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Araştırma Makalesi (Research Article)

A Nonlinear Relationship Between Corporate Size and Profitability

Bahadır KARAKOÇ[1]

Abstract

Corporate growth is a natural consequence of management's wealth maximization efforts. However, its effects on profitability are not fully understood. This study examines the size-profitability relationship using quarterly data from publicly listed Turkish firms. The findings indicate that size is positively correlated with profitability. However, this relationship is not linear. After reaching a certain point in size, the marginal return becomes negative, raising questions about growth-related decisions. The findings are robust to alternative econometric methods (GMM and FE-OLS), alternative measures of size, and alternative specifications of nonlinearity.

Keywords: Firm Size, Profitability, Nonlinear Relationship, ROA, Publicly Listed Firms.

JEL Codes: G32, L21, L25.

Şirket Büyüklüğü ile Kârlılık Arasındaki Doğrusal Olmayan Bir İlişki

Öz

Firmalarda büyüme, yönetimin servet maksimize etme çabalarının doğal bir sonucudur. Ancak, bunun kârlılık üzerindeki etkileri tam olarak anlaşılamamıştır. Bu çalışma, halka açık Türk şirketlerinden elde edilen üç aylık verileri kullanarak firma büyüklüğü-kârlılık ilişkisini incelemektedir. Bulgular, firma ölçeğinin kârlılıkla pozitif bir şekilde ilişkili olduğunu göstermektedir. Ancak, bu ilişki doğrusal değildir. Firma hacminde belirli bir nokta aşıldıktan sonra marjinal katkısı negatif hale gelmektedir ki ve bu durum büyüme ile ilgili kararların sorgulanması gerektiği anlamını taşımaktadır. Bulguların, alternatif ekonometrik yöntemler (GMM ve FE-OLS), alternatif büyüklük ölçüleri ve doğrusal olmayan farklı spesifikasyonlar kullanılarak tutarlı olduğu gösterilmiştir.

Anahtar Sözcükler: Firma Büyüklüğü, Kârlılık, Doğrusal Olmayan İlişki, ROA, Halka Açık Firmalar.

JEL Kodları: G32, L21, L25.

[1] Sorumlu Yazar (Corresponding Author): Bahadır KARAKOÇ, Dr., Samsun Üniversitesi, Siyasal Bilgiler Fakültesi, Ekonomi ve Finans Bölümü, Samsun/Türkiye, bahadir.karakocamsun.edu.tr, ORCID ID: 0000-0001-8137-2233.

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1. INTRODUCTION

A firm's profitability reflects how effectively it has organized and managed its production factors, showcasing its overall operational efficiency. Profitable firms create secure investments for investors and provide stable employment for workers. By reinvesting profits into new ventures and paying taxes, they contribute to the national economy. Profitable companies also invest in pioneering R&D projects, enhancing the quality of life for everyone (Barauskaite and Streimikiene, 2021; Purbawangsa et al., 2020; Salam et al., 2021; Lefebvre, 2022; Mayer, 2021).

While these benefits hold globally, they are particularly significant for Türkiye for several reasons. Türkiye's economy is highly sensitive to global market fluctuations (Uygur, 2010). Its dependency on imported energy, geopolitical risks, and exchange rate fluctuations make firms vulnerable to external shocks (Bilgili vd., 2022; Hidayah, 2024). Profitable firms with liquidity reserves are more likely to survive such shocks and continue their operations uninterrupted. Furthermore, intense global competition requires all firms, including Turkish ones to prioritize profitability and efficiency to stay competitive internationally and to navigate economic volatility (Atabek et al., 2017; Demir & Javorcik, 2018). Profitability and efficiency are also key factors for attracting foreign investment (Olshanska & Tymoshenko, 2021)-an essential goal for Türkiye in its pursuit of economic growth. In certain industries such as textiles, automotive, and tourism, Turkish companies face fierce competition that continues to narrow profit margins. To retain a competitive edge, they must focus on maximizing efficiency and profitability (Atabek et al., 2017). Additionally, Turkish firms often contend with economic policies that create a challenging environment, such as high interest rates and inflation; in such a climate, increasing profitability and operational efficiency is critical to managing financial pressures. Finally, as Türkiye strives to become a regional economic power, the profitability and efficiency of its firms will play a critical role in strengthening Türkiye's role in international trade.

In today's business world, with advancements in communication technology and the effects of globalization, competition has become fierce, causing the profit margins to become thinner every day and driving a global push for cost-effectiveness (Al-Ali & Al-Shabeeb, 2024; Liu & Zhao, 2024). To increase profitability, firms must either boost the profits generated from their operations or cut costs. For instance, large firms often achieve this through economies of scale: the ability to produce large quantities while spreading overhead costs across many units (Celli, 2013). In addition, they often gain competitive advantages through established reputations (Järvinen et al., 2009), easier access to external financing sources (Kaur et al., 2024), and a strong customer base (Yang et al., 2014), advantages that smaller companies typically lack (Vandaie and Zaheer, 2014). These factors, associated with economies of scale, increase efficiency in large firms.

However, some key characteristics that initially contribute to increased profitability in large firms may eventually lead to declining efficiencies, a phenomenon commonly referred to as diseconomies of scale. For instance, with growth in size, the number of managerial levels increases, adding layers of responsibility for decision-makers. This expansion in bureaucracy can result in miscommunication or delays in coordination (Canback et al., 2006). Furthermore, due to their large size, firms may respond slowly to disruptive shifts in business practices or technological developments, ultimately reducing profitability and falling behind competitors. Over-diversification in the portfolio of goods and services—a common strategy among large firms to expand into somewhat unrelated areas (Hoskisson, Short, & Yiu, 2011; Benito-Osorio et al., 2015) —can also divert attention from their core goods and services, leading to suboptimal performance. Empirical evidence (e.g., Ezeoha, 2008; Sukadana and Triaryati, 2018) supports these arguments, showing that firm size can be negatively related to profitability. Therefore, determining the optimal size at which profitability is maximized is critical for long-term success.

Unfortunately, most of the existing literature on the size-performance relationship either focuses on direct correlations (e.g., Isik et al., 2017; Dang et al., 2019; Posti & Maiti, 2023) or the moderating effect of size (Li & Chen, 2018; Farooq et al., 2021; Hui et al., 2024). There is limited empirical

evidence on how the advantages arising from economies of scale turn into diseconomies of scale over time. Hence, the purpose of this paper is to address this gap in the literature and provide a comprehensive assessment of the firm size-performance relationship. In the empirical analysis, we explore this relationship using publicly traded firm data from Türkiye, measuring the size via total assets. For robustness, we also used net sales and two alternative regression models, FE-OLS and difference GMM, to account for the effects of unobserved firm effect and deal with the endogeneity issue. Our findings indicate that as firms grow they receive the benefits of the expansion. However, the relationship is not linear. After a certain threshold value in size, the marginal benefit becomes negative. In capturing the nonlinear dynamic in the relationship, first, we rely on the squared terms of size variables (both assets and sales). We checked the robustness of this finding by employing an alternative size variable for firms falling in the top 25th percentile of the size distribution. The findings remain consistent across both cases, as the alternative variable also shows a negative and statistically significant coefficient when included alongside the traditional size variables.

Undoubtedly, the issue of profitability is of paramount importance to interested parties. Debt holders would prefer to lend to more profitable firms (Mazur, 2007; Xu, 2012; Irmak, 2024). Business partners would like to lend to and possibly establish long-term partnership ties with more profitable firms (Delannay and Weill, 2004). Even those who are at the opposite end of the supply chain tend to prefer to buy from those who are more profitable (e.g., Gofman and Wu, 2018). And of course, all else being equal, investors would direct their savings toward more profitable firms. Because of this great importance, the issue has been discussed at length (Ezeoha, 2008; Kebewar, 2013; Olaniyi et al., 2017; Sukadana and Triaryati, 2018 to cite just a few).

Growth in size, as the natural outcome of a company's routine activities, such as innovation and investment in physical assets, is expected to contribute to profitability immensely. However, the evidence is not clear on whether the structure that emerges after reaching a certain size increases productivity. While some studies (e.g., Sritharan, 2018; Fonseca and Guedes, 2022) have shown that profitability increases as firms grow, there are also studies (e.g., Ezeoha, 2008; Kebewar, 2013; Sukadana and Triaryati, 2018) that show that firm size negatively affects profitability. The current study contributes to the performance and financial planning literature by addressing the question of nonlinearity in the relationship by providing empirical evidence from one of the largest developing economies.

The rest of the study is organized as follows. The next section presents a literature review. The data and methodology of the study are introduced in the third section. The fourth and fifth sections of the study present empirical findings and the conclusion of the study, respectively.

2. LITERATURE REVIEW AND HYPOTHESIS

The debate surrounding the relationship between a corporation's size and its profitability has long been a topic of interest in the business and academic communities. While some studies have suggested that larger firms enjoy economies of scale and greater access to financing, thereby leading to higher profitability, others have found the relationship to be more complex or even negative. (Ezeoha, 2008; Sukadana and Triaryati, 2018).

Olaniyi et al. (2017) used a dynamic panel generalized method of moments approach to address the potential issue of endogeneity, and their findings revealed a bidirectional relationship between firm size and profitability. Specifically, they found that while firm size positively Granger-causes profitability, profitability also negatively Granger-causes firm size, suggesting that the popular assumption of a unidirectional relationship from size to profitability may be oversimplified. This bidirectional relationship has important implications for corporate strategy and decision-making. Firms may need to carefully consider the potential trade-offs between growth and profitability, as a singular focus on increasing size may not necessarily translate to higher profits. Additionally, the authors' findings highlight the importance of considering the possibility of feedback effects when analyzing the firm size-profitability relationship.

The exploration of corporate profitability has been a focal point of economic and financial research, revealing intricate relationships between various factors and firm performance. The literature presents a spectrum of insights, particularly regarding the impact of debt, corporate governance, and macroeconomic conditions on profitability across different sectors and regions. Kebewar (2013) provides an examination of the French service sector, revealing a negligible negative correlation between debt and profitability. This study emphasizes that while debt does not significantly influence profitability, factors such as growth opportunities and tax positively correlate. The findings suggest that corporate managers may not need to overly concern themselves with debt levels when considering profitability, particularly in the context of service firms.

He expands the discourse by investigating the determinants of profitability among top non-financial firms in the United States. This study identifies internal factors, including leverage, liquidity, and size, as significant contributors to return on assets (ROA). By establishing that ROA serves as a reliable proxy for financial performance, it underscores the importance of various operational dimensions in enhancing profitability, thus providing a more nuanced understanding of performance metrics in corporate settings. Ng'eni (2015) reviewed the empirical evidence on the corporate governance-performance relationship. The mixed associations reported in this literature highlight the complexity of governance structures and their varying impacts on profitability. The study advocates for further empirical research to address gaps, particularly regarding unlisted companies, thereby suggesting that corporate governance is a crucial, albeit complex, driver of profitability. Ghasemi and Hisyam Ab Razak (2017) contribute to this discussion by examining the determinants of profitability in the ACE market of Bursa Malaysia. Their findings indicate that asset liquidity positively influences profitability while increasing debt adversely affects it. This research reinforces the notion that financial health is contingent upon effective management of liquidity and leverage, echoing earlier findings while also suggesting avenues for future studies on competition and innovation's roles in profitability. Rahman (2022) investigates the relationship between profitability and the weighted average cost of capital in the food and allied industries of Bangladesh. The study suggests that while higher levels of debt can initially enhance profitability, excessive leverage may lead to financial risks that diminish returns. This nuanced perspective adds another layer to our understanding of the impact of capital structure on profitability, reinforcing the need for strategic financing decisions. Finally, Azzabi and Lahrichi (2023) provide a comprehensive overview of contemporary research on bank performance determinants, emphasizing the significance of macroeconomic factors and governance on profitability. Their review indicates a growing recognition of digitalization and sustainability as emerging influences on financial performance, suggesting that the landscape of profitability determinants is continuously evolving. Dalci (2018) finds that leverage has an inverted U-shaped effect on profitability. Initially, leverage positively impacts profitability, likely due to the tax shield that allows firms to deduct interest payments from their taxable income. However, beyond a certain point, higher leverage starts to negatively affect profitability. This decline can be attributed to the increased risks of bankruptcy, financial distress, and severe agency problems, as well as information asymmetry. These challenges are particularly pronounced for Chinese firms, which face additional difficulties due to specific institutional characteristics in China.

Together, these studies illustrate a multifaceted landscape of corporate profitability characterized by the interplay of firm-specific and macroeconomic factors. The ongoing discourse underscores the necessity for continued investigation into these relationships to inform corporate strategies and policy-making better.

In light of evidence from previous studies, we test the validity of the following hypothesis:

H_1: There is a statistically significant linear relationship between corporate size and profitability.

H_2: There is a statistically significant nonlinear relationship between corporate size and profitability.

3. DATA AND METHODOLOGY

3.1. Data

The empirical analysis was conducted using publicly traded firm (quarterly) data from Türkiye, covering the period of 2017-2022. This data is retrieved from Refinitiv Eikon and includes a sample of firms of differing sizes. For example, when separated by total assets we have 147 firms whose book value of total assets is worth more than $100M and 66 firms whose book value of total assets is less than $1M. Similarly, when classified by net sales, we have 142 firms whose sales are more than $30M, and 96 firms whose net sales are less than $300K. This diversity enables adequate exploration of the effects of corporate size on profitability.

In data handling, two percent from both ends of each variable is removed to eliminate the effects of outliers. In addition, we ensured that all balance sheet variables had observations of less than total assets. Lastly, all negative observations in sales or total assets have been removed. Furthermore, we included all active and passive firms. This approach enables working with more comprehensible data, avoiding selection bias. Employing only the data from active firms while excluding those from dead ones increases the biases that being active may be related to being profitable. The final data set has 10,004 observations belonging to 421 firms. Table 1 provides descriptive statistics for the final dataset.

Table 1. Descriptive Statistics

Small firms by asset size						
Variable	**# obs**	**# firm**	**Mean**	**Std. dev.**	**Min**	**Max**
ROA	6,512	274	-0.077	0.349	-1.798	0.331
Debt	6,512	274	0.188	0.210	0.000	0.999
LnSize (Total Assets)	6,512	274	11.778	1.918	6.413	14.600
AR	6,512	274	0.129	0.111	0.000	0.540
Capex	6,512	274	0.041	0.050	0.000	0.309
R&D	6,512	274	0.905	0.293	0.000	1.000
Tobin	6,512	274	3.244	5.457	.0002	38.231
					Large firms by asset size	
Variable	**# obs**	**# firm**	**Mean**	**Std. dev.**	**Min**	**Max**
ROA	3492	147	0.109	0.099	-1.254	0.330
Debt	3492	147	0.321	0.178	0.000	0.998
LnSize (Total Assets)	3492	147	15.645	0.737	14.600	17.431
AR	3492	147	0.109	0.081	0.000	0.526
Capex	3492	147	0.048	0.047	0.000	0.307
R&D	3492	147	0.933	0.249	0.000	1.000
Tobin	3492	147	3.168	4.333	.0002	37.904

ROA measures profitability as the ratio of EBITDA to total assets. Debt is the ratio of total debt to total assets, indicating leverage. LnSize (Log of Total Assets): Natural logarithm of total assets, used as a proxy for firm size. AR (Accounts Receivable): Ratio of accounts receivable to total assets, reflecting credit extended to customers. Capex (Capital Expenditures): Ratio of capital expenditures to total assets, indicating investment. R&D: Binary variable indicating R&D investment (1 if R&D occurs, 0 otherwise). Tobin (Tobin's Q): Market valuation measure, calculated as the market value of assets divided by their replacement cost. The data is categorized into small and large firms based on asset size, with descriptive statistics (mean, standard deviation, minimum, and maximum values) provided for each group. The source of data is the author's calculations.

The descriptive statistics reveal notable differences between small and large firms. Large firms, on average, exhibit significantly higher profitability, with a mean ROA of 0.109, compared to the negative value of -0.077 for small firms. Large firms also carry more debt, with a mean debt level of 0.321, possibly as a result of maintaining greater access to credit markets. Small firms, however, have a debt level of 0.188. Interestingly, small firms show slightly higher AR ratios, which could indicate extended credit terms to customers. However, capital expenditure and R&D investment are quite similar across firm sizes, with large firms allocating marginally more resources to both. The descriptive statistics reveal clear differences between small and large firms, with large firms showing higher profitability, greater leverage, and larger size. However, both groups of firms exhibit notable similarities, particularly in their levels of accounts receivable, capital expenditure, R&D expenditure, and Tobin’s Q, indicating that some firm behaviors and strategies are consistent across groups.

3.1.1. Dependent Variable

Inspired by the previous studies (e.g., Ezeoha, 2008; Kebewar, 2013; Sukadana and Triaryati, 2018), we calculated profitability as follows.

$$ROA = \left(\frac{\text{EBITDA}_t}{Total\ Assets_t}\right)$$

3.1.2. Explanatory Variables

The base regression equation is illustrated in Equation (1).

$$ROA_{it} = \alpha + LnSize_{it-1} + LnSize^2/Large\_Size_{it-1} + X_{it-1} + \mu_i + \delta_t + \varepsilon_{it} \quad (1)$$

In accordance with the hypothesis in Section II, we explore the relationship between size and profitability via LnSize variable, which is the natural logarithm of total assets. The results obtained with this variable are reported in Tables 3 and 4. For robustness, we also use net sales (Brouwer et al., 1996; Gaur and Kesavan, 2015) in logarithmic form, and the results from this second set of analyses are exhibited in Tables 5 and 6. We expect to observe a positive relationship based on the previous studies (e.g., Olaniyi et al., 2017; Sritharan, 2018) indicating that as firms grow they become more cost-efficient. Our second hypothesis requires to test for nonlinearity in the relationship. The validity of this claim is investigated via $LnSize^2$, which is the square of LnSize variable. Again, to increase the reliability of the findings, the squares of both size variables (sales and total assets) are added to the analysis. To further explore this dynamic we established an alternative variable, labeled Large_Size, by interacting the dummy variable for large firms with the LnSize variables. Negative and statistically significant coefficients for $LnSize^2$ and Large_Size would indicate that the size-profitability relationship is not linear and the marginal benefits of growing may come to an end at some point.

3.1.3. Control Variables

The control variables in Equation (1) are denoted by X_{it-1}. The first variable is liquidity. Previous studies show that efficient management of working capital components (cash, receivables, and payables) is key to maintaining liquidity. High liquidity allows firms to meet short-term obligations and invest in profitable projects without resorting to costly external financing (Mathuva, 2010). Ratios like the current ratio and quick ratio often provide a buffer during financial downturns, preventing a liquidity crunch that might lead to distress or operational disruptions. This ensures smoother operations, which positively impacts profitability. Furthermore, companies with more liquidity might be better positioned to fund growth and capitalize on new opportunities without incurring high financing costs (Riddiough and Wu, 2009). While maintaining a substantial amount of liquid assets can allow firms to react to investment opportunities, thereby boosting profitability, it can also lead to inefficient management of those resources and reduce profitability significantly (Cyrus et al., 2002). Given that firms' growth opportunities and access to external finance vary widely having large reserves of liquid assets may not have a typical effect on profitability. In this study, the liquidity variable is calculated using cash and cash equivalents as shown in Table 2.

Table 2. Variable Descriptions

Acronym	Calculation
Dependent variables	
ROA	$\text{EBITDA}_{it}/\text{Total Assets}_{it}$
Explanatory variables	
LnSize	$\text{Log(Total Assets)}_{it}$ & Log(Sales)_{it}
Large_Dummy	$= 1$ if total assets $>$ \$100M, 0 otherwise & $= 1$ if sales $>$ \$20M, 0 otherwise
Large_Size	Large_Dummy*LnSize
Control variables	
Debt	$Interest\ bearing\ debt_{it}/\text{Total assets}_{it}$
AR	$Accounts\ receivable_{it}/Total\ assets_{it}$
Capex	$Capital\ expenditures_{it}/\text{Total assets}_{it}$
R&D	$= 1$ if R&D > 0, 0 otherwise
Tobin	$Market\ value\ of\ equity_{it}/Book\ value\ of\ equity_{it}$
Liquidity	$Cash\ and\ cash\ equivalents_{it}/\text{Total assets}_{it}$

The table presents the variables and their corresponding calculations used in the regression estimations. The raw data was obtained from Refinitiv Eikon and supplemented by the author's calculations, covering the period from 2017 to 2022. All monetary variables are originally in U.S. dollars and are scaled by total assets. LnSize is calculated as the natural logarithm of total assets or sales. The threshold value for the Large_Dummy variable is the 75th percentile of the relevant variable (total assets or sales).

Leverage is another key control variable that can influence profitability through various channels. According to Cyrus et al. (2002), leverage can enhance profitability, particularly for firms with high growth prospects and strong operational efficiency. By using debt financing, firms can increase their return on equity as long as the cost of debt is lower than the return on investment generated by the borrowed funds. The leverage effect can enhance market value-added and economic value-added metrics when the cost of debt is carefully controlled (e.g., Dalci, 2018), thus positively affecting corporate profitability. It provides the benefit of a tax shield, as interest payments on debt are tax-deductible. This reduces the company's taxable income, effectively lowering the cost of capital and increasing profitability (Modigliani and Miller, 1963).

Although leverage, when managed effectively, amplifies profits, it can also have notable negative effects. Highly leveraged firms face increased debt obligations (interest payments), which can strain profitability, especially during periods of economic downturn or declining revenues (Gill and Mathur, 2011). The potential downside of excessive leverage is that where firms might destroy value if their growth is financed too aggressively through debt (Cyrus, 2002). When debt levels become unsustainable, it increases financial distress, leading to declining profitability (Alarussi and Alhaderi, 2018; Dalci, 2018). Excessive debt can tighten liquidity, as more cash is tied up in servicing debt rather than funding operations or growth initiatives. This can result in reduced profitability if the firm becomes constrained in its ability to meet short-term obligations (Mathuva, 2010). Moreover, firms with excessive leverage are at a higher risk of financial distress or even bankruptcy, particularly during periods of economic instability. If earnings decline, highly leveraged firms may find it difficult to meet debt obligations, which can lead to defaults or restructuring (Myers and Majluf, 1984; Myers, 2001). Firms in cyclical industries or those exposed to high market volatility are especially vulnerable to financial distress when they are heavily geared.

From this discussion, it can be concluded that leverage can enhance corporate profitability by amplifying returns and providing tax benefits, but it also increases financial risk and the potential for financial distress. Therefore, careful management of leverage is essential to maintaining long-term profitability and minimizing risk. Accordingly, we expect that firms that maintain moderate, well-managed leverage tend to perform best, while those that over-leverage may experience declining profitability and increased vulnerability to market downturns.

Investment is the third control variable. Corporate investment decisions may be in various forms. In this case, we specifically use capital expenditures (Capex) that target capacity increases and research and development (R&D) expenses made to develop new products or enhance existing ones. Both kinds of investment can significantly impact profitability, hence they are included as two separate

variables. These investment decisions tend to involve long planning and are aimed at supporting long-term growth objectives and maintaining firms' competitive position (Huang and Hou, 2019). Machinery, equipment, and technological investments can reduce costs, and increase profit thereby boosting profitability (Firli et al., 2015; De Luca and De Luca, 2018). Especially young technology-driven companies tend to invest heavily as their survival depends on the success of these initiatives (Demirel and Mazzucato, 2012; (Guilong et al., 2017). Investment decisions can be unprofitable as well. In some cases, expansion efforts can result in great losses due to mismanagement or wrong investment decisions. For example, a project with a rate of return less than the rate of return on the existing assets will lower the profitability. Furthermore, if financial resources are exhausted by financing these low return-yielding projects then profitable opportunities to arise in the future will be missed. Or years of R&D investment may not simply yield a novel product, ending with a large sum of loss and a significant drop in profitability.

On the other hand, overinvestment—especially in low-return projects—can destroy profitability. When companies invest heavily in assets that don't generate sufficient returns, their return on existing assets and other profitability metrics may decline. Firms that invest aggressively without considering the cost of capital may face situations where the cost of debt or equity used to finance those investments outweighs the profits generated, leading to lower net profitability. Overinvestment in acquisitions without a clear strategy or focus on profitability can lead to financial distress, as seen in this case. R&D investments, while essential for innovation, can be risky. Firms in industries with high R&D intensity often face long development cycles and uncertain outcomes, which can negatively affect short-term profitability. Furthermore, high R&D expenditures can increase a firm's risk of financial distress, particularly if these investments are financed through debt (Şahin and Irmak, 2024).

Investment, whether in capital assets, R&D, or acquisitions, can be a powerful driver of corporate profitability when managed effectively. However, overinvestment or poorly executed investments can destroy value and reduce profitability. Firms that focus on strategic, well-targeted investments—balancing growth and return—tend to experience the most significant positive impact on their profitability.

Finally, we include Tobin's Q variable, measured by dividing the market value of equity by the book value of equity. This measure tends to reflect the investors' perception of a company's growth opportunities and the future profitability of current projects. As the gap between market value and the book value widens it reflects how much more growth will be achieved (Riddiough and Wu, 2009). Although investment in a company as the engine of growth is already included, it is still necessary to account for the factors that are not on the financial tables but are noticed and factored into valuation by the investors.

3.2. Methodology

In the econometric analysis, the relationship represented by Equation (1) is estimated via the difference GMM with the addition of a once-lagged dependent variable as an explanatory variable. This approach is consistent with previous studies of a similar nature (e.g., Olaniyi et al., 2017; Dodoo et al., 2020). Profitability is a product of bringing together production factors. If this assembly is successful profitability may be trending upward. If not, it is likely to trend downward. Hence, profitability may include an autocorrelated portion. In other words, profitability is a process that is correlated with past profitability. Such a structure in the dependent variable can be captured by including a lagged dependent variable as shown in Equation (2).

$$ROA_{it} = \alpha + ROA_{it-1} + LnSize_{it-1} + LnSize^2/Large\_Size_{it-1} + X_{it-1} + \mu_i + \delta_t + \varepsilon_{it} \qquad (2)$$

Firm heterogeneity is another important concern voiced in the literature exploring the topic of profitability (e.g., Lenox et al., 2010; Balasubramanian, 2010). These factors include the geographic location of firms, the industry, corporate governance structure, etc. If they are not accounted for they will appear in residuals and be correlated with other explanatory variables resulting in an endogeneity

problem. This issue can be effectively dealt with by differencing the variables in Equation (2), removing μ_i from the analysis. The difference GMM requires that the AR (1) test with the null hypothesis of no first-order autocorrelation in the residuals be rejected. The generally accepted rule is that the P-value of the test should be less than 0.05. The second requirement of this method is the AR (2) test with the null hypothesis of no second-order autocorrelation in the residuals not to be rejected. Hence the P-value for this test should be typically greater than 0.05. Finally, the model requires the Hansen test not to be rejected. This test checks whether the instruments as a group are exogenous, i.e., uncorrelated with the error term. A p-value above 0.05 indicates that the instruments are likely valid, while a low p-value suggests possible issues with endogeneity (Roodman, 2009). Based on the results of these tests, appropriate lag structures are determined to achieve orthogonality.

For methodological robustness, we also conducted FE-OLS analysis and reported the results. Although the classical textbook procedure for selecting the appropriate OLS model dictates choosing between random effect and fixed effect (for example Brooks, 2019), for this specific case we had to disregard this rule based on the findings and arguments presented in the previous literature (e.g., Lenox et al., 2010; Balasubramanian, 2010). As briefly discussed above, firm heterogeneity could significantly influence profitability and therefore should be accounted for in the analysis. FE model, through the demeaning process, removes that effect thus, enabling the estimation of Equation (1) with FE-OLS.

To obtain robust results, we utilize both FE-OLS and the difference GMM. While the former effectively handles unobserved firm heterogeneity, the latter additionally addresses the endogeneity problem. However, GMM estimation can produce varying coefficients due to its sensitivity to instrument selection (Ashley & Parmeter, 2015; DiTraglia, 2016). To deal with this issue we select instrument sets that minimize the number of lags while satisfying the orthogonality condition, which is tested using the AR (2) and Hansen tests (Roodman, 2009). This approach ensures that the lag structure is selected from the closest lags that do not reject the null hypothesis of orthogonality.

4. EMPIRICAL FINDINGS

4.1. Size-Profitability Relationship

We start the empirical analysis with the estimation of the difference GMM. The results from this analysis are reported in Table 3. The autocorrelation and heteroscedasticity robust standard errors are provided in parentheses. All estimations include a constant and time dummies. The key variables of interest are LnSize, LnSize^2, and Large_Size variables. While the first variable reveals the effects of size on profitability, the others will show if the relationship is linear.

Table 3. The Effect of Size on Profitability (GMM estimation)

	1	2	3
ROA_{t-1}	0.565***	0.240***	0.240***
	(.177)	(.018)	(.018)
LnSize	0.032***	0.081***	0.052***
	(.021)	(.013)	(.007)
LnSize^2		-0.005***	
		(.001)	
Large_Size			-0.001***
			(.000)
Debt	0.340***	0.184***	0.184***
	(.056)	(.025)	(.025)
AR	0.082***	0.332***	0.332***
	(.081)	(.055)	(.055)
Capex	0.027	0.094	0.094
	(.055)	(.039)	(.039)
R&D	0.001	0.001	0.001
	(.010)	(.010)	(.010)
Tobin	0.008***	0.008***	0.008***
	(.003)	(.003)	(.003)
AR (1)	.000	.000	.000
AR (2)	.805	.813	.840
Hansen	.095	.097	.112
# obs	8,780	8,780	8,780
# firms	367	367	367

This table reports the output from the difference GMM analysis of Equation (2). The dependent variable is profitability (ROA). The explanatory variables are LnSize: The natural logarithm of total assets, LnSize^2: The square of the natural logarithm of total assets, Large_Size: The interaction of the dummy variable for large firms and size variable, Debt: Interest-bearing debt, AR: Accounts receivable, Capex: Capital expenditures, R&D: Binary variable indicating R&D investment (1 if R&D occurs, 0 otherwise) and finally, Tobin Q: Market value of equity divided by the book value of it. Statistical significance levels are indicated as follows: *** for 1% significance ($p < 0.01$), ** for 5% significance ($p < 0.05$), and * for 10% significance ($p < 0.1$).

LnSize receives a coefficient of 0.032. A positive coefficient significant at one percent suggests that as firm size increases, profitability also increases, but the effect is relatively small in magnitude. In column two, the coefficient becomes 0.081. The relationship is much stronger and more significant here. A one percent increase in firm size results in an 8.1 percent increase in profitability. This substantial jump in significance and effect indicates that adding other variables (like LnSize^2 and Large_Size) might help better capture the complexity of the relationship between size and profitability. In column three the coefficient for size variable is 0.052. The effect size is similar to Model 1, but slightly stronger in significance ($p < 0.01$). The relationship remains positive, showing that firm size positively affects profitability. LnSize^2 is included in column two, with a coefficient of -0.005, which is negative and highly significant ($p < 0.001$). This indicates a nonlinear relationship between firm size and profitability, where the positive effect of size diminishes as firms grow larger. To ensure the robustness of this finding, the Large_Size variable is introduced. Its coefficient, -0.001 ($p < 0.001$), is also highly significant, further supporting the idea that firms become less profitable beyond a certain threshold value for size.

The debt variable receives consistently positive and significant coefficients. They are 0.340 ($p<0.001$), 0.184 ($p<0.001$), and 0.184 ($p<0.001$), in columns one, two, and three, respectively. This suggests that higher levels of leverage are associated with greater profitability. The positive effect might be due to the efficient use of debt to finance profitable projects or the tax advantages of debt financing. However, it is important to interpret these findings cautiously, as high debt can also increase financial risk over time, giving rise to interest payments and eventually lowering profitability.

AR with the coefficients of 0.082 ($p<0.001$) in column one, 0.332 ($p<0.001$) in column two, and

0.332 ($p<0.001$) in column three seems to have a large, positive, and highly significant impact on profitability. This suggests that firms with more receivables might enjoy higher profitability because extending credit can help drive revenue growth.

Unfortunately, our analysis reveals no statistically significant relationship between profitability and investment (both R&D and Capex). The lack of significance may be due to the fact that the returns on R&D investments take longer to materialize, or to factors specific to the sectors or period examined.

Our final explanatory variable is Tobin's Q, which is expected to have a positive coefficient. This variable receives the coefficient of 0.008 ($p<0.001$) in column one, 0.008 ($p<0.001$) in column two, and 0.004 ($p<0.001$) in column three. These highly significant coefficients indicate that firms with higher market valuations relative to their asset replacement costs tend to be more profitable. A high Tobin's Q suggests that the market believes the firm can generate strong future profits, and this belief aligns with higher current profitability.

4.2. Robustness Check: Exploring Size-Profitability Relationship via FE-OLS

In this section, we report the findings from FE-OLS estimations. The results are presented in Table 4. The coefficients for LnSize are 0.016 (significant at the 10 percent) in column one, 0.096 ($p<0.001$) in column two, and 0.015 ($p<0.05$) in column three. On the other hand, $LnSize^2$ receives a coefficient of -0.003 ($p<0.001$), which shows that the relationship is not linear after a certain point additional growth brings lesser marginal benefit. As in the previous section, we included the Large_size variable to check the robustness of the nonlinear relationship. The findings are consistent as the coefficient is -0.002 ($p<0.001$), low in magnitude but high in significance, indicating that the positive effect of a firm growing in size is not linear.

Table 4. The Effect of Size on Profitability (FE-OLS Estimation)

	1	2	3
LnSize	0.016*	0.096***	0.015**
	(.006)	(.033)	(.006)
$LnSize^2$		-0.003***	
		(.001)	
Large_Size			-0.002***
			(.000)
Debt	0.044****	0.048***	0.043***
	(.014)	(.012)	(.017)
AR	0.381***	0.381***	0.384***
	(.056)	(.056)	(.056)
Capex	0.231***	0.230***	0.230***
	(.060)	(.060)	(.060)
R&D	0.004	0.003	0.003
	(.007)	(.007)	(.007)
Tobin	0.004***	0.004***	0.004***
	(.001)	(.001)	(.001)
R^2	0.03	0.03	0.03
# obs	9,661	9,661	9,661
# firms	381	381	381

This table reports the output from the FE-OLS analysis of Equation (1). The dependent variable is profitability (ROA). The explanatory variables are LnSize: The natural logarithm of total assets, $LnSize^2$: The square of the natural logarithm of total assets, Large_Size: The interaction of the dummy variable for large firms and size variable, Debt: Interest-bearing debt, AR: Accounts receivable, Capex: Capital expenditures, R&D: Binary variable indicating R&D investment (1 if R&D occurs, 0 otherwise) and finally, Tobin Q: Market value of equity divided by the book value of it. Statistical significance levels are indicated as follows: *** for 1% significance ($p < 0.01$), ** for 5% significance ($p < 0.05$), and * for 10% significance ($p < 0.1$).

While the debt variable has coefficients of 0.044 in column one, 0.048 in column two, and 0.043 in column three, all significant at one percent, the coefficient for AR is 0.0381 ($p<0.001$) in all three columns of the table. Capex and R&D receive coefficients of 0.230 ($p<0.001$) and 0.003 ($p>0.10$). Finally, the coefficient for Tobin's Q is 0.004 ($p<0.001$) in all columns.

4.3. Robustness Check with an Alternative Measure of Size: GMM Estimation

In the previous section, the analysis focused on the size-profitability relationship using the natural logarithm of total assets as a measure of firm size. To ensure robustness, this section will use the natural logarithm of net sales instead. The variables LnSize, LnSize², and Large_Size are recalculated by using sales. Table 5 reports the results of this analysis.

Table 5. The Effect of Size on Profitability (GMM Estimation with Sales as the Measure of Size)

	1	2	3
ROA_{t-1}	0.255***	0.268***	0.257***
	(.018)	(.018)	(.018)
LnSize	0.004***	0.195***	0.165***
	(.001)	(.053)	(.048)
LnSize²		-0.008***	
		(.000)	-0.002***
Large_Size			(.000)
Debt	0169***	0165***	0168***
	(.024)	(.024)	(.024)
AR	0.411***	0.390***	0.410***
	(.054)	(.056)	(.054)
Capex	0.083**	0.079**	0.079**
	(.039)	(.039)	(.039)
R&D	0.002	0.002	0.002
	(.007)	(.007)	(.007)
Tobin	0.015***	0.015***	0.015***
	(.002)	(.002)	(.002)
AR (1)	.000	.000	.000
AR (2)	.603	.597	.540
Hansen	.158	.160	.102
# obs	8,780	8,780	8,780
# firms	367	367	367

This table reports the output from the difference GMM analysis of Equation (2). The dependent variable is profitability (ROA). The explanatory variables are LnSize: The natural logarithm of sales, LnSize²: The square of the natural logarithm of sales, Large_Size: The interaction of the dummy variable for large firms and size variable, Debt: Interest-bearing debt, AR: Accounts receivable, Capex: Capital expenditures, R&D: Binary variable indicating R&D investment (1 if R&D occurs, 0 otherwise) and finally, Tobin Q: Market value of equity divided by the book value of it. Statistical significance levels are indicated as follows: *** for 1% significance ($p < 0.01$), ** for 5% significance ($p < 0.05$), and * for 10% significance ($p < 0.1$).

The coefficients for LnSize are 0.004, 0.195, and 0.165, in columns one, two, and three, respectively. These coefficients are highly significant at the one-percent level, supporting our early conclusion that size positively affects profitability. Although we avoid a direct comparison due to differences in the lag structure of the instrumental variables, the coefficients for the LnSize variable based on sales generally demonstrate a stronger effect compared to those based on total assets. While $LnSize^2$ has a coefficient of -0.008, Large_Size receives a coefficient of -0.002, in columns two and three, respectively. Both coefficients are highly significant and suggest that the size-profitability relationship is not linear, reinforcing the findings in previous sections.

4.4. Robustness Check: Estimation of an Alternative Size Measure via FE-OLS

The final set of analyses focuses on estimating Equation (1) via FE-OLS and using sales as the alternative measure of size. The findings are demonstrated in Table 6.

Table 6. The Effect of Size on Profitability (FE-OLS Estimation with Sales as the Measure of Size)

	1	2	3
LnSize	0.032***	0.084***	0.034***
	(.003)	(.014)	(.003)
LnSize²		-0.004***	
		(.000)	-0.002***
Large_Size			(.000)
Debt	0.023	0.023*	0.023*
	(.002)	(.014)	(.014)
AR	0.281***	0.266***	0.273***
	(.040)	(.040)	(.040)
Capex	0.070	0.07	0.07
	(.047)	(.047)	(.047)
R&D	0.008	-0.007	-0.007
	(.007)	(.007)	(.007)
Tobin	0.004***	0.004***	0.004***
	(.001)	(.001)	(.001)
R^2	0.05	0.05	0.05
# obs	9,661	9,661	9,661
# firms	381	381	381

This table reports the output from the FE-OLS analysis of Equation (1). The dependent variable is profitability (ROA). The explanatory variables are LnSize: The natural logarithm of sales, LnSize²: The square of the natural logarithm of sales, Large_Size: The interaction of the dummy variable for large firms and size variable, Debt: Interest-bearing debt, AR: Accounts receivable, Capex: Capital expenditures, R&D: Binary variable indicating R&D investment (1 if R&D occurs, 0 otherwise) and finally, Tobin Q: Market value of equity divided by the book value of it. Statistical significance levels are indicated as follows: *** for 1% significance ($p < 0.01$), ** for 5% significance ($p < 0.05$), and * for 10% significance ($p < 0.1$).

LnSize (the natural logarithm of sales) has statistically significant coefficients of 0.032, 0.084, and 0.034 in columns one, two, and three, respectively. These coefficients indicate that a one percent increase in size translates to 0.032, 0.084, and 0.034 increases in profitability. The LnSize² variable (the square of the natural logarithm of sales), however, receives a statistically significant and negative coefficient of -0.004, ($p<0.001$) presented in column two of the table. The coefficient for the Large_Size variable -0.004, ($p<0.001$) in column three reinforces this finding that while size positively affects profitability after a certain threshold is reached the return on size diminishes.

5. CONCLUSION, DISCUSSION AND MANAGERIAL IMPLICATIONS

5.1. Conclusion

In this study, the size-profitability relationship was examined using publicly traded firm data from Türkiye. The main method used for econometric analysis is the difference GMM. For robustness, FE-OLS estimations were also conducted. Our findings can be summarized as follows. While firm size positively impacts profitability, large firms ultimately face diminished effects. More specifically, findings suggest that growing in size contributes to profitability to a degree after which it has a diminishing effect. Hence, firms appear to utilize the benefits of growing to a certain threshold value in size. On the other hand, external borrowing seems to help profitability, possibly due to the effective use of leverage to finance growth or profitable projects. Operational variables like accounts receivable strongly boost profitability, suggesting that effective credit policies and investment in productive assets are key drivers of firm success. While we did not observe any significant effects from R&D investment and capital expenditures, Tobin's Q appears to capture profitability potential. The findings are robust to alternative measures of size, nonlinearity, and econometric methods.

When considered within the broader context of profitability literature our findings offer new evidence. Some of the previous studies (e.g., Sritharan, 2018; Fonseca and Guedes, 2022) have reported results indicating positive effects of size on profitability, and some (e.g., Ezeoha, 2008; Kebewar, 2013; Sukadana and Triaryati, 2018) found negative effects of size. Our findings of an inverted U-shaped relationship with an optimal point after which the marginal benefits of size

declines partially align with both streams of this literature.

5.2. Discussion

We consider alternative explanations for the diminishing returns on size. For example increasing complexity at the managerial level (Pierce and Aguinis, 2013). As firms expand, they initiate new operations, operationalize new units and naturally assign new managers, who are usually motivated through a bonus system. However, difficulties in the decision-making process among units increase bureaucratic hurdles, and coordination-related costs tend to accompany such a growth process (Maani and Li, 2010). Hence, a decline in the productivity of assets in large corporations may arise.

Another possible argument for declining efficiency may be saturated markets (e.g., Khouja and Smith, 2007; Liu and Yang, 2009). As firms expand so does their market share and competitive power. However, after reaching a certain point they naturally exhaust their growth opportunities and start experiencing difficulty in maintaining the growth pace, leading the decreases in marginal return on operations. However, our findings are not in complete agreement with this argument because they clearly show that Tobin's Q is positively related to performance, suggesting that the market valuation-performance relationship implies otherwise.

Generally speaking, most small firms start venturing with a completely new product or in an industry with room for new entrances, i.e., industries with a lack of stiff competition. In such industries, profit margins are thicker and projects are profitable. On the other hand, unlike smaller counterparts, large firms tend to cluster in certain industries where each player has a long history in the business. To remain competitive, they may engage in aggressive pricing strategies which result in further trimming the profit margins and hammering overall profitability.

Unlike smaller firms, large corporations take up projects on a large scale, and the profits and losses from these projects can be astronomical when compared to small-scale projects initiated by small firms (Dey, 2009; Baydoun, 2011). The complexity and riskiness involved in such projects will be reflected in large firms' profitability. Although, only financial data is available to us, diminishing returns may stem from the losses of such large-scale high-risk projects.

The rising inflation in Türkiye during the period of this study may have had implications for firms' cost structures, potentially putting pressure on profitability. Large firms, due to long-term contracts, fixed cost structures, or product lines with limited price flexibility (Nilsen et al., 2018), might have faced challenges in adapting to price changes. Additionally, managing working capital tends to become more complex during inflationary periods (Corelli, 2023), which could have negatively influenced profitability.

The COVID-19 pandemic, which coincided with this period, brought about significant disruptions that may have affected firm performance. Many sectors experienced a sharp decline in demand, particularly tourism, retail, and entertainment, leading to potential revenue losses. At the same time, logistics and supply chain disruptions, alongside health measures and employee support programs, likely added to firms' operational costs (Laari et al., 2024; Figueira-de-Lemos et al., 2024).

Exchange rate fluctuations during this period might have also posed additional challenges, particularly for firms in sectors dependent on imported inputs, such as energy (Liu, 2024). Although large firms typically have greater capacity to manage foreign exchange risks, they may have encountered difficulties in fully reflecting increased costs in their prices, which could have influenced profitability (Escolar et al., 2023).

These macroeconomic factors, prevailing during the study period, should be considered when interpreting the findings, as they may have shaped the relationship between firm size and profitability.

5.3. Managerial Implications

Our results indicate an inverted U-shaped relationship between firm size and profitability. This

finding may help firms to plan their growth strategies more consciously. In particular, it emphasizes the importance of considering the costs as well as the benefits of growth. Firms that are too large may face problems such as bureaucratic obstacles, and operational complexities, which may hurt their profitability. By understanding the limits of their size, firms can avoid exceeding the optimal scale and use their resources more efficiently. Moreover, this result allows other firms in the sector to assess their competitive advantages, sustainably shape their growth strategies, and better manage their risks. It can also guide policymakers in reassessing incentive mechanisms for firm size. This kind of information is critical for building a healthier structure not only for individual firms but also for the sector and the economy as a whole. This is especially important given Türkiye's current economic conditions. Türkiye has experienced various economic shocks (Harris, 2023). During this period, sharp increases in exchange rates, high inflation, and elevated interest rates have significantly hindered firms' ability to operate in both domestic and international markets[2]. Additionally, the relative stabilization in exchange rates over the last few years has reduced the competitive advantage of exporting firms and led to a decline in their profitability. Consequently, in fragile economies like Türkiye, financial planning ensuing profitability plays a key role in ensuring firm survival.

5.4. Limitations and Future Research Avenues

Although the econometric method used in this study examines the relationship between firm size and performance by taking into account the time-invariant firm characteristics such as location and industry, it is not investigated whether this relationship differs across sectors. A more detailed examination of cross-industry differences is considered a separate research topic that can significantly contribute to the literature. Future studies may focus on an in-depth examination of this relationship across sectors and may complement the current findings.

The findings of this study suggest that the relationship between firm size and performance in Türkiye is not linear. However, it should be noted that these results may not be directly generalized to companies in developed countries. In particular, structural factors such as the level of institutionalization, internal culture, and equality of opportunity could not be included in the analysis. These factors can play a decisive role in the performance of large firms and may have different effects in different countries.

In addition, comparative studies may be needed to better understand the impact of such structural factors and assess the generalizability of the results. In future research, a comprehensive examination of the impact of such factors would provide valuable contributions to both the literature and policymakers.

[2]The recent economic era is commonly referred to as the period of unorthodox economic policy. See Şenses (2022) for a detailed account of the associated economic events.

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