet

Küresel telekomünikasyon endüstrisi, son yirmi yılda köklü bir yapısal dönüşüm ve varoluşsal bir krizin içinden geçmektedir. Geleneksel olarak ses ve mesajlaşma gelirlerine dayalı olan iş modeli, internet tabanlı iletişim araçlarının yükselişi ve mobil penetrasyon oranlarının doygunluğa ulaşmasıyla sürdürülebilirliğini yitirmeye başlamıştır. Sektördeki bu tıkanıklık, literatürde ve endüstri jargonunda sıklıkla basit boru (dumb pipe) riski olarak tanımlanmaktadır. Gilder (2000), bant genişliğinin zamanla sonsuz ve neredeyse ücretsiz hale geleceğini, bu durumun da altyapı sağlayıcılarının kâr marjlarını eriteceğini öngörmüştür. Benzer şekilde Isenberg (1997), Aptal Ağ (Stupid Network) tezinde, telekom operatörlerinin akıllı şebeke özelliklerini yitirerek sadece veri taşıyan basit altyapı sağlayıcılarına dönüşme riskiyle karşı karşıya olduklarını, katma değerin yalnızca şebekenin ucundaki cihazlara ve uygulamalara kayacağını yıllar öncesinden belirtmiştir. Bu emtialaşma tuzağından kurtulmak isteyen operatörler, kendilerini, *Telco* olarak isimlendirilen ve sadece bağlantı sunan şirketlerden, *Techno* olarak adlandırılan dijital ekosistem oyuncularına dönüştürme stratejisi izlemektedirler. Bu stratejinin merkezinde ise telekomünikasyonun devasa müşteri tabanı ile finansal hizmetlerin kârlılığını birleştiren Gömülü Finans (Embedded Finance - EmFi) yer almaktadır. Finansal teknolojilerin (Fintech) sağladığı altyapıyı, kendi ana faaliyet alanlarına entegre eden operatörler, bu sayede yalnızca bir iletişim sağlayıcısı olmaktan çıkıp, müşterilerinin günlük finansal ihtiyaçlarını karşılayan merkezi bir platform haline gelmektedirler.

Ancak literatür incelendiğinde, gömülü finans çalışmalarının çoğunlukla bankacılık sektörü perspektifinden ele alındığı, şirket düzeyinde ve de özellikle telekom gibi önemli sektör şirketleri özelinde ve özellikle gelişmekte olan piyasalarda bu dönüşümün şirket değerine olan uzun vadeli etkisini ölçen ampirik çalışmaların kısıtlı olduğu görülmektedir. Mevcut çalışmalar genellikle fintech duyurularına piyasanın verdiği kısa vadeli tepkileri olay çalışması yöntemiyle incelerken, bu stratejik dönüşümün uzun vadeli firma değeri üzerindeki kalıcı etkileri yeterince araştırılmamıştır.

Bu çalışmanın temel amacı, Türkiye'nin pazar lideri operatörü Turkcell'in gömülü finans stratejilerinin, şirketin piyasa değeri üzerindeki uzun vadeli etkisini ekonometrik modeller aracılığıyla test etmektir. Çalışma, fintech uygulamalarını kavramsal olarak ele alan önceki araştırmaların aksine, gömülü finans gelirlerini sürekli bir zaman serisi verisi olarak kullanarak, bu stratejik dönüşümün hissedar değeri üzerindeki elastikiyetini ölçmeyi ve literatürdeki ampirik boşluğu doldurmayı hedeflemektedir. Bu bağlamda çalışma, aşağıdaki temel araştırma hipotezleri çerçevesinde kurgulanmıştır:

H1: Gömülü finans gelirleri (EmFi), firmanın piyasa değeri üzerinde uzun dönemde istatistiksel olarak anlamlı ve pozitif bir etkiye sahiptir.

H2: Firmanın gömülü finans entegrasyonu ile piyasa değeri arasında, şoklardan sonra dengeye geri dönen kararlı bir eşbütünleşme (cointegration) ilişkisi mevcuttur.

Çalışmanın teorik zemini, işlem maliyeti teorisi, ağ etkileri, kaynak tabanlı görüş ve sinyalleme teorisi olmak üzere dört temel teori üzerine inşa edilmiştir. Coase (1937) ve Williamson (1985) tarafından geliştirilen İşlem Maliyeti Teorisi perspektifinden bakıldığında; gömülü finans uygulamaları, müşterilerin finansal hizmetlere erişimindeki arama ve bilgi maliyetlerini minimize etmektedir. Operatörler, halihazırda sahip oldukları faturalama altyapısını bir ödeme aracı olarak kullanarak, müşteriler için finansal işlemleri görünmez ve zahmetsiz hale getirmektedir. Ağ etkileri teorisine göre ise, platforma katılan her yeni finansal kullanıcı, ekosistemin toplam değerini artırmakta ve kilitleme etkisi (lock-in) yaratarak müşteri sadakatini pekiştirmektedir. Kaynak tabanlı görüş, Turkcell'in sahip olduğu eşsiz veri ve altyapının taklit edilemez bir kaynak olarak rekabet avantajı sunduğunu savunurken; Sinyalleme teorisi, bu teknolojik dönüşümün sermaye piyasalarına gelecek büyüme potansiyeli olarak yüksek kaliteli bir sinyal gönderdiğini öne sürmektedir.

Araştırmada, Turkcell İletişim Hizmetleri A.Ş.'nin finansal verileri kullanılmıştır. Analiz dönemi, şirketin dijital dönüşüm stratejilerini hızlandırdığı ve Paycell ve Financell gibi gömülü finans geliri elde eden iştiraklerinin bilançoda yer almaya başladığı 2016 yılının son çeyreği -2016Q4 ile projeksiyon verilerini içeren 2025 yılının üçüncü çeyreği -2025Q3 arasını kapsamaktadır. Veri seti üç aylık çeyreklik frekansta düzenlenmiş olup, toplam 36 çeyrek uzunluğundan oluşmaktadır. Bağımlı değişken olarak, şirketin piyasa tarafından algılanan değerini temsil eden piyasa değeri (market capitalization) kullanılmıştır. Temel bağımsız değişken ise şirketin fintech ve dijital servislerden elde ettiği gelirleri temsil eden gömülü finans gelirleri, bilançoda yer aldığı ismiyle finansal operasyon gelirleri kalemidir. Değişkenler, elastikiyet yorumuna imkân tanıması ve varyansın stabilize edilmesi amacıyla doğal logaritmaları alınarak analize dahil edilmiştir. Analiz yöntemi olarak Gecikmesi Özbağlaşımlı Dağıtılmış Gecikme Sınır Testi (Autoregressive Distributed Lag Bound Test-ARDL) yaklaşımı tercih edilmiştir. ARDL yönteminin seçilmesinin başlıca nedeni çalışmanın örneklem hacminin küçük olması ve ve bu yöntemin, serilerin bütünleşme dereceleri farklı olsa bile sağlam ve tutarlı sonuçlar verebilmesidir (Pesaran vd., 2001). Analiz süreci şu aşamalardan oluşmuştur. Serilerin tanımlayıcı istatistikleri incelenmiş ve korelasyon analizi sonuçlarına bakılmıştır. Ardından serilerin durağanlık yapıları Augmented Dickey-Fuller (ADF) ve Phillips-Perron (PP) birim kök testleri ile incelenmiştir. Sonrasında değişkenler arasında uzun dönemli bir ilişkinin varlığını test etmek için ARDL Sınır Testi (Bounds Test) uygulanmıştır. Eşbütünleşme ilişkisinin doğrulanmasının ardından, uzun ve kısa dönem katsayıları tahmin edilmiş ve sistemin dengeden sapma durumunda ne kadar sürede tekrar dengeye geleceğini gösteren Hata Düzeltme Modeli (ECM) kurulmuştur.

Ampirik analizden elde edilen bulgular, her iki araştırma hipotezini de güçlü bir şekilde desteklemektedir. Diğer bir ifade ile, sonuçlar, Turkcell'in piyasa değeri ile gömülü finans gelirleri arasında istatistiksel olarak anlamlı ve pozitif yönlü bir uzun dönem ilişkisi olduğunu ortaya koymaktadır. Sınır testi sonucunda hesaplanan F-istatistiği değeri, üst kritik sınır değerini aşarak seriler arasındaki birlikte hareket etme davranışını yani H2 hipotezini doğrulamıştır. Uzun dönem katsayı tahminleri incelendiğinde, gömülü finans gelirlerindeki %1'lik bir artışın, şirketin piyasa değerinde %0.47'lik bir pozitif ve istatistiksel olarak anlamlı artışa yol açtığı tespit edilmiş böylece H1 hipotezi doğrulanmıştır. Bu bulgu, çalışmanın temel hipotezini desteklemekte ve gömülü finansın sadece operasyonel bir çeşitlilik aracı olmadığını, aynı zamanda güçlü bir değer yaratıcısı olduğunu kanıtlamaktadır. Teorik çerçeve ile uyumlu olarak, bu pozitif etki; azalan işlem maliyetleri, artan çapraz satış imkanları ve ekosistem kilitlenmesi mekanizmalarıyla açıklanmaktadır. Kısa dönem analizleri ve Hata Düzeltme Modeli (ECM) sonuçları ise, sistemin şoklara karşı verdiği tepkiyi göstermektedir. Hata düzeltme teriminin (ECM-1) katsayısı, beklendiği üzere negatif ve istatistiksel olarak anlamlı bulunmuştur. Bu katsayı, piyasa değerinde meydana gelen kısa vadeli bir sapmanın, takip eden dönemlerde %70'inin düzeltilerek uzun dönemli dengeye yakınsayacağını göstermektedir. Sonuçlar, Sinyalleme Teorisi ve RBV ile uyumlu olarak, piyasanın gömülü finans kaynaklı yeni bilgilere rasyonel tepki verdiğini ve fiyatlama mekanizmasının etkin çalıştığını işaret etmektedir. Tanısal testler modelin otokorelasyon ve değişen varyans sorunlarından arınmış olduğunu doğrulamıştır.

Bu çalışma, telekomünikasyon sektöründe yaşanan dijital dönüşümün finansal sonuçlarına dair önemli kanıtlar sunmaktadır. Elde edilen sonuçlar, Turkcell'in bir telekom operatöründen, telco'dan, güçlü bir teknoloji şirketine, Techco'ya dönüşüm sürecinde, gömülü finansın kritik bir kaldıraç görevi gördüğünü göstermektedir. Isenberg (1997) ve Gilder (2000) tarafından yıllar önce öngörülen basit taşıyıcı olma riskine karşı, gömülü finans stratejisinin şirket için etkili bir değer yaratma mekanizması olduğu H1 ve H2 hipotezleri doğrulanarak ampirik olarak kanıtlanmıştır. Çalışmanın bulguları, hem şirket yöneticileri hem de düzenleyici otoriteler için önemli çıkarımlar barındırmaktadır. Yöneticiler için bu sonuçlar, dijital finansal servislere yapılan yatırımların sermaye piyasaları tarafından ödüllendirildiğini teyit ederken; düzenleyiciler için ise telekom operatörlerinin artık sistemik olarak önemli finansal aktörlere dönüştüğünü ve hem telekom hem finans şirketlerini birlikte denetleyebilen *hibrit* denetim mekanizmalarının gerekliliğini ortaya koymaktadır.

Gelecek araştırmalar için finansal hizmetlere giriş yapmış diğer yerel ve küresel telekom operatörleri de çalışmaya dahil edilerek geniş kapsamlı bir panel veri analizi yapılabilir. Ancak operatörler arasında finteche özgü gelirlerin raporlanmasında henüz küresel bir standart bulunmaması ve tutarlı zaman serisi verilerinin eksikliği, şu aşamada böyle karşılaştırmalı bir çalışmayı kısıtlamaktadır. Buna ek olarak, bu çalışma piyasa değerine odaklanmış olsa da, gelecek araştırmalar gömülü finansın hisse senedi getiri volatilitesi üzerindeki etkisini inceleyebilir. Ayrıca, kârlılığın düzenleyici maliyetler nedeniyle azalabileceği eşik seviyeleri gibi doğrusal olmayan etkilerin araştırılması, dönüşüm sürecine dair daha derinlikli bir anlayış sunacaktır. Sonuç olarak, ampirik bulgular Turkcell'in gömülü finansa yönelik stratejik yöneliminin sadece kısa vadeli bir trend olmadığını, aksine temel bir değer yaratma mekanizması olduğunu güçlü bir şekilde ortaya koymaktadır. ARDL analizi sonuçlarıyla doğrulanan bu çıkarımlar, teknolojinin gelişimi ile birlikte, bağlantı temelli ilişkileri finansal gelir akışlarına dönüştürmekte ve bu da değer artışı olarak, uzun vadede, yatırımcılar tarafından ödüllendirilmektedir.