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Analyzing Türkiye's Import Dependency of Exports: A Sectoral Approach

Türkiye'nin İhracatının İthalata Bağımlılığının Analizi: Sektörel Bir Yaklaşım

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Abstract

The high import dependency of exports is an important cause of external vulnerability for economies pursuing an export-led growth strategy. The purpose of this paper is to analyze the import dependency of exports in Türkiye, which adopts the export-led growth model, and to identify the sectors that will contribute to reducing the import dependency of exports. This study investigates Türkye's time-varying import dependency of exports from January 2013 to January 2024 using ISIC Rev.4 classification and state space model. The findings reveal that while the import dependency of exports was on a downward trend from early 2013 until September 2019, this trend reversed after this date and the import dependency of exports started to increase rapidly. A one percentage increase in the deviation of exports from their potential increases the import dependency of exports by 0.65% on average. The highest import dependence of exports is observed in the Manufacturing sector. When examining manufacturing sub-sectors, Textile, Wearing Apparel and Basic Metals show the highest dependency increase, while Beverages, Tobacco Products and Printing & Reproduction of Recorded Media sub-sectors exhibit the lowest. From this point of view, in order to reduce the import dependency of exports, policies such as increasing export potential, reducing deviations from potential and encouraging vertical integration with the domestic industrial structure, as well as providing tax advantages to encourage the use of domestic intermediate goods especially in sectors with high import dependency can be recommended. Furthermore, technological innovations that allow using domestically produced intermediate goods and capital goods also may create permanent effects on decreasing import dependency.

Jel Codes: *F14, L52, L60*
Keywords: *Import Dependency of Exports, Time-Varying Analysis, Kalman Filter*

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Öz

İhracatın ithalata bağımlılığının yüksek olması, ihracata dayalı büyüme stratejisi izleyen ekonomiler için önemli bir dış kırılganlık nedenidir. Bu çalışmanın amacı, ihracata dayalı büyüme modelini benimseyen Türkiye için ihracatın ithalata bağımlılığını analiz etmek ve ihracatın ithalata bağımlılığının azaltılmasına katkıda bulunacak sektörleri belirlemektir. Bu çalışma, ISIC Rev.4 sınıflandırması ve durum uzayı modelini kullanarak Ocak 2013'ten Ocak 2024'e kadar Türkiye'nin ihracatının zamanla değişen ithalat bağımlılığını araştırmaktadır. Bulgular, 2013 yılı başından Eylül 2019'a kadar ihracatın ithalata bağımlılığı azalma eğilimindeyken, bu tarihten sonra bu eğilimin tersine döndüğünü ve ihracatın ithalata bağımlılığının hızla artmaya başladığını ortaya koymaktadır. İhracatın potansiyelinden sapmasındaki yüzde birlik bir artış, ihracatın ithalata bağımlılığını ortalama %0,65 oranında artırmaktadır. İhracatın ithalata bağımlılığının en yüksek olduğu durum İmalat sektöründe görülmektedir. İmalat alt sektörleri incelendiğinde, Tekstil, Giyim Eşyası ve Ana Metaller en yüksek bağımlılık artışını gösterirken, İçecekler, Tütün Ürünleri ve Kayıtlı Medyanın Basılması ve Çoğaltılması alt sektörleri en düşük bağımlılık artışını sergilemektedir. Bu açıdan bakıldığında, ihracatın ithalata bağımlılığını azaltmak için ihracat potansiyelinin artırılması, potansiyelden sapmaların azaltılması ve yerli sanayi yapısıyla dikey entegrasyonun teşvik edilmesi gibi politikaların yanı sıra özellikle ithalata bağımlılığın yüksek olduğu sektörlerde yerli ara malı kullanımını teşvik edecek vergi avantajlarının sağlanması önerilebilir. Ayrıca, yurt içinde üretilen ara malı ve sermaye mallarının kullanılmasına olanak sağlayan teknolojik yenilikler de ithalat bağımlılığının azaltılmasında kalıcı etkiler yaratabilir.

Jel Kodları: *F14, L52, L60*
Anahtar Kelimeler: *İhracatın İthalata Bağımlılığı, Zamanla Değişen Analiz, Kalman Filtresi*

1. Introduction

The integration of production and trade in the globalization process makes production processes more interdependent at the international level. Reducing customs tariffs and making it more difficult for countries to resort to non-tariff instruments increase the interdependence of economies through foreign trade. While developments in information technologies make it possible to carry out production processes in different countries, developments in logistics systems enable many of the intermediate and investment goods used in the production process to be easily imported from different parts of the world at lower costs (Aydın et al., 2010).

Globalization through vertical integration brings up the phenomenon of import dependency of exports, which is defined as the dependence of the production of exported goods on the use of imported inputs (İnançlı and Konak, 2011). The degree of import dependency of exports can be caused by reasons such as industrialization strategy, technology used in the production of exported products, exchange rate regime (policy), inward processing regime and external dependence on energy. These affect the import dependency of exports both through different channels and in mutual interaction (Dikici, 2020). At this point, adopting an export-led growth strategy may require eliminating the source of this vulnerability if a country has a high import dependency of export. Moreover, different sectors may have different input demands and thus not all sectors will have a similar kind of import dependence. Thus, this paper aims to identify the sectors that would benefit from reducing the import dependency of exports and relevant policies by analyzing the import dependency of exports for an internationally well-connected country; Türkiye.

Studies on the import dependency of exports are mostly interconnected with the import dependency of production. Casero and Astarloa (2010), Bravo and Alvarez (2012) and Knuuttila et al. (2014) employ input-output analyses for each product in a given economy time-invariant intermediate inputs parameter involved in its production to determine the import of the product itself and use of imported products to meet the different components of a product. Those studies highlight the importance of high import dependency of output. On the other hand, Marwah and Tavakoli (2004) study the relationship between imports and economic growth by estimating the production elasticities by experimenting with various production function types. They argue that import contributions are 0.292, 0.529, 0.353 and 0.472 to one-point growth in Indonesia, Malaysia, Philippines and Thailand, respectively. Islam et al. (2012) examine the relationship between imports and economic growth in 62 countries by using the ARDL approach. They find that a long-run relationship holds for the majority of the sample.

Regarding the import dependency of exports, Loschky and Ritter (2007) examine the import content of exports for Germany by making a sectoral degradation and show that the import content of German exports rose from 31% in 1995 to 45% in 2006 using the relevant two input-output tables. Thus, they report an increasing import dependency trend. Breda et al. (2008) use input-output tables to estimate the import content for some European countries. They provide comparable estimates of the import content of exports in each manufacturing sector for a set of European countries and indicate a significant increase between 1995 and 2000 in vertical integration. Feng et al. (2016) find that imports of intermediate goods have a strong positive effect on China's firm exports, and the strength of the relationship differed systematically. Their findings suggest that export performance improves when imports provide local firms with intermediate inputs of superior quality or technology. Following the definition of vertical specialization proposed by Hummels et al. (2001), Amador and Cabral (2009) suggest that the dependency of exports on imports in East Asian countries is very high, with a significant increase in vertical specialization in high-tech products. Cuihong and Jiansuo (2007) use China's non-competitive input-output table and the definition of vertical specialization to describe the dependency ratio of imports of China's exports and reveal that the dependency of Chinese exports on imports is very high.

Studies investigating dependency on imported inputs using Turkish data employ different methods and claim that the weight of imports used in production is very high. These studies put forward the import-intermediate input dependency of sectoral production (see: Şisman et al., 2004; Yükseler and Türkan, 2006; Ersungur and Kızıltan, 2007; Saygılı et al., 2010; Şenesen and Şenesen, 2010; Ersungur et al., 2011; Özlale and Karakurt, 2012; Duman and Özgüzer, 2013; Aydın et al., 2015; Aydoğuş et al., 2015; Kundak and Aydoğuş, 2018; Tok and Sevinç, 2019; Ünal, 2020; Dineri and Işık, 2021; Kurt, 2023). Şenesen and Şenesen (2003) assess the structure of import dependency in Türkiye via backward linkages by using input-output tables from the 1970s to the 1990s in the context of economic policies. The import dependency on exports increased in leading export sectors such as Agriculture, Textiles, and Food after the 1980s. They conclude that production in technology and energy-intensive sectors has become more dependent on intermediate goods imports as the variety of products increases, pointing to the structural changes in the economy. Erduman et al. (2020), using the input-output tables of Türkiye for 2002-2018, find that the average import content is around 28% for exports. They state that import dependency has an increasing trend in exports. The highest import requirements are detected in Coke and Refined Petroleum Products, Basic Metals and Motor Vehicles as these are characterized by high capital intensity and advanced technology usage. The Services, Agriculture, Forestry and Fishery, and Mining sectors have the lowest import requirements. Ünal (2020) analyzes imported input dependence in Türkiye's basic industrial sectors between 2002 and 2014 by using input-output tables (World Input-Output Database tables). The study concludes that Türkiye's industrial imported input dependence has increased significantly, with computer, electronic and optical products and the automotive industry leading these industries. Karabulut (2020) tests the import-to-export relationship using Dynamic Ordinary Least Squares (DOLS) and Fully Modified Ordinary Least Squares (FMOLS) between 1992 - 2019 and reports bidirectional causality with exports being highly dependent on imports in the long term. Saygılı and Saygılı (2011) apply the Kalman filter approach to analyze the dynamics of the export supply and demand parameter estimates. They estimate export supply and demand functions under different specifications. Their results support the view that structural changes in the composition of exports determine the recent variances in the parameters of the export equation in Türkiye. The results on the high import and income elasticity of exports suggest that the global growth pattern has a significant role in determining the exports of Türkiye. Another set of studies uses the cointegration approach with Turkish data. Akbaş and Şentürk (2013) analyze whether Türkiye's import and export transactions with France, Germany, Holland, Italy, Spain, Great Britain, Belgium, Luxemburg, Denmark, Russia, the U.S., Iran, Saudi Arabia, China, United Arab Emirates and Iraq were interdependent between 1990 and 2012. Yıldırım and Kesikoğlu (2012) investigate the causality relationships among imports, exports and real exchange rates for Türkiye in the 2003-2011 period using a leveraged bootstrap corrected Modified Wald Test (MWALD). They conclude that the dependency between imports and exports renders the exchange rate policy neutral when the findings are evaluated as a whole. Kurt (2023) finds that the import content of exports was approximately 10% in the 1995-98 sub-period and approximately 21% in the 2008-18 sub-period. In the study, this is explained by the increase in the share of the labor force in total income. However, while the positive effect of the increase in the share of labor in total income on private consumption expenditures sufficiently balances the import content of exports, the negative effect on private investments remains relatively small and constant throughout the sub-periods.

The import dependency of exports is not fixed. Higher export demand will meet higher output demand to the extent that this higher export demand does not match with lower domestic demand. Thus, sectors' investment and intermediate input demand will increase. Saygılı et al. (2010) argue that this higher investment and intermediate goods demand will increase the import demand to the extent that higher investment and intermediate goods demand will not match domestic supplies. In other words, to the extent that export demand will not meet available domestic sources, import demand will increase.

The purpose of this study is to estimate the time-varying import dependency of exports and how the deviation of exports from their potential (with available resources) will affect this dependency for total exports as well as different export sectors. In order to estimate this relationship, the necessary data for total imports, total exports, and different export components have been collected for the period January 2013-January 2024. The selection of Türkiye is motivated by its internationally well-connected industrial structure and the high share of its industrial export sector in total exports as well as external balances. Studying the import dependency of exports is important for countries to determine which sector they may prioritize to stimulate forward integration on exports. This, in turn, will contribute to improving the foreign trade balance and reducing the current account deficit.

The majority of studies on the import dependency of exports are seen to employ input-output analyses. One of the main reasons for this is that the tables in question can directly reveal the connections between sectors. However, input-output tables are published irregularly and are not accessible for each year, which may cause data generation problems. This is inconvenient for any time-varying analysis. Fixed input-output tables do not capture the substitution of goods from domestic consumption to export.

Unlike previous studies, this analysis contributes to the literature with econometric methodology by allowing us to estimate the time-varying import dependency using Kalman filtering. The first contribution of our paper is that we propose a methodology that allows us to see the historical development rather than using infrequently generated fixed input-output tables. The second contribution is that we provide specifications that could help determine economic policies that will reduce dependency on imported inputs while also positively affecting unemployment, which can be seen as one of the most important problems of our time.

The empirical evidence gathered in this study suggests that a one-percent increase from its potential deviation in exports will increase imports by 0.651 percent on average. It is also suggested that an increasing deviation in the potential of exports sustains the import dependency of exports. This effect is highest in the Manufacturing sector and Textiles and Wearing Apparel sub-sectors. This is a convenient result because the Manufacturing sector has the highest share in Turkish exports with 94.25% (see Table 1 in Data section). When the import dependency of exports is examined for various Manufacturing sub-sectors, then the dependency increase is highest in the Textile, Wearing Apparel and Basic Metals industries and lowest in the Beverages, Tobacco Products and Printing & Reproduction of Recorded Media sub-sectors.

This paper is organized as follows: Section 2 introduces the state space methodology that we employ. In section 3, the data used in the paper is discussed. We provide empirical evidence in Section 4. In Section 5, we conclude the paper.

2. Methodology

The Kalman filter method (1960) estimates unobservable state variables using observed data. A general state space model is given as follows:

$$\varphi_t = \mu + J\varphi_{t-1} + LZ_t + \eta_t \tag{1}$$

$$y_t = A'x_t + B'\varphi_t + \varepsilon_t \tag{2}$$

$$E(\eta_t\eta_k') = \begin{cases} H, & if\ t = k \\ 0, & otherwise \end{cases} \tag{3}$$

$$E(\varepsilon_t\varepsilon_k') = \begin{cases} W, & if\ t = k \\ 0, & otherwise. \end{cases} \tag{4}$$

Equation (1) is the state equation, and (2) is the signal equation. The state equation captures the coefficients' dynamics in the observation equation over time. In the state equation, φ_t is the state vector; μ is a constant term and Z_t is the vector of exogenous variables. In signal equation, y_t is the dependent variable and x_t is a vector of explanatory variables. The J, L, A, B, H and W are system matrices. $\{\eta_t, \varepsilon_t\}_{t=1}^{T}$ represent the error terms having Gaussian with mean zero and non-zero covariance matrices of H and W. In the Kalman Filter, initial values denoted by $\varphi_{1|0} \sim N(\hat{\varphi}_{1|0}, P_{1|0})$ are needed for estimation and taken by $\varphi_{1|0} = 0$ and $vec(P_{1|0}) = [I - (F \otimes F)]^{-1} vec(Q)$ following Hamilton (1994).

The Kalman filter is a recursive algorithm that starts with obtaining the Kalman Gain matrix (Harvey, 1990; and Hamilton, 1994). One may write;

$$M_t = P_{t|t-1}B\left(B'P_{t|t-1}B + W\right)^{-1} \tag{5}$$

$$P_{t|t} = [I - M_tB']P_{t|t-1} \tag{6}$$

$$\hat{\varphi}_{t|t-1} = J\hat{\varphi}_{t-1|t-1} \tag{7}$$

$$P_{t|t-1} = JP_{t-1|t-1}J' + H \quad (8)$$

$$\hat{\varphi}_{t|t} = \hat{\varphi}_{t|t-1} + M_t\left(y_t - A'x_t - B'\hat{\varphi}_{t|t-1}\right). \quad (9)$$

Equation (5) represents the Kalman Gain matrix. When the φ_t is updated by Equation (6) as the second step and projected to t of φ_t then its covariance can be calculated by Equations (7) and (8). As the last step, estimations are updated by Equation (9).

The main purpose of this paper is to estimate the effect of the deviation of exports from its potential on the import dependency of exports. Thus, the following equation (10) and (11) represent the state and signal equations in our specification, respectively:

$$import_t = \alpha_0 + \alpha_{1,t}\, export_t + \varepsilon_t \quad (10)$$

$$\alpha_{1,t} = \beta_0 + \beta_1\alpha_{1,t-1} + \beta_z Z_t + \eta_t. \quad (11)$$

where, α_0 is the constant term in the signal equation. $\alpha_{1,t}$ is the signal equation's slope term. $\alpha_{1,t-1}$ is the lag value of the signal equation's slope term. $\alpha_{1,t}$ depends on $\alpha_{1,t-1}$ and Z_t, in the state equation. Here, Z_t represents the exports' deviation from its potential. β_0 is the constant term in the state equation. β_1 is the coefficient of the lag value of the signal equation's slope term. ε_t and η_t are the error terms of the signal and state equations, respectively.

Note that the different export components of sectors to slope term (state equation rather than including these in the signal equation) are included. The reason for this is that any change in the exports of those considered sectors also affects the imports and exports of other sectors. One may consider including those sectors with input-output tables of the Turkish Statistical Institute; however, they are neither time variable nor compatible with the existing components of the export classification that we use.

3. Data

To investigate the import dependency of exports, the monthly foreign trade data according to the ISIC Rev.4 is used. The data span covers the observations from January 2013 to January 2024 for Türkiye. The data availability dictates the beginning of the study's sample period. All data are gathered from the Electronic Data Delivery System (EVDS) of the Central Bank of the Republic of Türkiye (CBRT).

The monthly export series has four main sub-components: Agriculture, Forestry & Fishing, Mining & Quarrying, Manufacturing, and Others. The Manufacturing sector has the highest share in total export with 94.25% on average. This is followed by Agriculture, Forestry & Fishing with 3.34%, Mining & Quarrying with 1.93% and the other remaining sectors with 0.48%. Therefore, we also consider our analyses for 23 sub-components of the Manufacturing sector. The two sub-components having the highest export weight in the manufacturing sector are Motor Vehicles Trailers & Semitrailers, and Basic Metals. Their total weight reaches around 25% of Manufacturing exports. On the other hand, sub-components with a weight above 5% account for about 50% of the Manufacturing sector exports. We report the shares of all subcomponents of exports in total exports in Table 1.

We use import and export series (in US dollars) in logarithmic form. In the analysis, we examine how the deviation of exports from their potential level affects the import dependency of exports by employing the deviation of the related logarithmic exports series from its potential level, which is calculated by the Band-Pass Filter Method: $[\log(X_i) - BPF(\log(X_i))]$, when estimating the import dependency of exports with the state space model.

Table 1. Share of subcomponents in total exports on average (January 2013-January 2024)

Sub-components	Share (%)	Sub-components	Share (%)
Agriculture Forestry & Fishing	3.34	Chemicals & Chemical Products	5.17
Mining & Quarrying	1.93	Basic Pharmaceutical Products & Preparations	0.75
Manufacturing	94.25	Rubber & Plastics Products	4.50
Others	0.48	Other Nonmetallic Mineral Products	2.66
Food Products	7.75	Basic Metals	11.06
Beverages	0.18	Fabricated Metal Products Except Machinery & Equipment	4.94
Tobacco Products	0.36	Computer Electronic & Optical Products	1.64
Textiles	6.88	Electrical Equipment	6.39
Wearing Apparel	9.32	Machinery & Equipment n.e.c.	5.65
Leather & Related Products	0.76	Motor Vehicles Trailers & Semitrailers	13.96
Wood & Wood Product	0.53	Other Transport Equipment	1.88
Paper & Paper Products	1.32	Furniture	1.52
Printing & Reproduction of Recorded Media	0.01	Other Manufacturing	3.36
Coke & Refined Petroleum Products	3.66		
Source: Calculated with data from the EDDS database.			

4. Empirical Evidence

In this paper, how the deviation of exports from their potential level affects the import dependency of total exports using state space models is examined. The estimates of the specifications are reported in Tables 2 and 3. The first column of Table 2 (Spec. 1) reports the estimates of the state space models as in Equations (10) and (11) in which imports are the US dollar value of Turkish total imports, exports are the US dollar value of Turkish total exports and Z_t is the deviation of total exports from its potential. The estimates of the signal equation are reported in Panel A, the estimates of the state equation are reported in Panel B, and test statistics are reported in Panel C for various specifications.

In Table 2 Panel A, α_0 is for the constant term in the signal equation and α_{1T} is the estimate of the final state value of the slope term. The estimate of $\alpha_{1,t}$ along with its ±2RMSE confidence band is also provided in Figure 1. While the import dependency of exports was on a downward trend from early 2013 until September 2019, this trend reversed after this date and the import dependency of exports started to increase rapidly. The estimates of both α_0 and $\alpha_{1,t}$ parameters are statistically significant in the first specification.[4] The final state value of $\alpha_{1,t}$ (α_{1T}) is 0.653, and the sample average of $\alpha_{1,t}$ is 0.651. This suggests that a one percentage increase in the deviation of exports from their potential increases the import dependency of exports by 0.65% on average. However, this value varies between 0.636 and

[4] The level of significance is at the 5% level unless otherwise stated.

0.666. The estimates are parallel to the relevant statistics in TUSIAD (2016). Panel B reports the estimates for the state equation. The estimate of the lag value of the signal equation's slope term is positive and less than one (0.919). These satisfy the non-explosiveness properties of $\alpha_{1,t}$. Moreover, the estimate of the exogenous variable Z_t (deviation of export from its potential) is both positive and statistically significant. The estimate suggests that as the export exceeds its long-term trend by one percent, the import dependency of exports increases by 0.008. However, $\alpha_{1,t-1}$ is the lag of $\alpha_{1,t}$ itself and has a feedback effect on import dependency. The long-run coefficient for import dependency is calculated as $[\beta_z/(1-\beta_1)]$, and it is 0.101. The estimate suggests that as the export exceeds its long-term trend, then the import dependency of exports increases.

Not all sectors are similar in capital-labor ratio and imported raw material or intermediate goods needs. Some of the sectors may use more imported materials than others. Thus, the exercise for the three main export sub-sectors is repeated: Agriculture Forestry & Fishing; Mining & Quarrying; and Manufacturing. The estimates are reported in Table 2 as specifications 2, 3, and 4.

The import dependency of total exports is very close to the others when the three main sub-sectors are considered as reported in Panel A. The contribution of the three main sub-sectors to the import dependency of total exports is examined in Panel B, the Manufacturing Sector's contribution is the highest in both the short-run (0.008) and the long-run (0.103). Following the Manufacturing sector, the contribution of Agriculture Forestry & Fishing is 0.002 in the short-run and 0.023 in the long-run. The contribution of the Mining & Quarrying sector is not statistically significant. This finding is parallel to Erduman et al. (2020) and Nas (2021) for Türkiye and Breda et al. (2008) in general.

The estimates of β_z coefficients are positive and statistically significant at the 1% level for Textiles and Basic Metals; are positive and statistically significant at the 5% level for Food Products, Wearing Apparel, Leather & Related Products, Fabricated Metal Products (except Machinery & Equipment), Electrical Equipment, Motor Vehicles Trailers & Semitrailers, and Other Manufacturing. Furthermore, β_z coefficients of Wood & Wood Products, Basic Pharmaceutical Products & Preparations, Rubber & Plastics Products, Basic Metals, Other Non-metallic Mineral Products and Machinery & Equipment n.e.c are positive and statistically significant at the 10% level.

The Textiles sector has a maximum β_z coefficient estimate of 0.007 with a 1% level of significance. This makes sense because the share of the Textiles sector in total exports is one of the largest ones among those sub-sectors and the Textiles industry (as in Şenesen and Şenesen, 2003 and Saygılı, 2014). The sector needs to import raw materials or intermediate inputs such as fiber, cotton and textile dye. In addition to the Textiles sector, the coefficients in other sub-sectors are as follows: 0.004 in Wearing Apparel; 0.003 in Basic Metals and Fabricated Metal Products (except Machinery & Equipment); and also 0.002 in Food Products, Leather & Related Products, Rubber & Plastics Products, Other Nonmetallic Mineral Products, Electrical Equipment, Machinery & Equipment n.e.c., and Motor Vehicles Trailers & Semitrailer.

On the other hand, Beverages, Tobacco Products and Printing & Reproduction of Recorded Media sub-sectors have the minimum effect on the import dependency of total exports. The exports of these sub-sectors do not have a statistically significant effect on total import dependency either. This result is compatible with the low share of this subsector in manufacturing exports 0.55% in total. This is parallel to Yükseler and Türkan (2006), where Tobacco Products are mentioned as having a lower use of imported inputs with a ratio of 9.41%.

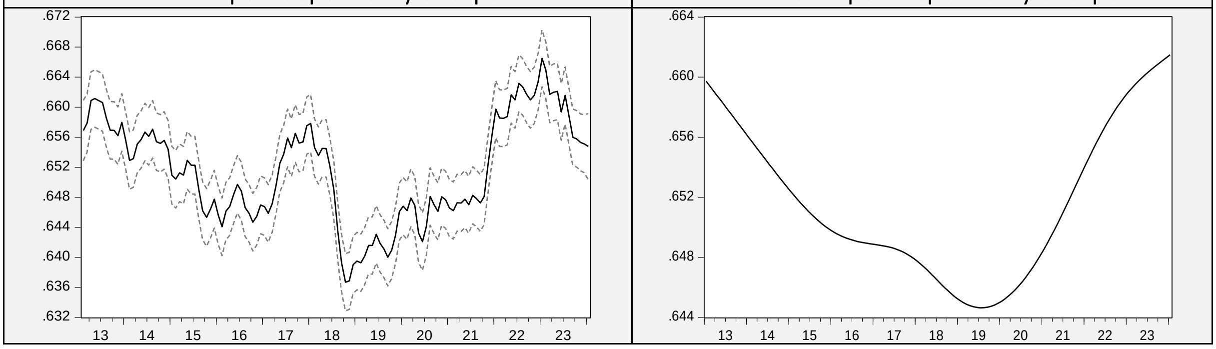
Table 2. Time-varying the total import dependency of exports in main sectors

	Spec.1	Spec.2	Spec.3	Spec.4
Panel A: Signal Equation: $import_t = \alpha_0 + \alpha_{1,t}\, export_t + \varepsilon_t$				
α_0	6.078***	6.914***	6.954***	6.113***
	(6.34)	(7.18)	(6.96)	(6.32)
α_{1T}	0.653***	0.606***	0.602***	0.651***
	(202.96)	(190.50)	(184.85)	(202.66)
Panel B- State Equation: $\alpha_{1,t} = \beta_0 + \beta_1\alpha_{1,t-1} + \beta_z Z_t + \eta_t$				
β_0	0.052***	0.024	0.025	0.049
	(2.90)	(1.30)	(1.20)	(2.77)
β_1	0.919***	0.915***	0.928***	0.923***
	(37.02)	(32.18)	(66.92)	(37.30)
Z_t:	Total Export	Agriculture Forestry & Fishing	Mining & Quarrying	Manufacturing
β_z	0.008**	0.002**	0.001	0.008***
	(3.10)	(2.09)	(0.87)	(3.09)
Long Run Coefficient	0.101	0.023	0.013	0.103
Panel C- Test Statistics				
Log likelihood	146.81	145.42	143.43	146.82
Akaike info criterion	-2.11	-2.09	-2.06	-2.11
Schwarz criterion	-1.98	-1.96	-1.93	-1.98
Hannan-Quinn criter	-2.06	-2.04	-2.01	-2.06

Note: The values in parentheses are z-statistics of estimates of corresponding parameters. ***, **, and * indicate the level of the significance at the 1%, 5%, and 10% levels respectively.

Figure 1: State value of import responsiveness to exports ($\alpha_{1,t}$) and its trend

A. Import dependency of exports | **B.** Trend of import dependency of exports



Note: Solid line represents state value of import responsiveness to exports. Dashed lines are confidence interval (±2RMSE).

Table 3. Time-varying the total import dependency of exports at sub-components of manufacturing sector

	Spec.5	Spec.6	Spec.7	Spec.8	Spec.9	Spec.10	Spec.11	Spec.12
Panel A- Signal Equation: $import_t = \alpha_0 + \alpha_{1,t}\ export_t + \varepsilon_t$								
α_0	7.09***	7.023***	6.934***	6.586***	6.825***	6.971***	7.126***	7.146***
	(7.28)	(6.90)	(6.47)	(7.04)	(7.02)	(7.07)	(7.31)	(7.28)
α_{1T}	0.596***	0.598***	0.603***	0.625***	0.610***	0.602***	0.593***	0.592***
	(186.97)	(183.05)	(177.97)	(197.82)	(189.32)	(188.96)	(184.42)	(185.22)
Panel B- State Equation: $\alpha_{1,t} = \beta_0 + \beta_1\alpha_{1,t-1} + \beta_z Z_t + \eta_t$								
β_0	0.018	0.031*	0.040	-0.045	-0.013	0.017	0.031**	0.020
	(0.89)	(1.75)	(1.02)	(-1.41)	(-0.47)	(0.86)	(2.05)	(1.12)
β_1	0.914***	0.932***	0.925***	0.905***	0.921***	0.918***	0.922***	0.934***
	(32.31)	(39.13)	(19.90)	(40.10)	(45.41)	(36.97)	(42.07)	(42.37)
Z_t:	Food Products	Beverages	Tobacco Products	Textiles	Wearing Apparel	Leather & Related Products	Wood & Wood Product	Paper & Paper Products
β_z	0.002**	0.0008	0.0003	0.007***	0.004**	0.002**	0.001*	0.001
	(1.97)	(0.86)	(0.19)	(3.22)	(2.14)	(2.09)	(1.65)	(1.51)
Long Run Coefficient	0.023	0.011	0.004	0.073	0.050	0.024	0.012	0.015
Panel C- Test Statistics								
Log likelihood	145.19	143.48	143.06	147.72	144.96	145.43	144.52	144.29
Akaike info criterion	-2.09	-2.06	-2.06	-2.13	-2.08	-2.09	-2.08	-2.07
Schwarz criterion	-1.99	-1.93	-1.93	-2.00	-1.95	-1.96	-1.95	-1.94
Hannan-Quinn criter	-2.04	-2.01	-2.01	-2.07	-2.03	-2.04	-2.03	-2.02

Note: The values in parentheses are z-statistics of estimates of corresponding parameters. ***, **, and * indicate the level of significance at the 1%, 5%, and 10% levels respectively.

Table 3. Time-varying the total import dependency of exports at subcomponents of manufacturing sector (*Continued*)

	Spec.13	Spec.14	Spec.15	Spec.16	Spec.17	Spec.18	Spec.19	Spec.20
Panel A- Signal Equation: $import_t = \alpha_0 + \alpha_{1,t}\ export_t + \varepsilon_t$								
α_0	7.020***	7.075***	7.179***	7.016***	7.116***	7.131***	7.191***	7.121***
	(6.89)	(6.92)	(7.16)	(7.21)	(7.31)	(7.21)	(7.64)	(7.27)
α_{1T}	0.599***	0.596***	0.613***	0.600***	0.593***	0.592***	0.588***	0.593***
	(183.77)	(183.54)	(185.86)	(188.14)	(185.04)	(185.54)	(187.47)	(185.46)
Panel B- State Equation: $\alpha_{1,t} = \beta_0 + \beta_1\alpha_{1,t-1} + \beta_z Z_t + \eta_t$								
β_0	0.033*	0.044	0.043**	0.027*	0.014	0.021	-0.005	0.021
	(1.78)	(0.89)	(1.98)	(1.69)	(0.66)	(1.02)	(-0.28)	(1.13)
β_1	0.932***	0.897***	0.927***	0.929***	0.921***	0.922***	0.937***	0.920***
	(32.97)	(8.59)	(28.79)	(43.32)	(44.39)	(32.35)	(37.23)	(39.49)
Z_t:	Printing & Reproduction of Recorded Media	Coke & Refined Petroleum Products	Chemicals & Chemical Products	Basic Pharmaceutical Products & Preparations	Rubber & Plastics Products	Other Nonmetallic Mineral Products	Basic Metals	Fabricated Metal Products Except Machinery & Equipment
β_z	0.0008	0.001	0.002	0.001*	0.002*	0.002*	0.003***	0.003**
	(0.96)	(0.94)	(0.81)	(1.76)	(1.83)	(1.78)	(2.76)	(2.02)
Long Run Coefficient	0.011	0.009	0.012	0.014	0.025	0.025	0.047	0.037
Panel C- Test Statistics								
Log likelihood	143.61	144.49	143.43	144.82	144.80	144.75	146.45	144.73
Akaike info criterion	-2.06	-2.08	-2.06	-2.08	-2.08	-2.08	-2.11	-2.08
Schwarz criterion	-1.93	-1.95	-1.93	-1.95	-1.95	-1.96	-1.98	-1.96
Hannan-Quinn criter	-2.01	-2.02	-2.01	-2.03	-2.03	-2.04	-2.05	-2.03

Note: The values in parentheses are z-statistics of estimates of corresponding parameters. ***, **, and * indicate the level of significance at the 1%, 5%, and 10% levels respectively.

Table 3. Time-varying the total import dependency of exports at subcomponents of manufacturing sector (*Continued*)

	Spec.21	Spec.22	Spec.23	Spec.24	Spec.25	Spec.26	Spec.27
Panel A- Signal Equation: $import_t = \alpha_0 + \alpha_{1,t} export_t + \varepsilon_t$							
α_0	6.272***	7.063***	7.092***	6.799***	6.946***	7.103***	6.976***
	(5.53)	(7.33)	(7.19)	(6.94)	(7.20)	(7.26)	(7.22)
α_{1T}	0.642***	0.597***	0.595***	0.612***	0.604***	0.594***	0.602***
	(197.26)	(186.10)	(185.32)	(189.03)	(188.08)	(184.89)	(185.18)
Panel B- State Equation: $\alpha_{1,t} = \beta_0 + \beta_1 \alpha_{1,t-1} + \beta_z Z_t + \eta_t$							
β_0	0.011	0.015	0.024	0.002	0.028	0.024	0.027
	(0.38)	(0.75)	(1.14)	(0.07)	(1.17)	(1.48)	(1.59)
β_1	0.904***	0.916***	0.923***	0.940***	0.927***	0.931***	0.917***
	(23.15)	(38.08)	(27.36)	(37.78)	(23.17)	(43.97)	(35.98)
Z_t:	Computer Electronic & Optical Products	Electrical Equipment	Machinery & Equipment n.e.c.	Motor Vehicles Trailers & Semitrailers	Other Transport Equipment	Furniture	Other Manufacturing
β_z	0.003	0.002**	0.002*	0.002**	0.001	0.001	0.001**
	(1.45)	(1.99)	(1.71)	(1.99)	(1.50)	(1.65)	(2.15)
Long Run Coefficient	0.031	0.023	0.026	0.033	0.013	0.014	0.012
Panel C- Test Statistics							
Log likelihood	144.95	145.07	144.62	144.98	144.59	144.47	145.26
Akaike info criterion	-2.09	-2.10	-2.08	-2.09	-2.08	-2.09	-2.12
Schwarz criterion	-1.96	-1.97	-1.95	-1.96	-1.95	-1.95	-1.97
Hannan-Quinn criter	-2.04	-2.05	-2.03	-2.04	-2.03	-2.04	-2.06

Note: The values in parentheses are z-statistics of estimates of corresponding parameters. ***, **, and * indicate the level of significance at the 1%, 5%, and 10% levels respectively.

5. Conclusion

This paper assesses the time-varying import dependency of exports for Türkiye. To address the import dependency of exports, the state space models with the data from January 2013 to January 2024 are used. The empirical evidence suggests that the deviation of exports from their own potential increases the import dependency of exports. Compared to the conventional time- invariant Input-Output-Tables method, our method allows the substitution of goods from domestic consumption to export.

The empirical evidence suggests that as the total export exceeds its potential, the import dependency of exports varies between 0.636 and 0.666. Import dependency of exports was on a downward trend from early 2013 until September 2019. After this date, the import dependency of exports started to increase rapidly. This increase in import dependency of exports is associated with the decline in the real effective exchange rate and the increase in the import unit value index. In particular, the import unit value index increased rapidly between April 2020 and April 2022 (Pandemic period) and this increase was accompanied by an increase in the import quantity index as of September 2021, resulting in a rapid increase in the import dependency of exports.

A comparison of the three main export sectors reveals that the manufacturing sector has the highest import dependency. However, in the 23 sub-sectors according to ISIC Rev.4 classifications, the import dependency of export is highest in the Textiles, Wearing Apparel, and Basic Metals sub-sectors which have a very high share in total exports. The import dependency of export is lowest in the Beverages, Tobacco Products and Printing & Reproduction of Recorded Media sub-sectors.

The above conclusions illustrate the benefits of making accurate policy recommendations by identifying the sectors which could help decrease import dependency. Increasing export potential (and thus decreasing the actual deviation of each export from its potential) and encouraging vertical integration with the country's domestic industrial structure will help decrease the import dependency of exports. Furthermore, in sectors with high import dependency, policies such as providing tax advantages to encourage the use of domestic intermediate goods especially in sectors with high import dependency. Technological innovations that allow using domestically produced intermediate goods and capital goods also may create permanent effects on decreasing import dependency. By studying the share of subcomponents in total exports on average and the estimated parameter of import dependency of exports, Motor Vehicles Trailers & Semitrailers; Basic Metals; Textile; and Wearing Apparel sectors can be considered to be promoted to decrease the import dependency of exports.

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Çıkar Beyanı: Yazarlar arasında çıkar çatışması yoktur.
Etik Beyanı: Bu çalışmanın tüm hazırlanma süreçlerinde etik kurallara uyulduğunu yazarlar beyan eder. Aksi bir durumun tespiti halinde Fiscaoeconomia Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazarlarına aittir.
Yazar Katkısı: Yazarların katkısı aşağıdaki gibidir; (Birden fazla yazar varsa doldurulacaktır)

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Introduction: 2. Author, 1. Author

Literature: 2. Author

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