Chapter 1

Analyzing the Relationship Between the Firm's Total Factor Productivity and Firm Characteristics in the Turkish Manufacturing Sector

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Abstract

The empirical literature emphasizes total factor productivity growth (TFP) as the primary source of economic growth. The phenomenon of rising firm-level TFP has gained prominence in the investigation of the primary source of economic growth by policymakers. Within this scope, the contribution of TFP to economic growth in the Turkish economy is quite limited and analysis of the determinants of firm level TFP in the manufacturing industry becomes important. In this context, this paper investigated that the relationship between the firm's TFP and firm characteristics such as international trade participation, financial and ownership structure, firm size, price-to-cost margin, and profit before taxes for the Turkish manufacturing industry using firm level data. The results of the analysis indicate that international trade participation, firm size, and financial structure have a significant impact on a firm's total factor productivity. Our findings suggest, based on a heterogeneous firm level model, that for sustained economic growth, incentives should be provided to more competitive firms with high potential that can contribute to productivity improvement.

1. Introduction

In the growth literature, Total Factor Productivity (TFP), the primary source of economic growth, is frequently emphasized (OECD, 2015). Meanwhile, in the development literature, there is consensus that one of the most enduring issues in the economy is the disparity in living standards

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between nations, and that differences in productivity are a major cause of these disparities (Restuccia & Rogerson, 2017). Thereby, the difference in productivity between countries or firms with the same quantity of production resources depends on how efficiently they allocate and utilize those resources during the production process. Thus, increasing productivity is become important which is a key challenge for developing countries especially in the context of eliminating the productivity gap between developed and developing countries.

Productivity growth reflects the capacity to produce a higher level of output by better using the factors of production through the agency of new ideas and technological innovation (OECD, 2015). As a result, economic growth, living standards, and well-being are enhanced. Consequently, productivity enhancement is the key to long-term growth and development (Lewis, 1954; Easterly & Levine; 2001; Harris and Moffat; 2015).

The stand of this literature, it is possible to achieve long-term economic by implementing national policies that ensure TFP growth (Easterly & Levine, 2001). Within this framework, as far as the policymakers are concerned, it should be revealed which factors assume importance and should be targeted in order to achieve TFP growth so that it would contribute to sustainable long-term economic growth and enhance living standards (Kendrick, 1956). In this line, Giang et al. (2019) highlighted the source of the increase in the growth rate to the increase in productivity at the micro-level, and the drivers of productivity at the firm level have also become quite important. Although the literature on the various approaches and methods in measuring productivity has been developed, studies on the determinants of productivity at the firm level are quite a few in the literature, especially for the Turkish economy.

Recently, the contribution of TFP to the performance of economic growth in the Turkish economy is quite modest. Moreover, these conditions demonstrate the need to increase productivity rates in order to achieve higher and more sustainable growth. Atesagaoglu et al. (2017) note that TFP is also the primary source of growth in the Turkish economy over the past six decades. According to the 10th and 11th Development Plans, the labor and capital stock growth rates between 2007 and 2012 were 3.3% and 5.6%, respectively, while the TFP growth rate was -0.5%. Between 2012 and 2016, the contribution of TFP to the growth rate was 0.7%. During 2014–2018, the growth rate of capital stock was 7.3%, while the growth rates of labor stock and total factor productivity were 3.2% and 0.1%, respectively. Therefore, the contribution of TFP to growth was relatively low throughout

those periods, and growth was primarily driven by factor accumulation. This demonstrates the significance of TFP for sustaining growth and accelerating supply capacity. Achieving productivity growth is essential for ensuring the long-term sustainability of growth and the efficient transfer of scarce resources to more productive areas. In terms of enhancing productivity and economic growth, the manufacturing industry is one of the most important leading sectors for the Turkish economy. Consequently, the 10th and 11th Development Plans, as well as the United Nations Development Program's project for the development of the total factor productivity policy framework, have emphasized the importance of increasing both productivity and economic growth in the manufacturing industry. The consideration of intended policies has been emphasized. Within this context, the aim of this paper is to analyze the relationship between the firm's TFP and firm characteristics such as firms' participation in international trade, the financial and ownership structure, the firm size, price to cost margin and the profit before tax for Turkish manufacturing industry over the period 2006–2015.

Against this backdrop, this study has the following novelties. Although there is a large body of literature on the macroeconomic determinants of TFP, there are fewer studies on the microeconomic determinants of TFP, particularly for the Turkish manufacturing industry. As the use of microdata has become more practical, research has shifted its focus from the TFP growth of countries to the TFP growth of firms. In the country's development plans, the relatively modest contribution of TFP to economic growth in Turkey, a small open economy, is also taken into account. The objective of these plans is to increase the contribution of TFP to growth by implementing policies based on productivity. In addition, it seeks to determine and implement firm-level industrial policies aimed at structural transformation in the manufacturing industry sector in order to increase total factor productivity. Determinants of firm-level TFP in the manufacturing sector have therefore gained prominence. Studies at the macro level do not account for the fact that firms possess a variety of distinct characteristics. In other words, firms are heterogeneous. In this regard, it is investigated whether TFP considerably differs across firms and examining the relationship between these productivity differences and firm characteristics for the Turkish manufacturing industry in this study. Therefore, this study fills the gap in the existing literature by examining the relationship between TFP and firm characteristics using firm-level data from the Turkish manufacturing industry.

Moreover, studies that consider the heterogeneity of firms tend to provide policymakers with information regarding the extent to which TFP growth determinants should be targeted. Thus, micro-based policies are more likely

to produce positive results than macro-based policies, which tend to employ a single policy for the entire economy. In addition, from a macroeconomic policy perspective, the implementation of firm-level policies is essential for policymakers to ensure sustainable growth (Storey & Potter, 2020). In light of the heterogeneity of firms operating in the manufacturing industry, firm-based policies for the Turkish economy should be implemented specifically to boost TFP by investigating firm characteristics such as firm size, participation in foreign trade, and financial constraints. The empirical findings of this study suggest a strong relationship between total factor productivity and numerous firm characteristics.

This study consists of five parts including the Introduction. Section 2 presents the literature review in reference to the determinants of total factor productivity. Section 3 contains data, model and explanation for calculation of capital stock and total factor productivity. The findings are discussed in the Section 4 and Section 5 consists of the results.

2. Literature Review

Generally, the latest research argues that the productivity of firms is significantly influenced by their characteristics. A strong relationship exists between *TFP* and many firm characteristics. For this purpose, some firm characteristics were identified on the basis of theoretical and empirical support. The selectd empirical studies in the literature on the determinants of *TFP* are summarized in Table 1.

The line of analysis used in this study was determined in regards to the existing literature on determinants of *TFP*. The main determinant of total factor productivity is the use of imported intermediate inputs, which is one of the variables that characterizes the firm's international trade relationship. Firms provide access to better quality and affordable imported intermediate input using as a result of increasing competitive pressure with the acceleration of globalization (Castantelli et al., 2010). Since the use of imported intermediate inputs may be of higher quality than domestic intermediate inputs (Castellani et al., 2010) and less costly, it affects the firm productivity (Bandick, 2020). Thus, the diversification of intermediate goods can shorten the production process (Altomente et al., 2013) and the use of imported intermediate input directly positively increases firm productivity and leads to changes in factor shares (Görg & Hanley, 2005). In small open economies, it enables resources to be reallocated to more efficient and competitive production where different stages are carried out in different countries considering factors such as technological development

and labor cost of firms (Damijan et al., 2009). Briefly, the use of imported intermediate inputs also increases firm productivity by enabling the efficient use of resources in specialized fields. Thus, it allows firms to increase their production scale, market share and to benefit from economies of scale. It will also provide access to embedded technologies produced in other countries.

Export is one of the firm's characteristics that the literature on productivity growth focuses on. Numerous empirical studies since the early 1990s have revealed that firms operating in international markets are larger and more productive than firms operating purely in their domestic market (Bernard et al., 2003; Bernard & Jensen, 2004; Arnold & Hussinger, 2010; Melitz & Redding, 2015). Bernard et al. (2003), Melitz (2003), Helpman et al. (2004) and Yeaple (2005) theoretically investigated the relationship between firms and exports and developed heterogeneous firm models in international trade theory. Common and valid evidence in this literature is that there are significant productivity differences between firms operating in the sector. One factor of this heterogeneity is that firms are exporters. The common finding in the literature provides evidence that exporting firms are more productive than non-exporting firms. Firms operating in foreign markets incur higher sunk entry costs than firms operating only domestically, and exporting firms are more productive due to more intense competition. Helpman et. al. (2004) stated that firms operating in the foreign market are more productive because they incur high sunk costs. Therefore, exporting has been positively affected by productivity gains due to highly productive competitors and exposure to sunk costs.

Firm size is another factor that influences total factor productivity. The empirical evidence in the studies on firm size and productivity is ambiguous. On the one hand, Diaz and Sanchez (2008) stated that the increase in the size of the firm was negatively related to its organizational and managerial complexity. On the other hand, there is a positive relationship between firm size and productivity, according to Wagner (2002), Koellinger (2008), Harrison et al. (2013), Biesbroeck (2005), and Sahu and Narayan (2011). Larger firms are more open to foreign markets and have better technology, so there is a relationship between firm size and productivity.

The firm's financial constraint is a significant factor in determining its *TFP*. It has been determined that financial factors influence firm activities and are highly effective at fostering economic growth (Chen & Guariglia, 2013) Financially constrained firms may be unable to pursue new investment opportunities due to insufficient resources. In addition, financially constrained firms cannot access external financial support and cannot be successful in

increasing their productivity by carrying out R&D activities that is noted a main linkage which financial constraints affect productivity (Brown et al., 2009; Kim, 2021). It has been determined in the literature that financial factors negatively impact firm productivity (Gatti & Love, 2008; Kim, 2021).

The ownership structure of a firm is one of the determinants of total factor productivity. The differences in productivity between foreign-owned firms and domestic firms are a highly contested issue. While Harris and Robinson (2003), Girma and Görg (2007), Arnold, Matthias and Jovarcik (2009), and Girma et al. (2015) concluded that firms with foreign ownership are more productive than domestic firms, Griffith (1999), Benfartello and Sembenelli (2006), and Wang and Wang (2015) concluded that firms with foreign ownership have no or a negligible positive effect on firm productivity. Both positive and negative effects of foreign partner firms on *TFP* were discussed by Rahmaddi and Ichihashi (2013). On the one hand, it is expected that firms with foreign partners will increase their productivity by expanding their productive capacity and providing cost advantages (Ding et al., 2016). Alternatively, cultural differences, cheap labor, and a greater emphasis on raw materials may result in a decline in *TFP* (Zhang et al., 2021).

The price-cost margin, which is the measure of the firm's competitiveness, is among the determinants of the firm's *TFP*. Competition leading to the efficient allocation of production factors is important in achieving sustainable growth. Competitive pressure up to a certain level encourages innovation and thus increases *TFP* growth (Nickell 1996; Meyer & Vickers 1997). In this context, as emphasized in the European Central Bank (ECB) (2014), allocating resources towards more productive areas generally increases productivity and a country's competitive position. The differentiation of the price-cost margin in different sectors, which is the measure of market power, has an effect on the allocation of resources among economic activities and the competitive position of the country (Loecker & Warzynski, 2012). Beyond the macroeconomic and sectoral analysis, it has been emphasized in micro-analyses that there is a significant heterogeneity of price-cost margin, even among firms operating in the same sector. The profit margin determined by a firm in a foreign market also depends on its relative productivity compared to its foreign competitors. If the competitive environment in the foreign market is more challenging than their competitors, exporters may have to work with lower profit margins in order to compete with their more productive foreign competitors. An internal distribution of profit margins between the firms will heavily depend on productivity differences, trade costs, and the competition pressure between foreign and domestic markets. Melitz and Ottaviano (2008) state that the price-cost margin fell after

liberalization in trade. More competition can be expected to force firms to adopt new technologies and operate more productively.

Another determinant of firm productivity is firm profitability. In general, the studies on the effects of firm profitability on firms' *TFP* are limited. The effect of firm profitability on productivity is expected to be positive in the literature (Foster, et al., 2008; Chandra et al., 2016). More efficient firms engage in more international activities because they can cover sunk costs. Profitability and competition can provide more resources for reproduction, technological innovation, and research and development, which enables increased productivity (Zhang et. al. 2021).

Table 1. Selected Empirical Studies on the Determinants of TFP

Author(s)	Period	Country	Determinants
Girma and Görg (2004)	1980-1992	Ireland	Capital intensity, outsourcing intensity, intermediate input intensity
Görg, Hanley and Strobl (2008)	1983-1998	Ireland	Exporting status of the firm, ownership structure, outsourcing intensity
Taymaz, Voyvoda and Yılmaz (2008)	1983-2001	Turkey	Import, export, size, regional intensity, the share of sectoral foreign firms, import tax rate, wages
Farinas and Marcos (2010)	1990-2002	Spain	Imported intermediate input intensity, size, firm age, ownership structure
Castellani, Serti and Tomassi (2010)	1989-1997	Italy	Export, import, two-way traders, FDI
Harris and Moffat (2015)	1997-2008	The UK	Ownership structure, R&D, scale
Satpath, Chatterjee, and Mahakud (2017)	1997-2013	India	Firm size, embodied and disembodied technological intensities, R&D, imported intermediate input intensity
Van Biesebroeck (2018)	1998-2007	The UK	Exporting status of the firm, firm age, capital intensity
Bournakis and Mallick (2018)	2004-2011	The UK	Export, R&D, the rate of corporate taxation over EBIT
Doruk (2020)	2005-2013	Turkey	Capital/output ratio, ownership structure, export/capital stock ratio, economic growth
Kim (2021)	2006-2017	South Korea	Size, age, export activity, R&D intensity, financial condition
Khanna and Sharma (2021)	2000-2016	India	Firms size, capital intensity, FDI, profit rate
Albulescu and Turcu (2022)	2007-2016	Romania	Total assets, FDI, profit margin, intangible assets to total assets ratio, gender diversity, taxes to operational revenue ratio

3. Data and Model

The aim of this paper to analyze the drivers of *TFP* and to reveal that *TFP* considerably differs across firms. The model in econometric estimation based on theoretical and empirical literature is used to analyze the relationship between *TFP* and firm characteristics for the Turkish manufacturing industry,

$$TFP_{it} = \beta X_{it} + \varepsilon_t \quad (1)$$

where, TFP_{it} represents the total factor productivity of firm i at time t. Xit shows the characteristics of the firm like whether the firm has international trade relationship or not, the firm's financial and ownership structure, firm size, profit before tax and price-cost margin (PCM).

In line with the related literature, possible determinants of *TFP* used in the analysis are defined as follows: firms' participation in international trade, the financial and ownership structure, the firm size, price to cost margin and the profit before tax. The firms' participation in international trade, which is one of the *TFP* determinants of the firm, was proxy as the firm's imported intermediate input intensity and export activity. Imported intermediate input intensity was calculated as the share of the firm's imported intermediate input in the total input (Görg & Hanley, 2005; Farinas & Marcos, 2010). Two variables are used for describing the exporting activity of the firm. The first variable is the export intensity that calculated as the share of the firm's exports in sales. The second variable is an export dummy. It defines the export status of the firm, which takes a value of *1* when the firm is an exporter and *0* when the firm is a non-exporter. In both the theoretical and empirical literature, the trade status of the firm is a very important determinant of firm performance. While the relationship between exports and productivity is more prominent in the literature, the relationship between imports and productivity is relatively less discussed. The use of imported intermediate inputs increases a firm's productivity. However, firms with higher productivity import intermediate goods due to the fixed costs of imports. The firm's import of intermediate inputs also allows that firm to focus on activities that can use resources in more productive areas and to specialize in these areas. With the firm's use of higher quality imported intermediate inputs, it achieves both embedded technology and a wider variety of intermediate inputs, and thus, the productivity of the firm is positively affected. The use of imported intermediate inputs increases the firm's productivity and also leads to greater success in the export market. This explains why firms that import both exporters and imported intermediate inputs are more productive firms in the sector.

The variable firm size is computed as the ratio of firms' value added to the sector's total value added. It is incorporated into the analysis to account for economies of scale. The firm's ownership structure has a value of *1* if it has foreign ownership and *0* otherwise. The ratio of a firm's interest payments to its total expenditures indicates the firm's financial constraint and is used to calculate its financial structure. It is anticipated that this variable will have a negative relationship. PCM is the price-to-cost margin, which is calculated by dividing the value added minus wages by the gross production. The price-cost margin is regarded as a competitive indicator of a firm. Finally, the model includes the firm's profit before taxes as an indicator of performance.

Table 2. Data definition

Variables	**Definition**	
TFP	Total factor productivity	The firm's TFP was calculated using the Levinsohn-Petrin method. The firm's TFP were calculated by estimating sectoral (four digits) Cobb-Douglas production function.
imp_inp	Imported intermediate inputs intensity	the share of the firm's imported intermediate input in the total input
fincons	Firm's financial constraint	firm's interest payments to its total expenditures
dumexp	Firm's exporting status	a value of *1* when the firm is an exporter and *0* when the firm is a non-exporter
exp_intensity	Firm's export intensity	the share of the firm's exports in sales
firm size	Firm size	the ratio of firms' value added to the sector's total value added
profit	Profit before tax	firm's profit before tax
FDI	Firm's ownership structure	value of *1* if it has foreign ownership and *0* otherwise
PCM	Price-cost margin	dividing the value added minus wages by the gross production

In order to analyze the determinants of *TFP* in the Turkish manufacturing industry, two different micro datasets obtained from Turkish Statistical Institute (TURKSTAT) is used in this study. The first dataset is Annual Industry and Service Statistics which is the most recent questionnaire-relevant. In this dataset, there is information about the firms whose main economic activity is classified in four digits (NACE Rev.2). This information

includes firm's payments, revenues, expenses, value added, number of employees, stocks and investments, financial expenses, profit before and after tax etc. The second dataset is Foreign Trade Statistics, which includes information about the exported or imported product. export and import partner countries, and export and import values (export FOB/import CIF) at the firm level. The used dataset includes private sector firms that have been operating in the sector for more than three years and have 20 or more employees. Utilizing the four-digit Domestic Producer Price Index, the Capital Goods Price Index for investments, and the Energy Price Index for energy expenditures, the firm's value added, sales, incomes, and expenditures are deflated. These indices are provided by TURKSTAT. The data set spans the years 2006 through 2015 and contains 13,874 firms with a total of 93,918 observations.

Capital stock data for firms operating in the manufacturing industry is not included in the data set used in the study. In order to calculate the total factor productivity, the capital stock of the firms used in the production function estimation was calculated according to the Perpetual Inventory Method. According to PIM, three data is needed to calculate the capital stock. i) investment ii) initial capital stock and iii) depreciation rate. In the data set used, each firm has data on different investment types for each year. Thus, the capital stock of each firm is calculated as follows:

$$K_{it} = (1 - \delta)K_{it} + I_{it} \tag{2}$$

where K, I and δ are the capital stock, investments and depreciation rate respectively. The capital stock of each firm is calculated by subtracting the depreciation rate from the previous period's capital stock and adding the investment in the current period.

Harberger (1978) pointed out that it would be inconvenient to consider the growth and investments of a single period when calculating the initial capital stock. For this reason, starting capital stock is calculated by taking the average of three-period value added growth (g) and investments as follows:

$$K_t = I_t/(g_i + \delta) \tag{3}$$

In addition, different depreciation rates are used for each investment type in the calculation of capital stock. A depreciation rate of 5% for the building investment, 10% for the machinery investment and 20% for the patent is used, as in the study of Taymaz and Yılmaz (2007).

The natural logarithm of the estimated Cobb-Douglas production function for the firm-level *TFP* calculation can be written as follows:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \varepsilon_{it} \quad (4)$$

where y, l and k are output, labor and capital respectively and ε is the error term. In the equation, the error term ε_{it} can be divided into the productivity shock (v_{it}), which causes the estimation to be biased, and the error term (u_{it}), which includes unobserved and measurement errors that have no effect on firm decisions (Petrin et al., 2004).

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + v_{it} + u_{it} \quad (5)$$

Levinsohn-Petrin (L-P) (2003) method was used in the study for the estimation of total factor productivity. Since the factor elasticities of the production function may differ between sectors, they are estimated separately for each sub-sector (in 4 digits) and the total factor productivity is then calculated as the Solow residual as follows. Since the factor elasticities of the production function may differ between sectors, they are estimated separately for each sub-sector (in 4 digits) and the total factor productivity is then calculated as the Solow residual as follows.

$$TFP_{it} = y_{it} - \widehat{\beta_k} k_{it} - \widehat{\beta_l} l_{it} \quad (6)$$

One of the main assumption of this study is *TFP* considerably differs across firms. In order to capture these heterogeneities, we use whether the firms using and not using imported intermediate inputs and exporting and non-exporting firms differ in terms of productivity using the non-parametric Kolmogorov-Smirnov (K-S) test. It is a non-parametric test that checks whether the distribution of two variables comes from the same sample. In this context, the hypotheses to test whether the average *TFP* levels of the firms using and not using imported intermediate inputs have the same sample are as follows:

H_0: TFP distributions of firms that are using and not using imported intermediate inputs are identical.

H_1: TFP distributions of firms that are using and not using imported intermediate inputs are not identical.

Table 3. Two-Sample Kolmogorov-Smirnov Test for Equality of Distribution Functions

Smaller Group	D	P value
0	0.133	0.000
1	-0.004	0.458

Table 3 reports K-S test results for the manufacturing firms. According to the test results, the p-value for the K-S test of the null hypothesis that the *TFP* distributions for the firms that use and do not use imported intermediate inputs are identical is rejected against the alternative hypothesis. Hence, *TFP* distributions of the firms that use and do not use imported intermediate inputs are accepted non-identical.

The second hypotheses to test whether the *TFP* between exporter and non-exporter firms have same sample are as follows:

H_0: *TFP distributions of exporter and non-exporter firms are identical*

H_1: *TFP distributions of exporter and non-exporter firms are not identical*

Table 4. Two-Sample Kolmogorov-Smirnov Test for Equality of Distribution Functions

Smaller Group	D	P value
0	0.292	0.000
1	-0.002	0.782

According to the result obtained from the K-S test in Table 4, it shows that the *TFP* distributions of exporting and non-exporting firms differ significantly. This shows that the null hypothesis is rejected against the alternative hypothesis that the *TFP* distribution is not the same for exporting and non-exporting firms.

4. Empirical Results

The estimation results of our model are summarized in Table 5. Below is a summary of the significant findings based on the estimation outcomes. The estimation results for the basic model containing only international outsourcing as the regressor and controlling for year-specific fixed effects are displayed in columns (1) and (2). The relationship between import intensity of intermediate inputs and total factor productivity is positive and statistically significant. This result is consistent with the findings of other studies in the literature (Girma & Görg, 2004; Görg & Hanley, 2005; Amiti & Wei, 2009; Yu & Li, 2014). Görg and Hanley (2005), Amiti and Wei (2009), and Schwörer (2013) emphasized the importance of reallocating the firm's production process due to using imported intermediate input. These studies provide two explanations for the relationship. First, the use of imported intermediate inputs in the production process has a positive impact on the firm's level of productivity via the reallocation mechanism, as firms reorganize the least productive production stages to focus on more

productive core activities. Providing access to intermediate inputs of a higher quality at a lower price than the domestic market is a second method for increasing productivity. Thus, productivity gains have resulted from the redesign of the production process with the incorporation of imported intermediate inputs (Michel & Rycx, 2014). This study's result provides substantial evidence to support the literature's findings.

In columns 3-6 of Table 5, the estimation results of models that incorporate firm characteristics such as ownership structure (FDI), export intensity or exporting status, firm size (secva), financial constraint, profit before tax, and price-cost margin (PCM) are presented. While the effect of foreign ownership on TFP is positive and statistically significant for OLS results, it is statistically insignificant for fixed effects. This result indicates that firms with foreign ownership have a higher *TFP* than domestic firms. According to Harris and Moffat (2015), the productivity of firms with foreign ownership is higher than the average TFP, but foreign ownership is the least influential factor among the *TFP* determinants.

In addition, export activity has a substantial and positive impact on the *TFP*. Exporting boost firm's productivity and this result is in line with expectations, consistent with Girma et al. (2004), Damijan and Kostevc (2006), Bournakis and Mallick (2018) and Khanna and Sharma (2021) also support the theoretical prediction by Melitz (2003). Exporting firms are more productive than non-exporters.

The estimation results demonstrate that the effect of firm size on *TFP* is positive and statistically significant consistent with Zhang et. al. (2021). As the firm's share of value added in the sector increases, the firm's TFP also increases. According to Kim (2021), the greater the size of a firm, the greater its productivity.

The relationship between the financial constraints of firms and *TFP* is a negative and statistically significant. The financing difficulty faced by firms impedes the expansion of productivity. Since firms with financial constraints cannot reach sufficient investment level (Chen & Guariglia, 2013), resources cannot be used efficiently, which has a negative effect on firm productivity (Jin et al., 2019). Levine and Warusawitharana (2021) note that financial constraint decreases firm's productivity due to restricting innovative activities. Firms should receive financial support for activities that have the potential to boost long-term economic growth and productivity. In this context, Krishnan et al. (2015) and Robb and Robinson (2014) emphasized the importance of providing financial support to smaller and financially constrained firms in boosting firm productivity.

Table 5. Analysis Results Regarding TFP Determinants

Variables	OLS_1	FE_1	OLS_2	FE_2	OLS_3	FE_3
imp_inp	**0.079**	**0.015**	**0.096**	**0.012**	**0.051**	**0.013**
se	0.006	0.002	0.008	0.003	0.006	0.002
prob.	0.000	0.000	0.000	0.000	0.000	0.000
FDI			**0.831**	0.026	**0.298**	0.012
se			0.079	0.038	0.072	0.038
prob.			0.000	0.496	0.000	0.753
exp_intensity			**0.027**	0.002		
se			0.009	0.005		
prob.			0.003	0.726		
dumexport					**0.078**	**0.043**
se					0.024	0.010
prob.					0.001	0.000
PCM			**-0.339**	**-0.002**	**-0.717**	**-0.151**
se			0.022	0.007	0.018	0.007
prob.			0.000	0.803	0.000	0.000
firm size			**0.306**	**0.217**	**0.259**	**0.210**
se			0.016	0.024	0.016	0.023
prob.			0.000	0.000	0.000	0.000
profit			**0.276**	**0.126**	**0.376**	**0.135**
se			0.010	0.003	0.011	0.004
prob.			0.000	0.000	0.000	0.000
fincons			**-0.041**	**-0.019**	**-0.027**	**-0.020**
se			0.009	0.003	0.008	0.003
prob.			0.000	0.000	0.001	0.000
N	93918	93918	63570	63570	77898	77898
F-test	28.183	93.115	59.592	51.072	205.019	156,867

5. Conclusions

National productivity enhancement is crucial for boosting living standards, bolstering potential national security, and ensuring economic growth (Kendrick, 1956). Simply, targeting long-term growth and higher living standards can be sustained by national policies that increase capital and labor productivity and/or the rate of technological change within a country (Easterly & Levine, 2001). In this context, it is essential for policymakers

to identify which factors should be targeted for the improvement of *TFP*. However, one-size-fits-all policy prescriptions should be avoided in evaluating policies to increase *TFP* (Montalbano & Nenci, 2019) because of being unproductive (Van Bergeijk, 2011). Therefore, firm-based selective policies should be established taking into account firm heterogeneity since policy changes will differ between firms (Davies & Jeppesen, 2015).

The aim of this study is to determine how firm characteristics affect *TFP* and which policies should be implemented to increase *TFP* in this study considering firm heterogeneity covering the period 2006 and 2015 in the Turkish manufacturing industry. The firm characteristics were identified on the basis of theoretical and empirical support. These include imported intermediate goods, a firm's export status, foreign ownership, firm size, financial constraints, price cost margin, and profitability. In conclusion, estimation results reveal a strong relationship between *TFP* and a variety of firm characteristics, such as imported intermediate inputs, export status, and financial constraints, in the Turkish manufacturing sector. Since the financial constraints of the firms in the Turkish manufacturing industry are an impediment to their export growth, policymakers should focus on suggestions to reduce the limits faced by the firms as a result of rising credit costs and the relaxation of conditions imposed by financial institutions so that the firms can more easily access financing. Briefly, our findings suggest, based on a heterogeneous firm level model, that for sustained economic growth, incentives should be provided to more competitive firms with high potential that can contribute to productivity improvement.

Plouffe (2017) reveals that productivity-oriented policy recommendations in heterogeneous firm models differ from country and sector-based policy recommendations. To achieve sustainable economic growth, incentives should not be offered to all firms operating in the manufacturing sector, but rather to more competitive firms with high potential that can contribute to productivity enhancement. Therefore, policymakers must establish firm-based selective policies. Consequently, this study contributes to taking into account the characteristics of heterogeneous firms in policy choices of countries to increase *TFP* and, thus, the need to increase the number of studies that generate new knowledge.

Finally, this study has a limitation. Examining the relationship between firm characteristics and *TFP* is focused on. The *TFP* used in the above econometric model is derived from the estimation of a production function such as Cobb Douglas. Therefore, the last regression results are derived from the estimation of an estimated variable.

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