Do Intermediate and Capital Goods Imports Affect Productivity? Evidence from the European Union and Türkiye.

Ara ve Sermaye Malları İthalatı Verimliliği Etkiler mi? Avrupa Birliği ve Türkiye'den Kanıtlar.

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Abstract

Purpose: Global value chains divide production between countries, intensifying trade and creating interdependencies. Recently, some countries have imposed trade restrictions, straining these resource-efficient structures and global economic relations. This study aims to determine how the import of intermediate and capital goods affects productivity.

Methodology: Productivity is usually calculated using labor, capital, energy, or total productivity (TFP). This research defines productivity as total output divided by intermediate input, examining 23 European Union countries and Turkey with FIGARO input-output tables from 2010 to 2022. The study used the Two-Stage System Generalized Moment Estimator method to capture the internal dynamics of past productivity levels.

Findings: For countries other than Poland, Slovakia, Cyprus, Italy and Belgium, imports of intermediate goods increase productivity in the range of 2.52 to 25.27

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percent. Imports of investment goods, on the other hand, reduce productivity in the range of 0.54 to 9.15 percent in all countries except Hungary, Latvia, Poland, Sweden and Slovakia.

Implications: *The productivity variable, defined as an alternative to the literature, was examined using 19344 data, and it was observed to have a stable, strong relationship with the explanatory variables. Although the effect of imports of intermediate goods on productivity is consistent with previous studies, the results for imports of investment goods are paradoxical. The research differs from others in that it uses macroeconomic-scale data rather than firm-level data.*

Limitation: *Capital incomes are shown as operating surpluses in the input-output tables but do not reflect the returns or values of production tools such as machinery and equipment, which limits productivity measurement.*

Keywords: Productivity, Intermediate goods imports, Investment goods imports, Input-Output, OP-LP Model.

Jel Codes: F14, F47, O04.

Özet

Amaç: *Küresel değer zincirleri, üretimi ülkeler arasında bölüştürerek ticareti yoğunlaştırır ve karşılıklı bağımlılıklar yaratır. Son zamanlarda bazı ülkeler ticaret kısıtlamaları getirerek bu kaynak verimli yapıları ve küresel ekonomik ilişkileri zorlamaktadır. Bu çalışmada, ara ve sermaye malları ithalatının verimlilik üzerindeki etkisinin belirlenmesi amaçlanmaktadır.*

Yöntem: *Verimlilik genellikle emek, sermaye, enerji veya toplam verimlilik (TFP) kullanılarak hesaplanır. Bu araştırma, verimliliği toplam çıktının ara girdiye bölünmesi olarak tanımlamakta ve 2010-2022 yılları arasındaki FIGARO girdi-çıktı tablolarını kullanarak 23 Avrupa Birliği ülkesi ve Türkiye'yi incelemektedir. Çalışmada, geçmiş verimlilik seviyelerinin iç dinamiklerini yakalamak için İki Aşamalı Sistem Genelleştirilmiş Moment Tahmincisi yöntemi kullanılmıştır.*

Bulgular: *Polonya, Slovakya, Kıbrıs, İtalya ve Belçika hariç, ara malların ithalatı verimliliği %2,52-25,27 oranında artırmaktadır. Buna karşılık, yatırım mallarının ithalatı Macaristan, Letonya, Polonya, İsveç ve Slovakya hariç tüm ülkelerde verimliliği %0,54 ile %9,15 arasında düşürmektedir.*

Sonuç ve Katkılar: *Literatüre alternatif olarak tanımlanan verimlilik değişkeni, 19344 veri kullanılarak incelenmiş ve açıklayıcı değişkenlerle istikrarlı ve güçlü bir ilişkiye sahip olduğu gözlemlenmiştir. Ara malları ithalatının verimlilik üzerindeki etkisi önceki çalışmalarla tutarlı olsa da yatırım mallarının ithalatına ilişkin sonuçlar paradoksaldır. Bu araştırma, firma düzeyindeki veriler yerine makroekonomik ölçekteki verileri kullanması bakımından da diğerlerinden farklıdır.*

Sınırlılıklar: *Sermaye gelirleri, girdi-çıktı tablolarında işletme fazlası olarak gösterilir ancak makine ve ekipman gibi üretim araçlarının getirilerini veya değerlerini yansıtmaz; bu da verimlilik ölçümünü sınırlar.*

Anahtar Kelimeler: Verimlilik, Ara malı ithalatı, Yatırım malı ithalatı, Girdi-Çıktı, OP-LP.

Jel Kodu: F14, F47, O04.

1. Introduction

Classical Foreign Trade Theory focuses on the idea that countries specialise in the goods they produce efficiently and export, and import the goods they are less productive in. In this context, productivity is defined as the ratio of outputs generated in the production process to the inputs used to produce them. Trade theory was developed based on the productivity of physical labour. In productivity comparisons, the costs of production factors such as labour, capital, raw materials, and energy have also become more important over time. The export-productivity relationship has been frequently discussed in the literature. However, studies examining the contribution of imports are relatively limited. The primary reason for this is that, as Halpern et al. (2015) highlight, explaining the relationship between imports and productivity is methodologically challenging.

From a theoretical perspective, imported intermediate and investment goods are produced more efficiently than domestic inputs, thereby increasing technical efficiency (Topalova & Khandelwal, 2011), narrowing the domestic production gap (Gao et al., 2025), and facilitating resource reallocation (Kasahara & Lapham, 2013). When firms can acquire intermediate and investment goods at lower cost, their expenditure on research and development for domestic production is reduced (Wang et al., 2024). Therefore, the theoretical expectation is that domestic producers will gain access to lower-cost intermediate and investment goods through imports. With this cost advantage, productivity is expected to increase. This study investigates the effect of imported raw material and investment goods expenditures on productivity using a unique model and data set.

A significant portion of productivity research examining various countries and firms draws upon the models developed by Olley and Pakes (1996) and Levinsohn and Petrin (2003), both of which employ a Cobb-Douglas production function. The Olley and Pakes (OP) model incorporates labour, investment goods, firm age, and Hicks-neutral productivity shocks as determinants of production, with productivity shocks influenced by investment and firm age. Estimation within this framework proceeds in two stages: the production function is estimated first, followed by the efficiency (shock) function. Levinsohn and Petrin (LP) subsequently extended the OP model by incorporating intermediate goods into both functions. The LP model holds that materials and intermediate goods are more important in the production process than variables such as labour and investment goods. With the exception of Zaclicever and Pellandra (2018) for Uruguay, empirical studies indicate a more significant contribution of materials and intermediate goods to production (Amiti and Konings, 2007; Kasahara and Rodrigue, 2008; Bas and Strauss-Kahn, 2014; Halpern et al., 2015; Ahn & Choi, 2016; Yasin, 2022; Pane & Patunru, 2023; Khanna & Sharma, 2025).

Some studies use the ratio of total imports to demand (import penetration) as an explanatory variable (Fernandes, 2007; Amiti and Konings, 2007; Olper et al., 2014); others focus on final goods (Yu and Li, 2014; Khanna & Sharma, 2025). Most studies discuss intermediate goods (Kasahara and Rodrigue, 2008; Paul and Yaşar, 2009; Bas and Strauss-Kahn, 2014; Yu and Li, 2014; Halpern et al., 2015; Ahn & Choi, 2016; Zaclicever and Pellandra, 2018; Constantinescu et al., 2019; Martinez Zarzoso et al., 2021; Camino-Mogro and Maldonado, 2022; Yasin, 2022; Newman et al., 2023; Pana and Patunru, 2023; Bandick et al., 2024). Some research explores both intermediate

and investment goods to show a broader technical impact (Muendler, 2004; Habiyaremye, 2013; Caselli, 2018; Khanna & Sharma, 2025; Wang et al., 2024).

Within the OP and LP frameworks, the dependent variable—often referred to as productivity shock or total factor productivity—is determined by the explanatory variables specified in the primary structural model. Additional exogenous factors, such as effective public expenditures, research and development outlays, patent counts and expenditures, skilled human capital, and institutional quality, may theoretically alter the value of the productivity parameter. Therefore, in contrast to existing literature, the present study employs an observed productivity level as the dependent variable rather than an estimated productivity shock. Methodologically, EUROSTAT (2025) FIGARO input-output tables are used, in which the productivity variable is defined as the ratio of total output to total inputs. Empirical evidence suggests that, when materials and intermediate goods are included in such models, they exert a greater influence than fundamental factors like labour or investment goods. Additionally, this variable captures a broader dimension of productivity than metrics based on a single factor, such as labour or energy efficiency, given that input expenditures encompass technology, investment goods, labour, energy, and raw materials. Furthermore, the production of intermediate goods may involve input structures with different proportions of investment goods (or labour) relative to final goods.

A multitude of studies calculate total factor productivity by dividing the output in the Cobb-Douglas production function by the explanatory inputs (Kasahara and Rodrigue, 2008; Bas and Strauss-Kahn, 2014; Okafor et al., 2017; Pane and Patunru, 2023). In the context of input-output models, the difference between output and input reflects added value, which consists of public expenditure, investment goods, and labour income—collectively referred to as basic inputs. Investment income encompasses both the return on means of production, such as machinery and equipment, and entrepreneurial profits. Traditional production functions account for only the quantity of input factors, with factor prices influencing cost structures. However, failing to distinguish investor profits from the value of investment goods in productivity calculations can lead to analytical limitations. It is also pertinent to acknowledge that output levels depend on past investment stock. Thus, a persistent limitation of Cobb-Douglas-type functions is their inability to realistically depreciate past investment expenditures. The approach adopted in the present study may help address this theoretical shortcoming.

The principal independent variables are defined as the ratio of foreign intermediate goods to total intermediate goods (Muendler, 2004; Paul and Yaşar, 2009; Ahn & Choi, 2016; Camino-Mogro and Maldonado, 2022; Yasin, 2022) and the ratio of imported foreign investment goods to total investment goods (Muendler, 2004; Habiyaremye, 2013). The use of ratios for both dependent and independent variables serves to mitigate the potential for any single variable to exert undue influence on the analysis. Notably, Muendler (2004) presents a unique framework utilizing both ratios concurrently.

Whereas most existing studies utilize firm-level data, this research employs macroeconomic sectoral data, including input-output tables, to enable cross-country comparisons. By incorporating recent data (2010–2022) and analysing 72 models, the

study evaluates the relationship between productivity and imports of intermediate and investment goods at a more comprehensive macroeconomic level. While Constantinescu et al. (2019) conducted analogous country-level analyses utilizing value added per worker (1995–2001), the present study provides updated empirical insights regarding the global influence of imports on productivity.

Despite the increase in the impact of international value and supply chains, in a context where tariff wars are discussed, imports are shrinking, and even trade policy tools such as export bans are being implemented, it is very important to determine the consistent macroeconomic effects of imported intermediate and capital goods on productivity in terms of developing alternative policies. In this respect, our research question is as follows:

RQ1. Can the productivity calculation in the form of the ratio of total output to intermediate inputs created using input-output tables in selected periods and countries be used as a meaningful and comparable variable?

RQ2. Do imports of intermediate goods and investment goods have an impact on productivity? As much as the direction and level of the effect?

2. Literature

The literature explaining the relationship between imports and productivity generally focuses on the effects of intermediate and investment goods. The methodology used follows the models of Olley and Pakes (1996) and Levinsohn and Petrin (2003). Below, a literature summary is presented, listing the country, period, method, model, variables, and results examined by the authors.

Accordingly, Muendler (2004) investigated whether the productivity of Brazilian manufacturing industry firms changed after trade liberalization in the 1986-1998 period using Panel Extended Olley-Pakes FE, 2SLS-FE, Griliches and Mairesse-FE Methods. Production function variables: white- and blue-collar labour, domestic and foreign capital, facilities, domestic and foreign intermediate goods. The shock variable indicating productivity depends on variables such as domestic and foreign investments, firm age, structures, capital, the ratio of foreign capital goods to all capital goods, and the ratio of foreign intermediate goods to all intermediate goods. The last two variables are identical to those determined in this study. The proportion of foreign capital goods affects productivity by -5.6 percent according to the Olley-Pakes FE method, by -10.9 percent according to the 2SLS-FE method, and by -28.1 percent according to the Griliches and Mairesse-FE method. The ratio of foreign intermediate goods to all intermediate goods makes a positive contribution of 9, 8.1, and 41.8 percent, respectively.

Fernandes (2007) examined firms in Colombia between 1977 and 1991 with respect to trade policy and Total Factor Productivity variables. Levinsohn and Petrin (2003) modified their methodology to create a model in which productivity depends on observable raw materials, capital, and trade policy. As the ratio of imports to total demand, called Import Penetration, increased, productivity rose by 27.1 percent to 50 percent.

Amiti and Konings (2007) sought to explain the effects of Indonesia's final and intermediate goods tariff policies on productivity during 1991-2001 using the Panel OLS Method. Olley and Pakes (1996) adopted the model and showed that production is determined by labour, capital, material, and energy variables. The shock variable explaining production was associated with many variables, and it was concluded that the share of imports affected productivity by 23.3 percent.

Kasahara and Rodrigue (2008) investigated the relationship between the use of foreign intermediate goods and plant efficiency in Chile during 1979-1996 using OLS, the intra-group estimator, and system GMM methods. Two models were established, following Olley and Pakes and Levinsohn and Petrin. In both models, variables such as capital, qualified and unqualified labour, energy, and intermediate goods imports that affect production are common. In the first model, a proxy variable was used to capture the import decision, which affects productivity and production. The coefficient for this variable ranged from 11% to 22%. The different variable in the second model is defined as the ratio of imported inputs to domestic inputs. The coefficients for this variable range from 3.4% to 27%.

Paul and Yasar (2009) measured TFP and Labour Productivity of 1193 textile companies in Turkey for the years 1990-1996 with the unbalanced panel OLS method. Production in the study is modelled as a function of a wide range of variables, including capital, employment, inputs, qualified and unskilled labour, investment per employment, capital per employment, subcontracting status, FDI, productivity shocks, exports, and imports. The import variable is shown as the ratio of imported inputs to total inputs, as in this study. The elasticity coefficient of the variable was found to be 0.593. In the model using lagged and leading values, it was concluded that companies that began using foreign inputs this year had 35.9 percent higher labour productivity than those that did not import the previous year. The productivity increase in the year after using foreign inputs is 14.2 percent.

Habiyaremye (2013) investigated the situation of 340 manufacturing companies operating in Botswana between 1985 and 2010 with system GMM and 2SLS methods. In the model, an OLS regression is first established in which the value added of the manufacturing industry (not output) depends on capital stock and labour variables. The use of capital as stock is similar to the work of Paul and Yasar (2009). In addition, as used in this study, foreign capital expenditures were proportioned to all capital expenditures. The change in productivity after the regression was estimated was associated with imports of investment goods and skilled labour, as well as their lagged values. The author states that although imports affect productivity, their impact is low. The GMM system results show that the current-year effect is -0.006 percent. The first and second latency values are also at 0.02.

Bas and Strauss-Kahn (2014) investigated the relationship between imported inputs and the productivity of French manufacturing firms during the 1996-2005 period using the Unbalanced panel OLS method. In the study that tested the Olley-Pakes model, the variables explaining total factor productivity were labour, capital, raw materials, and foreign inputs. Surprisingly, they found that the contribution of imported intermediate inputs to production (9.6 percent) was greater than that of capital (7.4 percent). Imports of intermediate inputs from developed countries had a positive effect of around 9.5 percent, while imports from developing countries remained at 6.8

percent. The authors emphasize that this situation may be due to the technology content.

Olper et al. (2014) tested 9 food industries across 25 European countries during 1995-2008 using various dynamic panel methods. The dependent variable is GDP per labour unit, used as a measure of labour productivity. Independent variables are macroeconomic aggregates, including the historical value of labour productivity, the previous year's value of the import penetration rate, the average firm size, and the remaining GDP. They concluded that a 1% increase in imports also raised productivity by 0.09% to 0.14%, depending on the econometric model.

Yu and Li (2014) analysed total factor productivity for Chinese manufacturing firms between 2002 and 2006 using panel OLS and fixed-effects methods. The change in total factor productivity has been attributed to changes in imports of intermediate inputs, imports of final goods, complexity, ownership (state or foreign firm), and labour. The results show that the contribution of imported input to productivity is approximately 1.3 percent in all OLS models. In the fixed-effects model, this contribution is between 4 and 6 per mille.

Halpern et al. (2015) examined a sample of manufacturing firms in Hungary regarding imported inputs and productivity for the period 1993-2002. GMM was used as the econometric method in the study. The Production Function is modelled after the Olley and Pakes model, which consists of capital, labour, domestic, and foreign inputs. The increase in the amount of imported inputs increases income productivity by approximately 22 percent.

Ahn and Choi (2016) investigated productivity gains from the use of imported inputs at the firm level for the period 2006-2012 in Korea using Panel OLS, OP, and LP. The production function consists of labour, capital, and consumption variables for domestic and imported inputs. The efficiency shock is determined by the foreign input. As in this study, foreign input was measured as a proportion of total inputs. It is seen that imported intermediate goods have a positive effect on productivity between 19.5 and 19.9 percent.

Okafor et al. (2017) attempted to estimate the relationship between total factor productivity and imports using data from Ghanaian manufacturing companies for the period 1991-2002, employing Panel OLS, the Levinsohn-Petrin (2003) method, and System GMM. Production in the model: capital, qualified and unqualified labour, year-specific impact, and shock variable. Although the model predicted that a part of the productivity shock would be captured by the import surrogate variable, no coefficient was found to be statistically significant.

Caselli (2018) evaluated the productivity of firms in the Mexican manufacturing sector between 1994 and 2003 using panel OLS, fixed effects, and Wooldridge-Levinsohn-Petrin fixed effects (WLP-FE) methods. In the model, a production function is estimated using factors such as capital, labour, and materials, and the difference from output is identified as a productivity shock. The productivity shock variable depends on proxy variables for the lagged values of intermediate and investment goods imports and exports, the lagged values of capital and materials, and the constant effects of firms, sectors, and years. It has reached a limited finding that only investment goods exports contribute to productivity. Then, he developed a delayed

model of the learning effect, according to which he found that the import of investment goods contributed to productivity by about 28 percent, whereas the import of materials did not.

Zaclicever and Pellandra (2018) evaluated how the productivity of Uruguayan firms using foreign intermediate inputs changed during the 1999-2008 period. The established production model is designed to depend on capital, labour, energy, domestic and foreign inputs, sector, time, and productivity shocks. The productivity shock is determined by sorted variables other than capital and labour. Although they found that intermediate input imports had a positive effect on productivity, they noted that this effect remained limited.

Constantinescu et al. (2019) examined 14 manufacturing sectors across 40 countries during 1995-2001 using WIOD data. Productivity measures are based on value added per worker. Explanatory variables with natural logarithms taken; Capital per capita is determined as gross imports, imports of intermediate goods, gross exports, and exports of intermediate goods. The most important variable determining the productivity growth rate was found to be the import of intermediate goods, with an elasticity value of 19.9 percent. The authors used the Panel OLS method to solve the model.

Martinez Zarzoso et al. (2021) used economic census data for Egypt in 2013 with the OLS method. The total factor productivity model was created using firm shares in exports and input imports, foreign firm ownership, and stock markets, in the Cobb-Douglas and translog forms. The share of imports was identified as the most important and meaningful variable for productivity, with a value of 0.16 percent.

Mo et al. (2021) analysed a panel consisting of data of industrial firms in China between 2000 and 2006 using OP and LP methods. The explanatory variables of the studied function are Labour, Capital, Material, Use of imported intermediate inputs, research and development expenditures. Productivity, on the other hand, is determined by its own lagged values, previous-period input imports, previous-period R&D expenditures, and dummy variables related to company ownership. Accordingly, imports of capital goods increase company productivity by 2.2 percent, while imports of intermediate goods contribute around 1.9 percent.

Camino-Mogro and Maldonado (2022) investigated the Total factor productivity of Ecuadorian manufacturing firms in 2007-2018 using panel OLS and the modified Levinsohn and Petrin (2003) methodology. The variables that make up the production function are labour, capital, and materials, as well as the different ratios of imports and exports. Productivity shocks are correlated across three separate equations. In the first equation, there are lagged values of the shock, imported inputs, and exports. The second equation includes lagged ratios of imported inputs to domestic inputs and of foreign sales to domestic sales. In the last equation, the ratio of foreign inputs to total inputs and the lagged ratio of foreign sales to domestic sales were examined together. The coefficients for imported inputs in the first model were found to be statistically insignificant. While the OLS result for the second model, the ratio of imported input to domestic input, was 7.1 percent, the LP estimate was 8.5 percent. In the third model, the OLS coefficient was estimated at 2.7 percent, and the LP coefficient at 4.6 percent, for the ratio of foreign inputs to total inputs. This last variable is similar to the variable in this study.

Yasin (2022) examined the productivity and inefficiency of 23 sub-sectors of the Indonesian manufacturing industry during 2008-2015 using the unbalanced panel OLS method. The model related to productivity consists of standard variables such as capital, labour, raw materials, and energy that explain production. Inefficiency arises from imported raw material density, exports, absorptive capacity, foreign ownership, and their multiplication variables. Import raw material density is defined as the ratio of foreign input to all inputs, as in this study. The results indicate that raw material imports are a positive source of inefficiency, amounting to 0.008 percent. Exporting companies' imports of raw materials cause an inefficiency of 0.138 percent.

Newman et al. (2023) analysed the use of imported inputs by 90000 firms in Vietnam during 2008-2017 using panel regression. The research also used a Cobb-Douglas production function based on capital and labour. The efficiency shock obtained from the function was associated with the determined trade variables. According to the results, when the share of imports in total demand increases by 1 percentage point, productivity rises by 0.062 percentage points. Imports in firms vertically linked to the supply chain have an impact of 0.078 percent. The authors emphasized that the indirect productivity of firms that use no imported intermediate inputs increased by 0.05 percent due to competition in the input sector.

Pana and Patunru (2023) analysed the productivity level of Indonesian manufacturing industry firms between 2008 and 2012 using the Unbalanced panel regression method. The authors sought to estimate total factor productivity using a Cobb-Douglas function, following Olley and Pakes. While the dependent variable is production, the independent variables are capital, labour, domestic materials, and imported inputs (surrogate). A constant productivity shock indicates TFP. While domestic materials account for 93.6 percent of production, imported inputs increase production by 6.21 percent. There was no significant difference between imports from developed and developing countries. However, imports from East Asian countries have a positive effect on production, increasing it by 9.42 percent.

Bandick et al. (2024) examined a sample of importers, exporters, two-way trade, and no-trade firms with more than 10 employees in Sweden for the period 2007-2020. For productivity measurement, they designed a Dynamic two-way fixed model with leading and lagged import values. Other explanatory variables include labour productivity (sales per employee), export productivity, employment level, capital stock, and sector-specific growth rates. In solving this model, they use the Panel Event Study method. The results indicate that there is no difference in labour productivity between importing and non-importing firms. According to the difference-in-differences results, imports increased export productivity by 5.9 percent for small firms and 28.1 percent for large firms. In the Probit method, import values were used as the dependent variable. The arguments are as in the Dynamic two-way fixed model. Accordingly, export productivity and sectoral growth rates increase the probability of imports by more than 100%.

Khanna and Sharma (2025) investigated the effect of imports of intermediate, capital, and finished goods on productivity for 7000 firms in the Indian manufacturing sector during 2001-2020, using unbalanced panel data and the LP ACF method. In the model, the independent variable is the firm's output. The independent variables were determined as capital, labour, energy, and domestic inputs, in the form of the Cobb-

Douglas production function; the matrix was created based on three import forms: technology purchasing status (surrogate), R&D status (surrogate), and an observable productivity shock. According to the results, the contribution of intermediate goods to productivity ranged from 14.6 to 18.1 percent. The contribution of capital goods imports is around 2 percent, and final goods is around 7 percent.

Mulugeta and Söderbom (2024) analysed unbalanced panel data on firms in the Ethiopian manufacturing sector between 1996 and 2016 using OLS and System GMM. In the production function they use, it is assumed that intermediate inputs are flexible and labour and capital are inelastic. OLS results show that imported inputs have a positive effect on production: 2.8 percent for domestic firms and 7.5 percent for foreign firms. The System GMM findings indicate that domestic-company imports increased output by 0.009 percent, while foreign-company imports increased by 10.6 percent.

Wang et al. (2024) investigated the effects of intermediate and investment goods imports of firms in the Chinese manufacturing sector on general and domestic production in the 2000-2013 period using the panel regression method. They argue that imports affect production through scale and human capital. According to the scale channel, imports of intermediate and capital goods positively affect the general level of development. However, the relationship between intermediate goods imports and local development level is negative. Regarding the human capital channel, imports of intermediate goods negatively affect innovation-based output by 0.244 percentage points. Imports of capital goods support innovative production.

It is observed that a significant portion of the literature investigating the relationship between productivity and imports uses the Olley & Pakes (1996) and Levinsohn & Petrin (2003) models. In these models, total factor productivity (TFP) is estimated using the Cobb-Douglas production function. The resulting productivity shock (TFP) is then associated with imports of intermediate and investment goods, as well as many variables, as a dependent variable. The sample examined by the researchers generally includes companies.

Although the literature summary above indicates that the import of intermediate goods has a positive effect on productivity across many countries and periods, the coefficients vary by country. Since the effect of investment goods imports has been less studied, it may not be appropriate to generalize about the direction of the relationship.

In this research, a productivity variable is defined as the ratio of total intermediate inputs to total output, obtained from Figaro input-output tables, and is separated from the OP and LP models. In the literature, it has often been calculated that the effect of intermediate inputs on production is higher than that of traditional inputs, labour and capital. Therefore, the selected productivity criterion is an inclusive, undeviated and easily calculable variable. The study differs from the others primarily in its selection of the dependent variable. Independent variables are defined as the ratios of foreign intermediate goods to total intermediate goods and of imported foreign investment goods to total investment goods. Apart from Muendler (2004), no other study examines these variables together. The research focused on the general impact of imports of intermediate and investment goods on countries' macroeconomic productivity levels. Previous studies have often examined firms or

several manufacturing sectors. Conducting a large-scale study and using many models to compare the member countries of the European Union will make an important contribution to the literature. Designing the research model to yield similar results across many countries is an important means of developing new theoretical approaches.

3. Data and Method

The aim of the study is to examine the extent to which the level of productivity is affected by the import of intermediate and investment goods. For this reason, the selected productivity dependent variable was calculated as the ratio of total output expenditures to total intermediate input expenditures from input-output tables. The first independent variable is defined as "the ratio of imports of intermediate goods to all intermediate goods", and the other independent variable is defined as the "ratio of imports of investment goods to all investment goods".

The data set for this research was obtained from the Eurostat (2025a) FIGARO input-output tables covering the period 2010 to 2022. Countries examined; Belgium (BE), Bulgaria (BG), Southern Cyprus (CY), Czechia (CZ), Germany (DE), Denmark (DK), Estonia (EE), Spain (ES), Finland (FI), France (FR), Greece (GR), Croatia (HR), Hungary (HU), Italy (IT), Lithuania (LT), Latvia (LV), Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Sweden (SE), Slovenia (SI), Slovakia (SK) and Turkey (TR). Other European Union countries could not be included in the study due to data deficiencies and inconsistencies.

The specified 19344 pooled data from 24 countries, 62 sectors, and a period of 13 years (2010-2022) were logarithmically transformed. Data analyses were performed in MS Excel and Stata 15, and the models were as follows. Imports appear as a factor that reduces the gross national product in income calculations through expenditures. In this basic equivalence, it can be predicted that domestic intermediate, capital, and final goods production will decrease at least the same amount as imports, so the decrease in production will cause a decrease in employment. The controversy that has led to recent tariff increases stems from this relationship. However, in almost all countries, foreign inputs and capital goods are needed for production and export. Therefore, we know that countries impose lower taxes on imported intermediate goods with effective protective tariffs and gradations. Global liberalization processes and the activities of international value chains have gradually increased the interdependencies between countries. Analysing the positive or negative effects of imports on production within the complex network of relationships is very important for the policies to be implemented.

$Lnout_{ti} = c + a_1 \cdot Lnout_{ti(-1)} + \beta_1 \cdot LnM_iT_i + \beta_2 \cdot Lnyat_i + u_i$ **(Model A)**

$Lnout_{ti} = c + a_1 \cdot Lnout_{ti(-1)} + a_2 \cdot Lnout_{ti(-2)} + \beta_1 \cdot LnM_iT_i + \beta_2 \cdot Lnyat_i + u_i$ **(Model B)**

$Lnout_{ti} = c + a_1 \cdot Lnout_{ti(-1)} + a_2 \cdot Lnout_{ti(-2)} + a_3 \cdot Lnout_{ti(-3)} + \beta_1 \cdot LnM_iT_i + \beta_2 \cdot Lnyat_i + u_i$ **(Model C)**

Variables defined:

$Lnout_{fi}$: Total output expenditures/Total intermediate input expenditures

$Lnout_{fi(-1)}$: Previous Total output expenditures/Total intermediate input expenditures

$Lnout_{fi(-2)}$: Total output expenditures/Total intermediate input expenditures two periods ago

$Lnout_{fi(-3)}$: Total output expenditures/Total intermediate input expenditures three periods ago

LnM_iT_i : Ratio of foreign intermediate goods to all intermediate goods

$LnYat_i$: Ratio of foreign investment goods imports to total investment goods

In the models, the coefficients a_1, a_2, and a_3 indicate the percentage effects of dynamic delays, β_1 on imports of intermediate goods, and β_2 on imports of capital goods on productivity. H_{1a} hypotheses were determined for our first research question, and H_{1b} and H_{1c} hypotheses were determined for our second research question.

H_{1a}: The models established for the variable of total output expenditures/total intermediate input expenditures are statistically significant and comparable.

H_{1b}: The variable of the ratio of foreign intermediate goods to all intermediate goods has a positive and statistically significant effect on the variable of total output expenditures/total intermediate input expenditures.

H_{1c}: The variable of the ratio of foreign capital goods imports to total capital goods has a positive and statistically significant effect on the total output expenditures/total intermediate input expenditures variable.

The study primarily focuses on whether a fixed productivity variable, the ratio of total output from Input-Output tables to intermediate inputs, can serve as a meaningful, comparable alternative to Total Factor Productivity, which can be difficult and prone to deviation to calculate. Productivity is a phenomenon that cannot be easily detrended in the very short term. The current level of productivity carries dynamic effects from previous years. In the analysis of the models, the Two-Stage System Generalized Estimator of Moments method developed by Arellano and Bover (1995) and Blundell and Bond (1998) was used, which can best show these dynamic effects. The a_t parameters in all three models exhibit historical dynamics. To determine whether the productivity variable is comparable and significant, 72 cases were examined across 23 European Union countries and Turkey. Wald, Sargan, AR (1), and AR (2) tests were performed for the significance of the established models. Since the time dimension of the data is larger than the small section (sector) size, the System Generalized Moment Estimator Method was chosen (Blundell and Bond, 1998; Guliyev et al., 2023; Emako et al., 2023). The method was seen as advantageous for decomposing the dynamic effects from the past and for showing the consistent, undeviated effects of intermediate and investment goods imports.

4. Results

The results of the System Generalized Moment Estimator Method, which investigates the effects of imports of intermediate and investment goods on productivity for the period 2010-2022 in Turkey, are shown in Table 1. Accordingly, when the value of the Total output expenditures/Total intermediate input expenditures variable in Model A increases by one percent in the previous year, its value in the current year is expected to increase by 0.1783 percent. The lower value of the variable is 0.1671393, and the upper value is 0.1895453 (95%). It was understood that the parameter was statistically significant and positively signed. A one percent increase in the variable of the ratio of foreign intermediate goods to all intermediate goods increases productivity by 0.0596 percent. Therefore, a significant and positive relationship was found between the two variables. This parameter can be expected to take a value between 0.052427 and 0.0669012. A 1% change in the ratio of foreign investment goods imports to total investment goods results in a negative change of -0.0175 in productivity. The variable coefficient was estimated to be -0.0203614 to -0.0146965. The explanatory variables in Model A were found to be statistically significant. The Wald test results indicate that the model is also significant. It was evaluated that there was no autocorrelation from the AR (1) and AR (2) results. The Sargan test shows that the vehicle variants used in Model A are consistent.

Table 1. The Effects of Intermediate and Investment Goods Imports on Productivity in Turkey

$LNOutT_i$	Model A (N=734)			Model B (N=673)			Model C (N=612)		
Variable or Test	Coeffic.	Q. Error	P	Coeffic.	Q. Error	P	Coeffic.	Q. Error	P
$LNOutT_i(-1)$	0.1783	0.0057	0.000	0.2362	0.0044	0.000	0.2013	0.0078	0.000
$LNOutT_i(-2)$	-	-	-	0.1198	0.0032	0.000	0.1324	0.0039	0.000
$LNOutT_i(-3)$	-	-	-	-	-	-	-0.0096	0.0058	**0.095**
$LnMiT_i$	0.0596	0.0036	0.000	0.0565	0.0061	0.000	0.0713	0.0090	0.000
$LNYat$	-0.0175	0.0001	0.000	-0.0078	0.0018	0.000	-0.0069	0.0013	0.000
C	0.7105	0.0163	0.000	0.5991	0.0126	0.000	0. 6384	0.0293	0.000
Wald chi²	8197.99	-	0.000	4560.33		0.000	6206.69	-	0.000
AR (1)	-4.2154	-	0.000	-3.9314		0.000	-3.6113	-	0.000
AR (2)	1.8266	-	0.068	-1.1399		0.254	-1.5923	-	0.111
Sargan (chi²:43)	55.2416	-	0.965	58.097		0.913	55.4191	-	0.898

When the previous year's value of the productivity variable in Model B increases by one percent, the current year's value increases by 0.2362 percent. It can be said that a 1% increase from two years ago can increase productivity by 0.1198. The parameters are statistically significant and positively signed. For Model B, a one percent increase in the variable of imported intermediate goods increases productivity by 0.0565 percent.

Table 2. The Effects of Intermediate and Investment Goods Imports on Productivity in the EU. 2010-2022 **(Model A)**

LNOutT	LNOutT (1)	LnMiTi	LNYat	C	Wald chi²	AR (1)	AR (2)	Sargan
BE	0.0331 (0.000)	-0.0909 (0.000)	-0.0269 (0.000)	0.3971 (0.000)	1699.8 (0.000)	-3.7719 (0.0002)	-0.57941 (0.5623)	60.963 (0.8954)
BG	0.0571 (0.000)	0.0409 (0.000)	-0.0641 (0.000)	0.5909 (0.000)	11831 (0.000)	-2.9081 0.0036	0.81075 (0.4175)	61.108 (0.8929)
CY	0.2997 (0.000)	-0.0858 (0.000)	-0.0271 (0.000)	0.3757 (0.000)	2859.9 (0.000)	-4.1958 (0.0000)	-0.02292 (0.9817)	57.5124 (0.9437)
CZ	0.0386 (0.000)	0.1051 (0.000)	-0.0302 (0.000)	0.6322 (0.000)	985.56 (0.000)	-4.0083 (0.0001)	1.1638 (0.2445)	56.2443 (0.9565)
DE	0.0983 (0.000)	-0.0198 (0.000)	-0.0511 (0.000)	0.4405 (0.000)	3691.0 (0.000)	-4.6766 (0.0000)	2.9891 **(0.0028)**	58.8448 (0.9275)
DK	0.2035 (0.000)	0.0162 (0.000)	-0.0859 (0.000)	0.4494 (0.000)	1761.1 (0.000)	-4.2469 (0.0000)	0.12497 (0.9005)	57.9371 (0.9389)
EE	0.0841 (0.000)	0.1474 (0.000)	-0.0397 (0.000)	0.6595 (0.000)	2062.9 (0.000)	-4.8893 (0.0000)	-1.0727 (0.2834)	59.3153 (0.9211)
ES	0.0400 (0.000)	-0.0286 (0.000)	-0.0770 (0.000)	0.5020 (0.000)	2623.3 (0.000)	-3.5409 (0.0004)	-0.47784 (0.6328)	60.4966 (0.9032)
FI	**-0.0414** (0.000)	0.0203 (0.001)	-0.0292 (0.000)	0.6837 (0.000)	309.32 (0.000)	-4.1402 (0.0000)	0.00356 (0.9972)	61.0113 (0.8946)
FR	**-0.0918** (0.000)	0.1999 (0.000)	-0.0169 (0.000)	1.0083 (0.000)	5760.3 (0.000)	-4.3152 (0.0000)	1.6006 (0.1095)	57.9135 (0.9391)
GR	0.3327 (0.000)	0.2082 (0.000)	-0.0111 (0.000)	0.8678 (0.000)	13939 (0.000)	-3.1135 (0.0018)	1.0744 (0.2826)	57.2988 (0.9460)
HR	0.0850 (0.000)	0.0676 (0.000)	-0.0063 (0.000)	0.7386 (0.000)	206.31 (0.000)	-3.0314 (0.0024)	0.0335 (0.9732)	58.1142 (0.9367)
HU	0.0549 (0.000)	-0.0305 (0.000)	**0.0216** (0.000)	0.6352 (0.000)	1116.7 (0.000)	-2.1078 (0.0350)	1.3134 (0.1890)	57.9803 (0.9383)
IT	0.1384 (0.000)	-0.1262 (0.000)	-0.0581 (0.000)	0.1620 (0.000)	3972.0 (0.000)	-3.0004 (0.0027)	1.0326 (0.3018)	57.3347 (0.9457)
LT	0.0409 (0.000)	-0.0032 (0.000)	-0.0006 (0.000)	0.7205 (0.000)	15.15 (0.002)	-3.2335 (0.0012)	0.28203 (0.7779)	61.1922 (0.8915)
LV	0.1370 (0.000)	0.2177 (0.000)	-0.0278 (0.000)	0.8369 (0.000)	5351.7 (0.000)	-4.4742 (0.0000)	0.06412 (0.9489)	55.0585 (0.9664)
NL	0.1849 (0.000)	0.0249 (0.000)	-0.0328 (0.000)	0.5175 (0.000)	1021.1 (0.000)	-4.8546 (0.0000)	-0.5459 (0.5851)	58.555 (0.9313)
PL	0.0172 (0.000)	-0.0722 (0.000)	**0.0053** (0.008)	0.5301 (0.000)	599.17 (0.000)	-4.0273 (0.0001)	2.0365 **(0.0417)**	56.1232 (0.9576)
PT	0.1751 (0.000)	0.0716 (0.000)	-0.0267 (0.000)	0.6360 (0.000)	7996.1 (0.000)	-3.4992 (0.0005)	0.52915 (0.5967)	59.2404 (0.9221)
RO	**-0.0774** (0.000)	-0.0492 (0.000)	-0.0017 **(0.427)**	0.6568 (0.000)	568.33 (0.000)	-2.6632 (0.0077)	1.5267 (0.1268)	53.4669 (0.9768)
SE	0.1917 (0.000)	0.1404 (0.000)	**0.0206** (0.000)	0.7959 (0.000)	2039.9 (0.000)	-4.9392 (0.0000)	-0.47113 (0.6375)	58.9028 (0.9267)
SI	0.0517 (0.000)	-0.0809 (0.000)	**0.0304** (0.000)	0.5881 (0.000)	301.18 (0.000)	-3.0189 (0.0025)	0.07656 (0.9390)	60.2322 (0.9074)
SK	0.3651 (0.000)	0.0658 (0.000)	-0.0185 (0.000)	0.4799 (0.000)	15634 (0.000)	-3.1986 (0.0014)	1.9882 **(0.0468)**	60.9369 (0.8959)

Note: The values in parentheses are P-values. (N=734)

Table 3. The Effects of Intermediate and Investment Goods Imports on Productivity in the EU.2010-2022 **(Model B)**

LNOutT	LNOutT (-1)	LNOutT (-2)	LnMᵢTᵢ	LNYat	C	Wald	AR (1)	AR (2)	Sargan
BE	0.0459 (0.000)	0.0387 (0.000)	-0.0793 (0.000)	-0.0239 (0.000)	0.3798 (0.000)	747.53 (0.000)	-3.490 (0.0005)	-0.985 (0.3244)	59.110 (0.8964)
BG	0.1702 (0.000)	0.1502 (0.000)	0.1086 (0.000)	-0.0705 (0.000)	0.5020 (0.000)	14851 (0.000)	-2.744 (0.0061)	-0.620 (0.5346)	56.293 (0.9376)
CY	0.3861 (0.000)	0.1554 (0.000)	-0.0697 (0.000)	-0.0243 (0.000)	0.2242 (0.000)	3719.15 (0.000)	-3.867 (0.0001)	-1.486 (0.1370)	51.939 (0.9760)
CZ	0.1027 (0.000)	0.0960 (0.000)	0.0915 (0.000)	-0.0332 (0.000)	0.5169 (0.000)	2168.99 (0.000)	-4.026 (0.0001)	-0.666 (0.5054)	58.475 (0.9070)
DE	0.2277 (0.000)	0.2957 (0.000)	0.1502 (0.000)	-0.0153 (0.000)	0.5293 (0.000)	10251 (0.000)	-4.239 (0.0000)	-0.243 (0.8077)	60.253 (0.8077)
DK	0.2597 (0.000)	0.1059 (0.000)	0.0224 **(0.128)**	-0.0915 (0.000)	0.3311 (0.000)	1115.12 (0.000)	-3.9779 (0.0001)	-0.681 0.4957	55.2493 (0.9494)
EE	0.1274 (0.000)	0.0827 (0.000)	0.1444 (0.000)	-0.0423 (0.000)	0.5727 (0.000)	1490.34 (0.000)	-4.6669 (0.0000)	-1.9078 (0.0564)	59.1818 (0.8952)
ES	0.1199 (0.000)	0.1364 (0.000)	0.0276 (0.000)	-0.0776 (0.000)	0.4336 (0.000)	2264.30 (0.000)	-3.6981 (0.0002)	-1.5917 (0.1115)	57.9544 (0.9151)
FI	0.0548 (0.000)	0.1522 (0.000)	0.0502 (0.000)	-0.0230 (0.000)	0.5616 (0.000)	2424.25 (0.000)	-4.2788 (0.0000)	-1.2684 (0.2047)	58.2474 (0.9106)
FR	0.0330 (0.000)	0.1792 (0.000)	0.2167 (0.000)	-0.0262 (0.000)	0.8105 (0.000)	2396.52 (0.000)	-4.3967 (0.0000)	-0.0115 (0.9908)	53.8617 (0.9624)
GR	0.4329 (0.000)	0.3925 (0.000)	0.2527 (0.000)	-0.0060 (0.000)	0.5420 (0.000)	18943 (0.000)	-2.5673 (0.0102)	-1.6833 (0.0923)	58.9928 (0.8984)
HR	0.2156 (0.000)	0.1762 (0.000)	0.1389 (0.000)	-0.0160 (0.000)	0.5921 (0.000)	829.87 (0.000)	-2.6036 (0.0092)	-1.0698 (0.2847)	54.6477 (0.9554)
HU	0.3077 (0.000)	0.4663 (0.000)	0.0286 (0.000)	**0.0407** (0.000)	0.2363 (0.000)	60951 (0.000)	-2.0484 (0.0405)	0.1860 (0.8524)	59.4398 (0.8907)
IT	0.2711 (0.000)	0.3002 (0.000)	-0.0786 (0.000)	-0.0398 (0.000)	0.0304 (0.001)	94228 (0.000)	-3.002 (0.0027)	-0.2823 (0.7777)	58.3003 (0.9097)
LT	0.1344 (0.000)	0.1515 (0.000)	0.0737 (0.000)	**0.0057** (0.021)	0.6358 (0.000)	1129.1 (0.000)	-3.3125 (0.0009)	-1.1417 (0.2536)	59.8730 (0.8828)
LV	0.1730 (0.000)	0.0682 (0.000)	0.2034 (0.000)	-0.0411 (0.000)	0.7250 (0.000)	5432.5 (0.000)	-4.864 (0.0000)	-0.5436 (0.5867)	55.2501 (0.9494)
NL	0.2100 (0.000)	0.0583 (0.000)	0.0252 (0.000)	-0.0266 (0.000)	0.4761 (0.000)	4506.9 (0.000)	-4.5715 (0.0000)	-0.9407 (0.3468)	59.9937 (0.8805)
PL	0.1496 (0.000)	0.2080 (0.000)	-0.0147 **(0.109)**	**0.0085** (0.000)	0.3994 (0.000)	2903.4 (0.000)	-3.5042 (0.0005)	-1.7592 (0.0786)	58.7672 (0.9022)
PT	0.3500 (0.000)	0.3245 (0.000)	0.0675 (0.000)	-0.0285 (0.000)	0.2760 (0.000)	11674 (0.000)	-3.4922 (0.0005)	-2.9676 **(0.0030)**	57.8915 (0.9160)
RO	-0.0569 (0.000)	0.1449 (0.000)	0.0012 **(0.920)**	-0.0094 (0.003)	0.6131 (0.000)	408.90 (0.000)	-2.4117 (0.0159)	0.7986 (0.4245)	54.4365 (0.9573)
SE	0.2806 (0.000)	0.1059 (0.000)	0.1439 (0.000)	**0.0192** (0.000)	0.6640 (0.000)	4091.3 (0.000)	-5.5543 (0.0000)	-1.2576 (0.2085)	58.8486 (0.9009)
SI	0.1577 (0.000)	0.1852 (0.000)	-0.0202 (0.004)	**0.0278** (0.000)	0.4547 (0.000)	15521 (0.000)	-3.2005 (0.0014)	-1.1421 (0.2534)	58.9536 (0.8991)
SK	0.4109 (0.000)	0.1928 (0.000)	0.1172 (0.000)	**0.0018** **(0.529)**	0.4125 (0.000)	87270 (0.000)	-3.0334 (0.0024	0.9526 (0.3408)	60.9649 (0.8613)

Note: The values in parentheses are P-values. (N=673)

Table 4. The Effects of Intermediate and Investment Goods Imports on Productivity in the EU.2010-2022 **(Model C)**

LNOut	LNOut (-1)	LNOut (-2)	LNOut (-3)	LnM$_i$T$_i$	LNYat	C	Wald chi2	AR (1)	AR (2)	Sargan
BE	0.0888	0.0799	0.3519	-0.0328	-0.0218	0.1917	1297	-3.643	1.003	61.020
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.315)	(0.769)
BG	0.1310	0.0658	-0.0657	0.1343	-0.0756	0.6620	3723	-2.796	-0.976	58.620
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)	(0.328)	(0.832)
CY	0.4616	0.1086	0.1758	-0.0188	-0.0224	0.1264	1137	-3.936	0.2027	55.561
	(0.000)	(0.000)	(0.000)	**(0.091)**	(0.000)	(0.000)	(0.000)	(0.000)	(0.839)	(0.895)
CZ	0.1246	0.1193	0.1178	0.1013	-0.0326	0.4404	1147	-3.619	0.5194	58.739
	(0.000)	(0.000)	(0.000)	(0.000)	0.000)	(0.000)	(0.000)	(0.000)	(0.603)	(0.829)
DE	0.2124	0.2677	0.0634	0.1417	-0.0054	0.5119	2117	-4.4761	0.7031	60.257
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.482)	(0.790)
DK	0.2650	0.1155	0.1321	0.0502	-0.0889	0.2802	940.8	-4.0978	-0.446	59.230
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.655)	(0.817)
EE	0.2348	0.1320	0.2184	0.2175	-0.0509	0.4122	6226	-4.6694	0.3653	60.353
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.714)	(0.787)
ES	0.1689	0.1662	0.3303	0.0479	-0.0405	0.2435	1927	-3.7631	-0.2753	56.852
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.783)	(0.871)
FI	0.1124	0.1909	0.2102	0.0820	-0.0178	0.4143	6196	-4.2391	-0.1453	58.917
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.884)	(0.824)
FR	0.0571	0.1894	0.1352	0.2514	-0.0358	0.7412	1490	-3.8999	1.2082	55.018
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.227)	(0.905)
GR	0.2729	0.2656	0.3824	0.2122	-0.0151	0.3787	16349	-3.0005	0.5146	57.114
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.606)	(0.865)
HR	0.2634	0.1899	0.1817	0.2156	-0.0203	0.5375	3096	-2.5183	-0.1078	59.933
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.914)	(0.799)
HU	0.2589	0.5131	0.1642	0.1011	**0.0326**	0.1797	3570	-2.102	-0.1792	56.815
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.035)	(0.857)	(0.872)
IT	0.2636	0.2411	0.1472	-0.0457	-0.0264	0.0696	2828	-2.6451	0.9222	54.715
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.008)	(0.356)	(0.910)
LT	0.1743	0.1541	0.1901	0.1372	**0.0075**	0.5363	654.5	-3.4763	-0.0078	61.580
	(0.000)	(0.000)	(0.000)	(0.000)	(0.013)	(0.000)	(0.000)	(0.000)	(0.993)	(0.753)
LV	0.1491	0.0020	0.0460	0.2299	-0.0539	0.7785	2052	-4.5065	0.3679	51.776
	(0.000)	**(0.585)**	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.712)	(0.949)
NL	0.2233	0.1140	0.1934	0.0929	-0.0171	0.3812	2206.4	-4.3594	0.0648	54.999
	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.000)	(0.000)	(0.000)	(0.948)	(0.905)
PL	0.2194	0.2505	0.1812	-0.0118	**0.0022**	0.1989	32236	-3.4919	0.1021	58.013
	(0.000)	(0.000)	(0.000)	**(0.091)**	(0.000)	(0.000)	(0.000)	(0.000)	(0.918)	(0.846)
PT	0.3097	0.2770	0.3192	0.0884	-0.0253	0.1538	17737	-2.9916	-1.4533	61.266(
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.146)	0.762)
RO	0.0339	0.1794	0.0301	0.0043	-0.0103	0.5213	262.3	-2.3701	0.9183	53.448
	(0.056)	(0.000)	(0.000)	**(0.519)**	(0.001)	(0.000)	(0.000)	(0.017)	(0.358)	(0.929)
SE	0.3322	0.1006	0.0914	0.1421	**0.0183**	0.5575	3815	-5.2792	0.7971	54.161
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.425)	(0.918)
SI	0.1490	0.2010	0.2686	0.0292	**0.0235**	0.3210	1049	-2.9552	0.2421	58.403
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.003)	(0.808)	(0.837)
SK	0.3765	0.2219	-0.1638	0.1155	-0.0012	0.5153	92433	-3.3262	-0.1039	58.583
	(0.000)	(0.000)	(0.000)	(0.000)	**(0.539)**	(0.000)	(0.000)	(0.0009)	(0.917)	(0.832)

Note: The values in parentheses are P-values. (N=612)

When the values of the productivity variable in Model C for the previous year increased by one, two, and three percent, the current year values changed by 0.2013, 0.1324, and -0.0096 percent, respectively. The negative parameter of the third lag is not statistically significant. When the rate of intermediate goods imports changes by one percent in Model C, productivity changes by 0.0713 percent. The results were above Models A and B. Investment goods imports in Model C also reduce productivity by -0.0069 percent, like other models. According to Wald, Sargan, AR (1) and AR (2) tests, the model can be said to be significant.

Table 2 presents the results of the single-lag Model A, which examines the productivity relationship between intermediate and investment goods imports across 23 European Union member countries. Accordingly, it is understood that there is autocorrelation in the models for Germany, Poland, and Slovakia. The results for the other 20 countries were statistically significant. The dynamic productivity effect is 0.3327 percent in Greece, 0.2997 percent in Southern Cyprus, 0.2035 percent in Denmark, 0.1917 percent in Sweden, 0.1849 percent in the Netherlands, and 0.1751 percent in Portugal. The findings are similar to those obtained for Turkey. The results of Bulgaria, Czechia, Estonia, Hungary, Lithuania, and Slovenia are close to 5 percent. However, it is also observed that the dynamic effects in France, Finland, and Romania are negative. It was understood that the contribution of intermediate goods imports to productivity was 0.2177 percent in Latvia, 0.2082 percent in Greece, 0.1999 percent in France, 0.1474 percent in Estonia, 0.1404 percent in Sweden, and 0.1051 percent in Czechia. The parameters are also marked negative in Belgium, Germany, Spain, Hungary, Italy, Latvia, Poland, Romania, and Slovakia. The results of Bulgaria, Croatia, Portugal, and Slovakia are close to Turkey's values. As the ratio of foreign capital goods to domestic capital goods increases, productivity declines in almost all countries. The only countries with positive effects are Hungary, Poland, Sweden, and Slovakia. The parameter calculated for Romania is statistically meaningless.

Table 3 shows the results of Model B for the same country group. All models are statistically significant except Portugal. In contrast to the previous model, positive coefficients were observed in all countries except Romania for the two-lag dynamic effects. According to the coefficient totals, the two-year dynamic effects reached 0.8254 in Greece, 0.774 in Hungary, 0.6745 in Portugal, 0.6037 in Slovakia, 0.5713 in Italy, 0.5415 in the Greek Cypriot Administration, and 0.5234 in Germany. In Croatia, Sweden, Denmark, Poland, Slovakia, and Bulgaria, an impact of over 30 percent was observed. Since this value is 0.3560 percent in Turkey, it is similar to the countries in the last group. The effect of input imports on productivity in Model B is 0.2527 in Greece, 0.2167 in France, 0.2034 in Latvia, 0.1502 in Germany, 0.1444 in Estonia, 0.1439 in Sweden, and 0.1389 in Croatia. It is observed that the import of intermediate goods in Poland, Slovakia, Cyprus, Italy, and Belgium reduces productivity. However, the parameters for Denmark, Poland, and Romania were found to be statistically insignificant. In all countries except Hungary, Latvia, Poland, Sweden, and Slovakia, imports of investment goods are inversely related to productivity. The values for this parameter are significant in all countries except Slovakia.

Table 4 shows three lagging efficiency relationships investigated with Model C. According to the calculated country samples, all models are statistically significant. In terms of the total three-period lag, Hungary is ranked first in dynamic impact, with a

value of 0.9362 percent, followed by Greece (0.9209) and Portugal (0.9059). Productivity growth in countries other than Slovakia, France, Czechia, Romania, Latvia, and Bulgaria is over 0.50 percent. The effect of intermediate goods imports on productivity appears similar to that in Model B. The parameters for Cyprus, Poland, and Romania were found to be statistically insignificant. The effect of investment goods imports was negative in most countries, as in the previous two models. Countries with a positive impact are as described in Model B. The parameter value of Slovakia was not found to be significant at the 95 percent significance level.

Table 5. Correlation between prediction parameters (n=72)

Parameters	C	Σa_t	β_1	β_2
C	1.00	-0.63	0.52	0.08
Σa_t	-0.63	1.00	0.23	0.21
β_1	0.52	0.23	1.00	-0.02
β_2	0.08	0.21	-0.02	1.00

The distribution plots between the sums of the coefficients a_1, a_2, and a_3 of dynamic lags and the parameters β_1, which show the effect of intermediate goods, and β_2, which show the effect of investment goods, show that there is no relationship between the variables. Although there is no need to investigate the multiple linear connections in the analysis method, the result can still be evaluated because there is no relationship between the independent variables. Table 5 shows that the correlation between the constant coefficient "C" and the coefficient sums of the dynamic delays, as well as the coefficient β_1, is high.

5. Conclusion and Discussion

Theoretically, thanks to imports, domestic producers can reach cheaper intermediate and investment goods. With the dynamic effect of this, competition in the input sector increases, resource distribution changes, technological capacity develops and spreads widely. Therefore, increases in productivity within a sector or company benefit the entire economy. Intersectoral dependencies are important in both balanced and unbalanced development strategies. Additionally, access to cheap imports of intermediate and investment goods is a fundamental point of divergence between import-substitution and export-oriented industrialisation strategies.

This study aims to address the following research questions: "Do imports of intermediate goods and investment goods have an impact on productivity? As much as the direction and level of the effect?" The findings are expected to serve as an important indicator for evaluating the success of the selected industrialisation strategy.

One key factor to consider is the criterion used to assess efficiency. To determine this, a variable representing the ratio of total inputs to total outputs was used, derived from input-output tables, unlike in the existing literature. The empirical analysis was conducted using data from Türkiye and 23 European Union member countries,

employing the System Generalised Moment Estimation Method for the years 2010-2022.

The results indicate that the dependent variable, examined using a large dataset of 19344 observations, exhibits a stable and strong relationship with the defined explanatory variables. In this respect, it is concluded that our H1a alternative hypothesis, belonging to our first research question, is accepted. Accordingly, it has been proven that the variable based on intermediate input productivity is scientifically important.

It was observed that the ratio of intermediate goods imports to total intermediate goods had a positive effect on the calculated productivity variable. Therefore, the H_{1b} alternative hypothesis can be accepted for a significant number of countries. Numerous studies in the literature have come to similar conclusions: Muendler (2004) in Brazil, Kasahara and Rodrigue (2008) in Chile, Bas and Strauss-Kahn (2014) in France, Yu and Li (2014) in China, Ahn and Choi (2016) in Korea, Zaclicever and Pellandra (2018) in Uruguay, Constantinescu et al (2019) across 40 countries, Martinez Zarzoso et al (2021) in Egypt, Camino-Mogro and Maldonado (2022) in Ecuador, Pana and Patunru (2023) in Indonesia, Mulugeta and Söderbom (2024) in Ethiopia, and Khanna and Sharma (2025) in India. However, negative results were obtained for some countries and periods. Similar findings were reported in the models examined by Yasin (2022) for Indonesia and by Wang et al (2024) for China. In light of what has been said, although the use of imported intermediate goods generally has a positive effect on productivity, this situation may differ from country to country.

The results for the effect of capital goods imports on productivity largely indicate that the alternative hypothesis H_{1c} is unacceptable. Using variables similar to those in this research, Muendler's (2004) studies for Brazil and Habiyaremye's (2004) studies for Botswana also found that imports of investment goods negatively affected productivity. However, analyses by Caselli (2018) for Mexico, Khanna and Sharma (2025) for India, and Wang et al. for China show that the effect is positive. The analysis findings contradict the prevailing expectation in the literature.

Countries' productivity levels have dynamic effects on previous years. The Two-Stage System Generalised Moment Estimation method helps to illustrate these dynamic effects in the best light. The alpha parameter sums in the 2- and 3-lag models were significant and relatively large for many countries. When evaluated together with the C coefficient, which shows the autonomous variables that do not participate in the model, econometrically, a significant part of the productivity increases is due to non-import reasons.

Global liberalization processes and the activities of international value chains have gradually increased the interdependencies between countries. Analysing the positive or negative effects of imports on productivity within the complex relationship network is very important for the policies to be implemented. The level of integration of countries into the global economy, their technological infrastructure, exchange rates, financing of foreign trade, and other costs can alter productivity based on imported intermediate inputs. In this context, econometric analyses show that while intermediate goods imports have a limited, they do have a positive impact on productivity. In countries such as Greece, France, Latvia, Germany, Estonia, Sweden,

and Croatia, production based on intermediate inputs is relatively more efficient and should be maintained. In other countries, promoting domestic input production could be an effective policy solution.

A significant portion of the countries examined are developed nations with technological development capacity. Each possesses expertise in the production of capital goods. Therefore, the analysis conducted in this study found that the impact of capital goods imports on productivity was generally negative. It can be stated that the contribution of domestic capital goods to productivity is more positive. Only in Hungary, Poland, Sweden, and Slovakia is productivity positively affected by the increase in the proportion of imported capital goods. A common feature of these countries is that they are not members of the Eurozone. Of course, although the exchange rate is important, it may not be right to attribute the sole reason to the euro.

This research stands out from other studies in the literature due to the specific variable used to measure productivity and the approach taken in examining this variable across a large macroeconomic sample. Notably, the finding that capital goods imports have a negative effect on productivity in the broad sample analysed presents a significant paradox that contradicts existing theory. Future research could enhance the literature by conducting sector-based comparisons, investigating the direction and common trends of the coefficients over a more extended period, and placing greater emphasis on the implications of capital goods imports.

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Araştırma ve Yayın Etiği Beyanı

Bu çalışmanın tüm hazırlanma süreçlerinde etik kurallara uyulduğunu yazarlar beyan eder. Aksi bir durumun tespiti halinde Ticari Bilimler Fakültesi Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazarlarına aittir. Bu çalışma etik kurul izni gerektirmemektedir.

Research and Publication Ethics Statement

The authors declare that ethical rules are followed in all preparation processes of this study. In case of detection of a contrary situation, Journal of Commercial Sciences has no responsibility and all responsibility belongs to the authors of the study. This study does not require ethics committee approval.

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