

Effect of Labor Productivity on Firm Performance: The Case of Borsa Istanbul

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Abstract

This research examines the relationship between labor productivity and firm performance for companies traded on Borsa Istanbul during the period 2010–2021. Labor productivity, defined as output per unit of labor, is widely regarded as a central indicator of corporate efficiency and competitiveness. Enhancements in productivity are not only pursued as managerial objectives but also represent a prerequisite for operational continuity and sustainable growth. Within this framework, the study analyzes whether increases in labor productivity contribute to higher firm performance, while also accounting for firm-specific characteristics such as size, age, and labor costs. Firm performance is proxied by return on assets (ROA), and the explanatory variables include labor productivity, labor cost, firm age, and firm size. The firms in the sample exhibit notable differences in scale, cost structures, and productivity, reflecting considerable heterogeneity across the dataset. Ignoring this heterogeneity could lead to biased or inconsistent estimations. To address this concern, the study applies the Mean Group (MG) estimator developed by Pesaran and Smith (1995), which conducts separate regressions for each cross-sectional unit and then averages the coefficients, thereby accommodating parameter heterogeneity and mitigating the limitations of pooled or fixed-effects models. The empirical findings reveal that labor productivity and firm size exert a positive and statistically

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significant effect on firm performance, whereas firm age and labor costs are associated with a negative impact. These results underscore the strategic role of labor productivity in maintaining competitiveness and enhancing financial performance. Overall, the study contributes to the efficiency and performance literature by providing empirical evidence from an emerging market context.

1. Introduction

The relationship between labor productivity and firm performance continues to attract considerable attention from both scholars and policy makers, particularly within the context of increasingly competitive global markets. It is worth noting that high labor productivity is associated with stronger firm performance, improved profitability and competitive advantage, giving the firm the edge it needs to sustain its performance and flourish amid evolving market dynamics by investing in productivity-enhancing strategies (Gagliardi et al., 2023; Kekezi, 2021). The measure of labor productivity as output per labor unit is a key metric of organizational efficiency and competitiveness. This becomes critical particularly in developed economies, where higher labor costs make increases in labor productivity not just a managerial goal but a condition for survival and economic progress (Samuelson & Nordhaus, 2009; Gričar et al., 2021). Labor productivity goals are reflected in firm performance across various dimensions including profitability, and firm performance (İmrohoroglu & Tüzel 2014; Liu et al., 2021). Datta et al. (2005) assert that with enhanced labor productivity, firms strengthen their competitive position as well as their internal efficiency through a better firm performance. Although an economically relevant topic, there is still an open question about the causal and dynamic link between labor productivity and performance at a firm level which is often clouded by heterogeneous nature of firms and their operational settings.

Research indicates that increases in labor productivity have been shown to increasingly translate into positive company performance through improved product quality, operational efficiency and cost minimization (Datta et. al., 2005; Liu et al., 2021). From the microeconomic viewpoint, productivity growth has a positive effect on firm profitability and firm value, as it enables the organizations produce more output through the same or less resources (İmrohoroglu & Tüzel, 2014). Additionally, labor productivity has been recognized as an intermediate factor for converting internal capabilities into external market advantages, specifically when linked with absorptive capacity and innovation (Bøler et al., 2015). Likewise, another study further reveals that labor productivity is the most influential determinant of profitability

in the U.S. airline industry, even outweighing widely regarded indicators such as on-time performance (Mellat Parast & Fini, 2010). With a firm-level approach Hintzman et al. (2021) investigates if the intangible assets contribute to labor productivity. Their findings indicate that economic competencies and innovative assets -such as RD and organizational capital- enhance labor productivity in across EU. Yet, they note that each sampled country needs different strategy due to distinct regional effects.

That said, the empirical evidence regarding this relationship is still inconclusive. Prior research present conflicting results regarding the issue where productivity correlates positively with firm profitability or market value, while others are unable to identify a clear link, or even find negative relationship under specific firm characteristics or sectorial conditions (Anderson et al., 1997; Belderbos et al., 2004; Liu et al., 2021). İmrohoroglu & Tüzel (2014) reveal that range of findings (including negative or insignificant effects) indicates that the link between firm performance and productivity varies under certain circumstances which strengthen or change the relationship dynamics. Nguyen et al. (2019) indicate that firm performance is greatly influenced by the labor productivity among the firms listed on Vietnam Stock Exchange where they emphasize its impact on managerial behavior and investment decisions. On the other hand, Yousaf (2023) focuses on EFQM Excellence Model certified firms and conducts an analysis of the relationship between labor productivity and firm performance. The findings reveal a positive relationship between labor productivity and firm performance for the non-certified firms whereas a negative relationship for the certified firms. This suggests that from the quality management perspective, the relationship between labor productivity and performance may vary depending on the case. These conflicting results suggest that each case presents a certain scenario and the moderating variables can alter the strength or direction of the relationship.

In light of these complex relationship between labor productivity and firm performance, this study aims to present further evidence by adopting firm-level analytic framework that includes firm-specific variables such as return on assets (ROA), firm size, and firm age The dataset consists of non-financial firms listed on Borsa Istanbul (BIST) whose data are available to ensure the consistency of the analysis, banks, insurance companies and other financial institutions are not included in the sample.

This is justified by Mehran et al. (2011), who underline the complex structure of financial institutions and the volatility of their operating activities, which distress the enforcement of regulations. Previously, Fama

& French (1992) also state that while high financial leverage is typical for financial institutions, it is considered unusually high for non-financial firms and may signal financial distress. Focusing on BIST firms this study investigates the dynamics between labor productivity and firm performance. It also examines if the relationship shaped by different firm characteristics.

2. Model and Data

The goal of this study is to analyze the effect of labor productivity on firm performance based on a sample from Turkish firms⁴ for the period 2010–2021. The model is specified in a functional form as follows to examine the determinants of firm profitability. Firm performance (ROA) is modeled as a function of lagged firm performance (lagROA), labor productivity (lnlp), labor cost (lnlc), firm age (age), and firm size (lnfsz): These variables are represented as a functional relationship in Equation 1:

$$ROA = f(lagROA, lnlp, lnlc, age, lnfsz) \quad (1)$$

The algebraic representation in the panel data format is presented as follows:

$$ROA_{it} = \beta_1 lagROA_{it} + \beta_2 lnlp_{it} + \beta_3 lnlc_{it} + \beta_4 age_{it} + \beta_5 lnfsz_{it} + \varepsilon_{it} \quad (2)$$

In Equation 2, the subscript *i* denotes firms, *t* represents the time period, and ε indicates the error term. The β coefficients represent the slope coefficients. The natural logarithms of the variables labor productivity (lnlp), labor cost (lnlc) and firm size (lnfsz), which are included in the model, have been taken. The variables utilized in the empirical analysis, accompanied by their descriptions, data sources, and relevant citations, are displayed in Table 1.

4 Based on data availability, the analysis includes 164 firms, and the analysis period is limited to the years 2010–2021.

Table 1: Descriptive information on the variables

Variables	Calculation Method	Database	References
ROA (Return on Asset)	Earnings before interest and tax/ total assets	Thomas Eikon	Akgün & Memiş Karataş (2021); Bawazir et al. (2021); Jyoti & Khanna (2021); Yousaf & Bris (2021)
Firm size (lnfsz)	Natural log of total assets	Thomas Eikon	Khan et al. (2018); Ahmed & Bhuyan (2020); Ullah et al. (2020), Li et al. (2021)
Firm age (age)	The current year – firm's year of establishment	Thomas Eikon	Kuntluru et al. (2008); Shamsuzzoha & Tanaka (2021); Li et al. (2021).
Labour productivity (lnlp)	Total sales/ number of labour	Finnet Stockeys Pro	Chen (2010); Lannelongue et al. (2017); Gogokhia & Berulava (2021)
Labour cost (lnlc)	Total wages labour	Finnet Stockeys Pro	Chen (2010); Yousaf (2023)

3. Results

In this study, a dynamic and heterogeneous panel data framework is employed to test the impact of labor productivity on firm performance, utilizing panel data for 164 Türkiye firms over the period 2010–2021. Firm performance, described as a left-hand-side variable, is represented by return on assets (ROA). Right-hand-side variables in equation (2) include labor productivity (lnlp), labor costs (lnlc), firm age (age), firm size (lnfsz), and the one-period lag of performance (lagROA). Note that firm performance is expected to be affected by its previous values. Given that, we describe a dynamic model with the inclusion of lagged variables as a common strategy for addressing dynamic structures and improving model representation (Das, 2019).

Moreover, the firms examined in the analysis exhibit considerable variation with respect to size, age, cost structures, and productivity levels. This variation points to pronounced heterogeneity in the dataset and underscores the need to explicitly incorporate parameter heterogeneity into the empirical framework. Ignoring such differences across units may lead to biased and inconsistent estimation results. Accordingly, the analysis relies on the Mean Group (MG) estimator, as formulated by Pesaran and Smith (1995). This method involves estimating separate regressions for each cross-sectional unit and then averaging the estimated coefficients. In doing so, the

MG estimator explicitly allows for parameter heterogeneity and avoids the biases arising from imposing homogeneity restrictions as in pooled or fixed effects models (Pesaran & Smith, 1995).

The MG estimator is particularly well suited for panels with a relatively short time dimension (small T) and a large cross-sectional units (large N)⁵, as it provides consistent estimates of long-run parameters under these conditions. Although short time series may produce biased estimates at the individual unit level, Pesaran & Smith (1995) demonstrate that these biases tend to cancel out when averaged across many units, leading to consistent estimation of average long-run effects. Provided that the assumptions of cross-sectional independence and weak exogeneity of regressors are satisfied, the MG estimator is considered an appropriate and robust method for such a type of panel data structure.

The estimation results obtained from the MG estimator are provided in Table 2.

Table 2: Mean group estimator (Pesaran & Smith, 1995)

Variables	Coefficient	Standard Error	95% Confidence Interval
lagROA	-0.159***	0.041	[-0.24225, -0.07768]
lnlp	5.366**	2.038	[1.37072, 9.36211]
age	-1.071*	0.557	[-2.16444, 0.02114]
lnlc	-2.406*	1.417	[-5.18461, 0.37136]
lnfsz	6.366**	2.389	[1.68361, 11.04963]
Diagnostic tests			
Pesaran (2004) CD Test	1.57		
Pesaran (2007) CADF test	-14.073***		
RMSE	4.6812		
Wald χ^2 testi	35.69***		

*The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

The results show a positive and statistically significant effect of labor productivity in respect of the performance of the firms (at $p<0.05$ level of significance), meaning an increase in labor productivity leads to an

5 In this study, T = 12 and N = 164, indicating a relatively short time dimension and a comparatively large number of cross-sectional units (firms).

enhancement in the performance of firms. Similarly, firm size also has a significantly positive effect on company performance at the 5% level, implying that larger firms tend to be more profitable.

On the other hand, firm age and labor cost have significantly negative effects on performance at the 10% level. This supports the notion that older and more labor-intensive firms tend to exhibit lower profitability. The negative and statistically significant coefficient of the lagged dependent variable (lagROA) at the 1% level may indicate a mean-reverting pattern in performance over time.

Model diagnostics indicate no restriction regarding the validity of the findings. The Pesaran (2004) CD test yields a statistic of 1.57, which is below the critical value at the 5% level, indicating no cross-sectional dependence among the firms in the sample. The “Cross-sectionally Augmented Dickey-Fuller (CADF)” test proposed by Pesaran (2007) proves strong evidence against the null hypothesis, and confirms that the series do not suffer from unit root issues. The RMSE value of 4.6812 indicates a moderate level of prediction error, reflecting an acceptable model fit. The Wald χ^2 test assesses the joint significance of the explanatory variables in the model. It tests the null hypothesis that all slope coefficients are equal to zero against the alternative that at least one differs. In this case, the null hypothesis is rejected. This implies that the independent variables collectively have a statistically significant impact on the dependent variable.

Although the assumption of weak externality is not directly tested, the results from the Pesaran (2004) CD test reveal an absence of statistically significant cross-sectional dependence among firms, indicating that firm-level shocks do not exhibit systematic spillover effects across different units in the panel. This finding lends indirect support to the validity of the weak externality assumption. In addition, the substantial heterogeneity observed in firm-specific characteristics such as size, age, labor cost, and productivity, further reduces the likelihood of unobserved common influences affecting all firms in a uniform manner. Taken together, these factors suggest that the core assumptions underlying the MG estimator, namely cross-sectional independence and weak externality, are reasonably met in the context of this study, thereby supporting the reliability and robustness of the estimation results.

Collectively, these findings suggest that increases in labor productivity and firm size are positively associated with firm performance, while higher labor costs and older firm age may exert a detrimental effect.

3.1. Evaluation of the Findings: Theoretical Foundations

The findings obtained from the MG estimator presented in Table 2, along with their theoretical foundations, are provided below. Firm performance has been evaluated at the micro level through firm profitability:

- **Labor Productivity (lnlp):** A 1% rise in labor productivity is associated with a 0.053 unit increase in firm performance. This suggests that higher labor productivity positively affects firm performance. At a constant hourly compensation level, higher labor productivity results in lower unit labor costs, whereas lower productivity leads to an increase in unit labor costs (Garga et al., 2024). In this context, when labor productivity is high, unit labor costs decline, thereby enhancing firm performance. Hourly labor productivity is strongly correlated with earnings at both the individual and aggregate levels—across sectors, occupations, and national economies. This relationship stems from the fact that employees with higher average productivity contribute more significantly to firm profitability (Burda, 2018). A firm with higher labor productivity than its competitors generally achieves greater profitability, as labor productivity enables more efficient use of resources and serves as a fundamental indicator of a firm's economic performance (Pesce & Neirrotti, 2023). According to Liu et al. (2021), absorptive capacity is conceptualized as a valuable internal resource. Labor productivity functions as a mediating variable in the relationship between absorptive capacity and firm performance. In this context, firms that effectively assimilate external knowledge can enhance their labor productivity, ultimately improving firm performance.
- **Firm Age (age):** A one-unit increase in firm age reduces firm profitability by 1.071 units. Older firms tend to have lower profitability. As organizations evolve and reach higher levels of maturity, their governance structures typically become more formalized through the introduction of explicit rules, standardized procedures, and well-defined hierarchical arrangements. Although such institutionalization can strengthen administrative oversight and ensure greater predictability, it often leads to outcomes such as bureaucratic inertia, a decline in communication efficiency across managerial levels, and a noticeable slowdown in decision-making processes. These structural constraints limit employees' flexibility and responsiveness, particularly in situations where swift action is required, for example in capital market activities. At the same time, they restrict the organization's

ability to adapt to changing circumstances and to foster innovation, both of which are essential for sustaining a competitive advantage in dynamic markets. (Rahman & Yilun, 2021; Pervan et al., 2019). As firms age, the accumulation of structural rigidities may gradually weaken their operational efficiency, leading to rising variable costs and greater overhead burdens. Such inefficiencies are often accompanied by a decline in market share, as sales growth lags behind that of more dynamic competitors. The tendency to avoid innovation intensifies these challenges, since mature firms frequently scale back research efforts and capital investments over time. Consequently, they continue to rely on outdated machinery and infrastructure, which further constrains competitiveness. The productivity decline observed in aging firms is frequently attributed to organizational inertia and strategic inflexibility, which constrain their capacity to adapt to rapidly evolving external conditions. While some firms attempt to mitigate these limitations by establishing new, more adaptive entities, those that fail to do so face an increased risk of competitive displacement. Ultimately, environmental shifts that reward certain configurations of firm resources over others play a pivotal role in generating performance differentials across firms (Loderer & Waelchli, 2010; Coad et al., 2013).

- **Labor Cost (lnlc):** A 1% increase in labor costs results in a 0.024 unit decrease in firm profitability, indicating that rising labor costs can erode profits. Higher labor costs are associated with lower profitability. Labor cost is one of the fundamental components of a firm's competitiveness. As it increases, employers are more likely to lay off workers, substitute capital for labor, or relocate production to countries with lower labor costs (Houndjo, 2023). All employers are worried about labor costs, such as higher wage rates and employee incentives. While offering attractive wages and benefits can encourage individuals to apply for jobs and work efficiently, it also leads to increased operational costs, which in turn may reduce the employer's revenue and lower firm profitability (Hamermesh, 2014).
- **Firm Size (lnfsz):** A 1% increase in firm size is linked to a 0.063 unit increase in performance. The size of a firm has a significant impact on its performance through various mechanisms. Key characteristics of larger firms include their diverse capabilities, the ability to leverage economies of scale and scope, and the formalization of operational procedures (Majumdar, 1997). Larger firms tend to be more profitable due to their greater market share and competitive power, especially in

markets with high competition. With more resources at their disposal, these firms are better positioned to enter capital-intensive industries, giving them a competitive edge in more lucrative sectors with lower competition. Their ability to access larger opportunities and operate in high-capital markets further enhances their chances of outperforming smaller competitors (Bayyurt, 2007; Doğan, 2013). Larger firms may benefit from economies of scale, leading to higher performance.

- **lagROA:** A one-unit increase in past ROA leads to a 0.159 unit decrease in current performance. This result suggests that firms with higher performance in the past may experience declining performance in the present. One possible explanation is that prior success may lead to managerial overconfidence, which in turn results in less efficient decision-making. Supporting this, Musah et al. (2019) found that while lagged profitability tends to show a positive association with current profits in simple (univariate) regressions, the relationship often turns negative in multivariate models due to the influence of factors such as firm size, firm age, capital intensity, and high fixed costs. Similarly, Fama & French (2006) reported that when lagged profitability is high, its effect on profitability indicators like ROA and ROE tends to be statistically insignificant or negative. In summary, the effect of lagged profitability on current profitability may be overshadowed by firm-specific variables. These include firm size, firm age, capital intensity, high fixed costs, and other financial ratios. Moreover, high past profitability accompanied by low current-period profits may result from changes in market and competitive conditions, rising costs, economic crises, one-off revenues or expenses, managerial decisions, and macroeconomic fluctuations. These dynamics can disrupt profit stability and lead to intertemporal discrepancies in firm performance (Ertuş & Karaca, 2010; Karacan & Savcı, 2011; Gözütok Ünal, 2022).

4. Conclusion and Recommendations

While one of the primary goals of economies at the macro level is to ensure economic growth, at the micro level, the fundamental objective of firms is to maximize profitability. In this context, identifying the determinants of firm performance holds critical importance for firms' strategic planning. While a wide range of studies have investigated various factors, including firm size, firm age, and innovation, that have been empirically shown to influence firm performance, the role of labor productivity remains quite limited.

The results indicate that labor productivity ($\ln lp$) has a statistically significant and positive impact on firm performance, implying that firms with higher productivity levels tend to achieve greater financial success. Similarly, Li et al. (2021) and Yousaf (2023) found a positive relationship. On the other hand, İmrohoroglu and Tüzel found a negative relationship between labor productivity and firm performance. Findings show that firm size has a positive and significant relationship with firm performance indicating that large firms have an advantage in economically strong markets. There are studies in the literature that confirm the positive relationship between firm size and firm performance (Agiomirgianakis et al., 2013; Asimakopoulos et al., 2009; Nunes et al., 2009; Stierwald, 2010). However, firm age has a negative relationship which may reflect that older firms face difficulties in adapting to changing market conditions or achieving efficiency over time. Similarly, Doğan (2013) and Rahman & Yilun (2021) found a negative relationship. Similarly, labor cost has a negative effect on firm performance. In a similar vein, Vu et al. (2019) found a negative relationship between labor costs and firm performance. On the other hand, the lagged profitability has a negative effect on firm performance. Similar findings have been identified in a study conducted on SMEs in Indonesia (Musah et al., 2019). On the other hand, Isik & Tasgin (2017) found a positive relationship in their study.

Companies can implement a performance-based incentive system for employees to increase labor productivity. In addition, investments in human capital—such as health and education—that aim to improve the labor quality and thereby enhance productivity can be further strengthened. Furthermore, firms can prioritize technological advancements that support labor productivity throughout the production process.

Future research is encouraged to include different sectors, enabling a more refined analysis, facilitating the identification of whether the observed relationship varies significantly across different industries.

5. References

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