

Research Article/Araştırma Makalesi

The Effect of Economic Freedom on Export Sophistication in OECD Countries¹

OECD Ülkelerinde Ekonomik Özgürlüklerin İhracat Sofistikasyonuna Etkisi

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Abstract

This study investigates the effect of sub-indices of economic freedom namely, rule of law, government size, regulatory efficiency, and open markets on export sophistication for OECD countries for the period 2005-2019. According to the Generalized Moments Method (GMM) results, the rule of law, government size and open markets positively affect export sophistication. These results suggest that OECD countries should increase the level of rule of law, government size and open markets to enhance export sophistication.

Jel Codes: F10, F14, F19

Keywords: Export Sophistication, Economic Freedom, GMM

Öz

Bu çalışma, ekonomik özgürlüğün alt indeksleri olan hukukun üstünlüğü, kamu sektörü büyüklüğü, düzenleyici etkiler ve pazara erişimin ihracat sofistیکasyonuna etkisini OECD ülkeleri için 2005-2019 döneminde araştırmaktadır. Genelleştirilmiş Momentler Yöntemi (GMM) sonuçlarına göre hukukun üstünlüğü, kamu kesimi büyüklüğü ve pazara erişim, ihracat sofistیکasyonunu pozitif yönde etkilemektedir. Bu sonuçlara göre, OECD ülkeleri, ihracat sofistیکasyonunu artırmak için hukukun üstünlüğü, kamu kesimi büyüklüğü ve pazara erişim seviyelerini artırmalıdır.

Jel Kodları: F10, F14, F19

Anahtar Kelimeler: İhracat sofistیکasyonu, Ekonomik Özgürlük, GMM

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1. Introduction

One of the countries' biggest economic goals is steadily increasing the per capita real income. While some countries reach this target, some fall behind the target. While the economic size between countries shows significant differences, the effort to explain these differences has been one of the most important efforts of economists. In this process, besides the factor endowment of the countries and the efficient use of factors, the environment in which economic activities take place was also questioned.

Countries' export performance is one of the most important determinants of their goal of achieving a stable income increase. After the Second World War, it relied heavily on industrialization and foreign trade strategies based on import substitution all over the world. Since the 1960s, this policy has turned into an export-led growth strategy. However, it is observed that some countries could not achieve sufficient growth despite the large increases in their export volume. Because increasing the export volume alone is not enough. While the economy of countries whose export basket is concentrated in a small number and certain products may suffer from exports in the long run, countries with a high level of diversity in the export basket benefit from exports in the long run. For example, if a country bases most of its exports on a single product, a crisis or low demand for this product can seriously impact the country's economy (Pirasteh et al., 2009).

While diversifying the export basket, the sectors to be selected should be selected among the sectors with high productivity (Ağzade, 2020). Innovation and technological advancements are driving significant changes in production techniques. This is led to increased productivity, resulting in lower costs to produce high-value-added goods. As a result, economies are experiencing accelerated growth as they expand their production possibilities frontier. Many countries are strategically modified their export structures to prioritize high-value-added goods to maximize the benefits they offer. Through diversifying their exports and enhancing product quality, these nations are successfully attained accelerated rates of economic growth (Atasoy, 2020).

Export structures of countries have been the subject of many studies and the concept of export sophistication has emerged. Export sophistication refers to the degree of intricacy and value-added present in a country's exported goods and services. It serves as a significant indicator of a nation's economic advancement and competitiveness on the global stage. Countries that exhibit higher levels of export sophistication typically enjoy the ability to command premium prices for their exports and possess greater prospects for diversifying their economies. Related literature indicates that a positive correlation between higher levels of export sophistication and increased economic growth and development. Nevertheless, achieving elevated levels of export sophistication can be a formidable task, necessitating investments in education, training, research and development, and infrastructure. Additionally, countries may encounter barriers to entry in certain industries or markets, thereby limiting their potential to diversify their export portfolio (Hausman et al., 2007; Hidalgo & Hausmann, 2009).

Another issue for countries to achieve their export targets is economic freedom. Economic freedom is known as the level at which the property acquired by individuals through moral

and legal means is protected. The freedom of individuals to use, give away or exchange this property as they see fit is among the basic features of economic freedom (McAfee, 2009).

Economic freedom affects export sophistication in various ways. Economic freedom supports entrepreneurship, facilitate trade, increase competition, investment, and social welfare. Economic freedom provides the business freedom for the establishment and development of new businesses. This allows for the development of new ideas and technologies. In addition, economic freedom encourages the liberalization of foreign trade and the removal of trade barriers. This helps to increase exports and make imports cheaper. It also helps to increase international cooperation and investments. Economic freedom is based on a free market economy. Thus, it encourages competition. This creates an incentive for businesses to be more efficient and serve consumers better. Economic freedom enables investors to freely use their capital. As such, investments increase, and new businesses are established. It also helps in the development of capital markets. Economic freedom helps reduce poverty and increase social welfare. The free-market economy raises people's living standards by providing more employment and higher wages (Gwartney et al., 2010; Cuhadar et al., 2020).

While the literature has explored the relationship between economic freedom and export sophistication, the consensus has yet to be reached (Atasoy, 2020; Weldemicael, 2012). Moreover, there is a scarcity of studies that specifically investigate the impact of sub-indices of economic freedom on export sophistication. Existing research predominantly focuses on analyses conducted in the context of China (Rodrik, 2006; Hausman et al., 2007; Schott, 2008; Van Assche & Gangnes, 2010; Kuroiwa, 2014). Surprisingly, there is no study in the literature that examined the effects of all the sub-indices of the economic freedom index on export sophistication specifically for OECD countries. Thus, our study aims to fill these gaps in the literature and provide valuable contributions in these areas.

The aim of this study is to examine the effect of sub-indices of economic freedom namely rule of law, government size, regulatory efficiency, and open markets on export sophistication. To measure economic freedom, the sub-indices of the economic freedom index provided by the Heritage Foundation are utilized. Export sophistication is measured using the index developed by Rodrik and Hausman. Generalized Method of Moments (GMM) is employed for the analysis. Control variables such as economic growth, foreign direct investment (FDI) and population data are included in the study. The annual data covers the period 2005-2019 for OECD countries.

The rest of this study is organized as follows: the second section, review of the literature. The third section outlines the data sources and methodology used for this study. Subsequently, the fourth section presents the empirical findings derived from our analysis. Finally, the last section concludes the study, summarizing the main findings and their implications.

2. Literature Review

The export sophistication is a measure of a country's ability to produce and export high-value goods and services. Rodrik (2006) introduced an export sophistication index (EXPY). It is influenced by various factors, including economic freedom (Atasoy, 2021). Economic freedom

refers to the extent to which individuals and businesses are free to engage in economic activities without government interference. Previous research shows that countries with higher levels of economic freedom tend to have higher levels of export sophistication. This is because economic freedom fosters entrepreneurship, innovation, and competition, which are critical for the development of high-value industries (Welter, 2017). By promoting market-based policies, reducing regulatory barriers, and protecting property rights, economic freedom creates an environment conducive to investment, technological progress, and the adoption of advanced production methods, economic freedom plays a crucial role in enhancing a country's export sophistication. By creating a favorable business environment, economic freedom enables countries to develop and export high-value goods and services, contributing to their economic growth and prosperity (Weldemicael, 2012; Atasoy, 2021).

The relationship between different aspects of economic freedom and export sophistication has been investigated in various studies. Haini (2023) found that the impact of export sophistication on economic growth diminishes as developing economies become more globalized, while advanced economies benefit more from export sophistication when globalization is at a higher level. This suggests that the relationship between economic freedom, globalization, and export sophistication is complex and context-specific. Jarreau & Poncet (2012) examined the effect of export sophistication on economic performance in China and found a positive relationship between the two variables. These studies suggest that countries with higher levels of economic freedom may have an advantage in developing and exporting higher quality goods.

However, the relationship between economic freedom and export sophistication is not universally consistent. Liu et al. (2022) found that the relationship between export sophistication and total factor energy efficiency varied depending on factors such as regional corruption score, economic development, and openness. Azam (2020) also highlighted that export sophistication and export diversification show a convergent effect, while export competitiveness shows a divergent relation with independent variables. In conclusion, the relationship between economic freedom and export sophistication is influenced by various factors such as the level of economic development, globalization, and region. While some studies suggest that economic freedom promotes export sophistication and economic growth, other studies highlight the complexity and variability of this relationship. Further research is needed to gain a more comprehensive understanding of the relationship between economic freedom and export sophistication.

Economic freedom index can be accepted as an indicator of institutional quality (Tang, 2019; Atasoy, 2020). The existing literature examines the influence of institutional quality on various aspects, including export sophistication. These studies indicate that institutions play a crucial role in enhancing export sophistication by providing firms with better property rights, a reliable legal system, and the rule of law. To capture the multidimensional nature of development, many studies combine institutional quality variables with indicators like economic freedom, trade openness, or capital deepening. Overall, the prevailing notion in the literature is that higher institutional quality supports export sophistication, as demonstrated by studies conducted by Spatafora et al. (2012), Tang (2019), Rehman & Ding (2020), Atasoy (2020), and Rehman & Sohag (2022). Weak institutions are identified as a significant

determinant of poor economic performance, as discussed by Acemoglu et al. (2005). Martincus & Gallo (2009) examined the impact of institutions on export sophistication, considering both direct and indirect effects. Their findings suggest that better institutions are positively associated with a higher share of exports, both directly and indirectly. However, Kocenda & Poghosyan (2018) discovered a negative relationship between institutional quality, specifically the rule of law, and export sophistication. They found that countries with stronger institutional quality exhibited lower levels of export sophistication. Additionally, Zhang & Yang (2016) investigated the influence of intellectual property protection on export sophistication. Their empirical analysis revealed that in developing countries, FDI and imports mediate the relationship between intellectual property protection and export development. In summary institutional quality significantly influences export sophistication. While most studies indicate a positive relationship, some research highlights the negative impact of institutional quality, particularly in relation to the rule of law. The role of intellectual property protection in export development is also explored, with FDI and imports found to play a mediating role in developing countries.

China has become a prominent player in export transformation and numerous studies focus on analyzing its export sophistication. Rodrik (2006) revealed that China possessed a similar level of export sophistication as countries with significantly higher income levels. This finding is identified as a crucial factor contributing to China's rapid economic growth. Notably, the key determinant for China's future growth lies not solely in the volume of its trade but rather in its ability to consistently produce higher-income products. Hausmann et al. (2007) and Schott (2008) found similar conclusions, providing support for this observation. On the other hand, Van Assche & Gangnes (2010) and Kuroiwa (2014) didn't observe exceptional sophistication in China's electronics exports in their study.

The literature frequently addresses the distinction made by Kocenda & Poghosyan regarding the main oil exporting countries. The relationship between natural resources and export sophistication can have positive effects in countries with high institutional quality, while it may have negative effects in countries with low institutional quality (Zhu et al., 2010). However, Weldemicael (2012) found that export sophistication is high in oil-exporting countries despite having poor institutional structures and production processes. The analysis excluded countries where over half of their total exports are oil, but the results remained unchanged. Variables related to institutional quality are found to have a negative impact on export sophistication. Furthermore, Fan (2021) revealed that abundant natural resources have a negative effect on technological export sophistication.

Yu & Hu (2015) examined the China's manufactured export sophistication. They found that its level is lower compared to general export sophistication. Additionally, both finished goods export sophistication and overall export sophistication in China are found to be lower than those of major OECD countries. In a study by Fan (2021) focusing on technological products, China's export sophistication in machinery and transportation equipment is assessed using data from five countries. Despite China's high export volume in these sectors, its technological export sophistication is found to be at a low level.

There have been several firm-level studies conducted on China as well. Li & Lu (2018) examined the impact of research and development (R&D) and financing constraints on green export sophistication of Chinese firms. Their findings indicated that relaxing corporate finance restrictions and increasing R&D funding positively influenced the green export sophistication of companies.

Demir & Hu (2021) investigated the effects of institutional similarity and firm heterogeneity on export sophistication using Chinese data. The study presented various results, including the observation that firms with lower productivity tended to export more sophisticated products to countries with similar institutional characteristics. Export-oriented firms demonstrated a higher propensity to export sophisticated products and were more influenced by corporate similarities. Firms exporting to geographically distant markets exhibited lower sensitivity to institutional differences. Firms with greater product diversity and lower export concentration tended to export more sophisticated products and displayed greater sensitivity to institutional similarities. Private firms were found to export more sophisticated products compared to public firms and showed lower sensitivity to institutional similarities. The significance of institutional similarities diminished when firms exported to countries with stronger institutional frameworks. Finally, firms heavily relied on contract enforceability were more likely to export sophisticated products to markets with similar institutional settings.

Li et al. (2022) examined export sophistication using micro-level data from Chinese firms. They investigated the effects of labor cost shocks and input substitution resulting from minimum wage increases on export sophistication. The study revealed a positive relationship between minimum wage increases and export sophistication. This is attributed to the reduction in sales of less-developed products and the relative increase in the sales share of more advanced products in current production. Liu & Wang (2022) explored the impact of FDI in the service sector on the overall export sophistication of Chinese firms. The study found that loosening access to FDI in the service sector in China contributed to an increase in total export sophistication. However, the export sophistication of domestic inputs decreased while the export sophistication of imported inputs increased. In another study by Song et al. (2022) utilizing enterprise data, it is discovered that imports of intermediate goods and independent innovation had a positive effect on export sophistication in China. However, there was also a certain substitution effect between imports of intermediate goods and independent innovation.

Numerous studies have examined the correlation between FDI and export sophistication, highlighting two primary mechanisms through which FDI can enhance export sophistication. Firstly, FDI enables host countries to access advanced technologies and expertise from foreign producers, facilitating the production of goods that the host country may be unable to produce independently due to resource limitations. This direct effect of FDI positively impacts the quality of goods produced, thereby promoting export sophistication. Secondly, FDI promotes knowledge diffusion from foreign firms to domestic industries, leading to indirect improvements in export sophistication through enhanced efficiency and productivity. This knowledge transfer is often referred to as "cost discovery." By leveraging insights gained from foreign firms through FDI, the host country can enhance its export sophistication. Existing literature consistently demonstrates a positive relationship between FDI and export

sophistication. Studies by Zhang & Yang (2016), Hüseyini & Çakmak (2019), and Fan (2021) support this finding. Lutz (2019) examined the impact of exports to developed economies on export sophistication in developing countries and found that such exports increase export sophistication, albeit with diminishing returns. Additionally, FDI and income had non-linear effects on export sophistication, with diminishing income levels exerting a decreasing effect. This suggests that earnings from exports to advanced economies tend to be higher. Rehman & Ding (2020) investigated the bidirectional causal relationship between FDI and export sophistication, revealing that FDI strongly promoted export sophistication while export sophistication only weakly encourages FDI.

The literature contains several studies investigating the relationship between FDI, both inward and outward, and export sophistication. Li (2019) conducted a study focusing on the BRICS countries and analyzed the impact of outward and inward FDI on the EXPY. Panel data analysis covering the period from 1990 to 2010 is utilized. The findings indicated that a 1% increase in outward FDI led to an approximate 0.1% improvement in export sophistication. However, inward FDI did not demonstrate a significant effect on export sophistication for the BRICS countries. Rehman & Sohag (2022) conducted an empirical analysis on the G20 countries and found a positive relationship between outward FDI and export sophistication. Their study revealed that outward FDI had a favorable impact on export sophistication levels. Li et al. (2020) focused specifically on China and examined the influence of inward and outward FDI on manufacturing export sophistication. The results indicated a strong and positive effect of both inward and outward FDI on China's manufacturing export sophistication. In summary, these studies provide insights into the impact of inward and outward FDI on export sophistication. While the effects may vary across countries, there is evidence suggesting that outward FDI can contribute positively to export sophistication in certain economies, including China and the G20 countries.

Numerous studies have examined the relationship between size of economy and export sophistication, consistently revealing significant and positive effects. Both GDP per capita and overall size of economy have been identified as key drivers of export sophistication. Interestingly, even during major economic crises, countries, both developed and developing, have shown a degree of stability in their export sophistication levels (Kocenda & Poghosyan, 2018). In a study by Lin et al. (2017) focusing on sub-Saharan Africa, the causal effect of export sophistication on income was investigated using panel data. The results indicated that a 1% increase in export sophistication is associated with a long-term increase of approximately 0.08% in GDP per capita. Another study by Abdmoula (2023) examined the impact of export sophistication on economic performance. The findings provided strong evidence for the positive influence of the manufacturing sector on economic performance, with high-tech and information communication technology products demonstrated a particularly significant positive effect. In conclusion, the literature consistently highlights the significant and positive relationship between size of economy, measured by GDP per capita, and export sophistication. Furthermore, studies suggest that export sophistication can contribute to long-term improvements in income and economic performance, particularly through the manufacturing sector and high-tech products.

The literature has extensively investigated the influence of human capital, education, and R&D on export sophistication. A consistent finding in these studies is a positive correlation between export sophistication and human capital (Rehman & Ding, 2020; Fan, 2021; Rehman & Sohag, 2022). Education has also been identified as a contributing factor to export sophistication, with studies indicating a positive relationship (Hüseyini & Çakmak, 2019; Atasoy, 2020). Similarly, research examining the link between R&D and export sophistication consistently reveals a positive association (Yu & Hu, 2015; Hüseyini & Çakmak, 2019; Atasoy, 2020). Overall, the literature emphasizes the importance of human capital, education, and R&D in driving export sophistication, highlighting their positive impact on this aspect.

The literature also includes studies highlighting the benefits of trade openness and trade facilitation on export sophistication. These studies consistently demonstrate that trade facilitation and openness to trade strongly support export sophistication (Rehman & Ding, 2020; Rehman & Sohag, 2022; Hu et al., 2022). This positive effect is observed in both developing and developed countries (Hu et al., 2022). Specifically, the elimination of customs duties has been found to have a positive impact on export sophistication (Nguyen, 2016). Furthermore, improvements in transportation infrastructure have been shown to contribute to both short-term and long-term increases in export sophistication (Rehman & Sohag, 2022). Moreover, the liberalization of trade in the services sector can also have an impact on export sophistication, particularly in developing countries (Su et al., 2020). Overall, these studies highlight the significant role of trade openness, trade facilitation, and improvements in transportation infrastructure in fostering export sophistication.

Other factors that positively affect export sophistication are digitalization (Atasoy, 2020), factor structure, financial development (Yu & Hu, 2015), technology, trade cost (Weldemicael, 2014), cultural diversity (Fan, 2018), energy consumption and renewable energy (Rehman et al., 2023).

3. Data and Methodology

In this study, the empirical analysis involves calculating the EXPY and examining the impact of economic freedom on export sophistication using the Generalized Moments Method (GMM). This section of the study will discuss the data coverage and methodology employed to conduct the analysis.

3.1. Data

Our model is based on the model in Ozsoy et al.'s (2021) study. While Ozsoy et al. (2021) used three indexes related to economic freedom in their model, four indexes were used in our model. While population and FDI in the Ozsoy et al. (2021) model were used as control variables, patent and savings variables were not used because the purpose of our study differed. In addition, when calculating export sophistication, it is weighted by GDP per capita and there is a very high positive relationship between them (Atasoy, 2020). For this reason, economic growth rate was used instead of GDP per capita in the study.

In the study, 15 years of data between 2005-2019 for 38 OECD countries were used to test the effect of economic freedom on export sophistication. The data set descriptions of the model

are in Table 1. Export sophistication (*lnexpy*) was calculated by the author using data from UN Comtrade (SITC Rev 3., 4-digit). Economic freedom indicators such as rule of law (*lnrlaw*), government size (*lngovs*), regulatory efficiency (*lnreg*) and open markets (*lnopm*) were taken from the Heritage Foundation database. Economic growth (*grw*), FDI (*fdi*) and population growth (*pop*) were included in the model as control variables. These control variables were obtained from the World Bank database. Export sophistication, rule of law, government size, regulatory efficiency and open markets are used in logarithmic values. FDI was measured as a percentage of GDP.

Table 1: Descriptive Statistics

| Variable | T*N | Mean | Median | Minimum | Maximum |
|---------------|-----|------|--------|---------|---------|
| <i>lnexpy</i> | 570 | 8.10 | 7.92 | 6.27 | 10.54 |
| <i>lnrlaw</i> | 570 | 6.53 | 6.62 | 5.81 | 6.86 |
| <i>lngovs</i> | 570 | 6.27 | 6.34 | 5.12 | 6.76 |
| <i>lnreg</i> | 570 | 6.61 | 6.60 | 6.21 | 6.86 |
| <i>lnopm</i> | 570 | 6.63 | 6.65 | 6.25 | 6.79 |
| <i>grw</i> | 570 | 2.30 | 2.34 | -14.83 | 24.37 |
| <i>pop</i> | 570 | 0.60 | 0.56 | -2.25 | 2.89 |
| <i>fdi</i> | 570 | 5.17 | 2.86 | -57.53 | 86.47 |

Table 1 contains descriptive statistics. This table includes the number of observations (T*N), mean, median, minimum value and maximum value. The mean and median values show the measures of central orientation. In other words, it shows where the center of the distribution is located.

3.2. Methodology

3.2.1. Export Sophistication Index

Export sophistication serves as an indicator of the value and variety of a country's export portfolio. It is commonly measured using three criteria: the EXPY, the export complexity index, and the ratio of high-technology exports to total manufacturing industry. This study specifically focuses on calculating and utilizing the EXPY, which has gained substantial recognition in the literature in recent years.

This study utilizes the EXPY, originally introduced by Rodrik (2006) and Hausmann et al. (2007). The authors introduced the PRODY and EXPY indexes, which evaluate the sophistication levels of export goods and a country's entire export basket, respectively. Equation (1) presents the equation for PRODY index.

$$PRODY_k = \sum_j \frac{\left(\frac{x_{jk}}{X_j}\right)}{\sum_j \left(\frac{x_{jk}}{X_j}\right)} Y_j \quad (1)$$

Where x_{jk} is exports of country j in sector k ; X_j is total exports of country j ; Y_j is the per capita income of country Y .

In other words, the PRODY of product k is determined by the proportion of k 's exports in country j (x_{jk}) relative to the combined export shares of k in all countries, taking into account

the per capita income (Y_j) of the exporting countries. Consequently, a greater PRODY score signifies a greater influence on the export sophistication of that particular product.

The EXPY level of a country's entire export basket can be computed as the weighted average of the sophistication index of each export in that country. Equation (2) outlines the process for calculating EXPY:

$$EXPY_i = \sum_l \left(\frac{x_{il}}{X_i} \right) PRODY_l \quad (2)$$

Where $EXPY_i$ indicates x_{il} is exports of country i in sector l ; X_i is total exports of country i ; $PRODY_l$ refers to the export sophistication of the product l .

The EXPY index, which is derived from the PRODY index, is used as a metric to measure export sophistication. A higher value of the EXPY index indicates a higher level of sophistication in a country's exports. The underlying concept behind the EXPY index is that economies benefit from producing goods that are exported by wealthier nations. Extensive literature supports the idea that the advancement of a country's exports is a significant indicator of its future growth prospects (Atasoy, 2020). This index demonstrates that a country's growth potential is not solely determined by the quantity of its exports but also by the nature of the goods it exports (Zhu & Fu, 2013). In summary, the EXPY index measures the overall productivity of an economy's export basket by assigning a specific productivity level to each individual good. A country is considered a higher-quality exporter if its export basket consists of goods with increased productivity.

3.2.2. Generalized Method of Moments

In classical regression models, zero conditional means is a critical assumption for valid predictions. However, this assumption; internality is invalid in a model that includes ignored variable bias and measurement errors (Baum, 2006). To eliminate this invalidity, the GMM method is used (Bilgili & Bağlıtaş, 2022).

In panel data analyses where dynamic analysis will be performed, GMM is one of the most appropriate methods for conditions such as the time dimension being smaller than the cross-section dimension ($T < N$) and the variables being weak exogenous or internal variables (Hayakawa, 2019).

The difference and system generalized method of moments (GMM) estimators are two approaches commonly used in panel data analysis. The difference GMM estimator, also known as the first-difference GMM estimator, is based on the differences between consecutive observations of the variables of interest. On the other hand, the system GMM estimator, also known as the level-difference GMM estimator, incorporates both the differences and the levels of the variables in the estimation process (Miao & Qamruzzaman, 2021; Abudurehman et al., 2022; Mateev et al., 2023). The main advantage of the system GMM estimator over the difference GMM estimator is its ability to address the endogeneity problem more effectively. The system GMM estimator introduces additional instrumental variables, including lagged values of the dependent variable, to control for potential correlation between the independent variable and the error term in dynamic panel data models (Abdouli & Hammami, 2015; Abudurehman et al., 2022). This helps improve the

validity of the estimation results compared to the difference GMM estimator (Abudurehman et al., 2022). Furthermore, the system GMM estimator is generally considered to be more efficient than the difference GMM estimator in terms of estimation precision (Omri et al., 2015; Tan & Floros, 2012). It provides more accurate estimates by utilizing both the differences and the levels of the variables, which can capture more information and reduce bias (Tan & Floros, 2012).

In economic models that make decisions under the influence of experience and behaviour patterns, lagged values of variables can be added to the model to increase the explanatory power of the model (Demez & Akyol, 2021). Panel data models containing the lagged values of the variables are called dynamic (Tatoğlu, 2012). In such models, there may also be individual effects whose error terms cannot be observed (Baltagi, 2005).

$$Y_{it} = \alpha Y_{i,t-1} + \beta'_{it} X + \mu_{it} \quad i = 1, \dots, N; t = 1, \dots, T \quad (3)$$

$$\mu_{it} = \mu_i + v_{it} \quad (4)$$

α β'_{it} $1 \times K$ ve X , $K \times 1$ dimensions in equation 3 represent matrices. It is assumed that it follows the one-way error component model.

In equation 4, μ_i shows properties that do not change over time. v_{it} represents random noise represents residual errors (Baltagi, 2008; Harris & Malatyas, 1999). $\mu_i \sim IID(0, \sigma_u^2)$ and $v_i \sim IID(0, \sigma_v^2)$ are independent error terms among and from each other. Since the dependent variable in equation 3 is a function of the error term, the lagged value of the dependent variable is also a function of the error term. For this reason, the lagged value of the dependent variable and the error term are correlated. This means a deviation from the strict externality assumption. Balestra & Nerlove (1966) suggested using an instrument variable that is not correlated with the error term and has a high correlation with the variable it will replace. However, if there is a unit effect that is not considered in such a model, the estimations become biased. By using fixed effects and first difference estimators, the problem of correlation of explanatory variables will be eliminated. In the first difference model, the estimates may be biased. This is because the $(Y_{i,t-1}, Y_{i,t-1})$ is not orthogonal to (μ_{it}, μ_{it-1}) . The use of an instrument variable together with the dependent variable, the first difference of which is taken, eliminates this problem.

Arellano & Bond (1991) used the GMM estimator first difference model. Execution of the first difference model with general means variable with matrices is as in equations 5 and 6. Equation 7 contains the GMM estimator. $\hat{\Omega}$ represents the covariance matrix of the error term.

$$Z' \Delta Y = Z' \Delta Y_{-1} + Z' \Delta X \beta + Z' \Delta u \quad (5)$$

$$Z' \Delta Y = \delta Z' \Delta X + Z' \Delta u \quad \Delta X = [(Y_{i,t-1} - Y_{i,t-2}), (X_{i,t} - X_{i,t-1})] \quad (6)$$

$$\hat{\delta}_{GMM} = (\Delta X' Z (Z' \hat{\Omega} Z)^{-1} Z' \Delta X)^{-1} (\Delta X' Z (Z' \hat{\Omega} Z)^{-1} Z' \Delta Y) \quad (7)$$

The Sargan test was proposed by Arellano & Bond (1991) to test the validity of instrumental variables. The externality of the instrumental variables used with the Sargan test is examined. If there is no correlation between model residuals and independent variables, it shows that it

is exogenous. The Sargan test is tested against the null hypothesis in the over-identification constraints valid statement.

$$s = \Delta\hat{u}Z(\sum_{i=1}^N Z'_i \Delta\hat{u}_i \hat{u}'_i Z_i)^{-1} Z' \Delta\hat{u} \sim X^2_{p-K-1} \quad (8)$$

In equation 8, there is the equation $Z_i = \text{diag}(Y_{i1}, \dots, Y_{im})$, ($m = 1, \dots, T - 2$). This equation the residues obtained from $\Delta\hat{u}$ two-stage estimation, p the number of columns of Z , s test statistic are distributed in $p-K-1$ degrees of freedom X^2 (Baltagi, 2005).

The absence of quadratic autocorrelation ($E(u_{it}u_{it-2}) = 0$) is a necessary condition for the GMM estimator to be effective. The residues obtained by Arellona & Bond (1991) are used to test the autocorrelation. The null hypothesis means that there is no autocorrelation (Demez & Akyol, 2021).

$$s_{ab} = \frac{\hat{u}_{-2}\hat{u}}{\hat{u}^{1/2}} \sim N(0,1) \quad (9)$$

The test statistics created by Arellona & Bond (1991) can be seen in equation 9. In the equation \hat{u}_{-2} is the vector of the residues that are delayed twice. Acceptance of the basic hypothesis means that the error term does not contain autocorrelation (Demez & Akyol, 2021).

4. Results

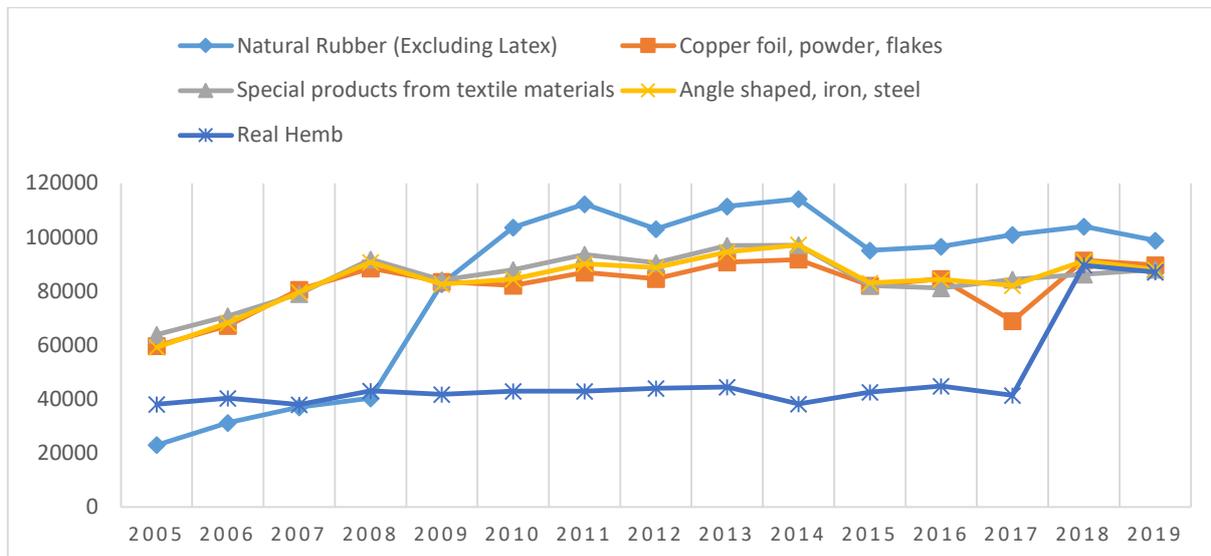
In this section, the results of the research will be analyzed in two subsections. In the first part, the data obtained as a result of the calculation of export sophistication will be presented while in the second part, GMM results will be presented.

4.1. Results of Export Sophistication Index Calculations

SITC Rev 3. 4-digit product groups from the United Nations Comtrade database and per capita GDP from Worldbank database are used to calculate PRODY and EXPY. The export data of approximately 900 product groups, each of which 38 countries export every year for 15 years, and the per capita GDP data of these countries in the relevant years are included in the calculation.

First, PRODY, which shows the productivity levels of the products, is calculated. The 5 product groups with the highest productivity are shown in Figure 1 for 2005-2019 period. Natural rubber is identified as the most productive product group and its productivity level increased significantly between 2008 and 2011. While the next three product lines are flat, hemp nearly doubled its productivity level between 2017 and 2018. All of these products are known to be an important source of intermediate goods for many valuable products. For example, hemp is used in many fields such as pharmaceutical (medical), paper making, fuel making, fabric making, automotive industry and cosmetics (UN Report, 2022).

Figure 1: The Five Most Productive Product Lines (2005-2019)



Sources: Author's calculations, UN Comtrade Database and Worldbank Database

Table 2 shows the EXPY results of OECD countries for the years 2005-2012-2019. All countries have a better EXPY in 2019 compared to 2005. However, the EXPY value of Australia, Chile, Colombia, Luxembourg, Mexico and Norway decreased in 2019 compared to 2012. The country with the highest EXPY value in 2005 and 2019 is Iceland. In 2012, Norway had the highest EXPY value. The countries that increased the EXPY value the most between 2005-2019 are Israel, Australia and Luxembourg, respectively. When the years 2005-2012 are compared, all of the countries increased the EXPY value and the countries that increased the most are Australia, Norway and Luxembourg, respectively. When comparing the 2012-2019 years, Australia, Canada, Chile, Colombia, Luxembourg, Mexico and Norway considered the EXPY value, while Iceland, Israel and Ireland are the countries that increased the most.

When we look at the EXPY values in general, it is seen that the countries performed better in the 2005-2012 period compared to the 2012-2019 period. The reason for this can be seen in the data on global exports of goods and services. While global exports of goods and services increased by less than \$1 trillion between 2012 and 2019, it increased by nearly \$10 trillion in the period 2005-2012 (Worldbank). This increase in global trade also had a positive impact on the export sophistication of OECD countries.

Table 2: EXPY Results

| Countries | 2005 | 2012 | 2019 | Countries | 2005 | 2012 | 2019 |
|------------|-----------|-----------|-----------|----------------|-----------|-----------|-----------|
| Australia | 29,318.29 | 49,158.85 | 43,824.75 | Japan | 29,709.66 | 37,066.42 | 39,562.71 |
| Austria | 29,327.61 | 37,601.56 | 38,998.42 | Latvia | 24,151.39 | 32,990.24 | 35,439.42 |
| Belgium | 30,856.14 | 38,607.40 | 41,747.98 | Lithuania | 23,661.28 | 34,432.19 | 36,658.05 |
| Canada | 31,716.77 | 40,543.60 | 40,472.33 | Luxembourg | 39,477.15 | 53,868.94 | 53,144.12 |
| Chile | 16,196.20 | 26,427.47 | 25,274.33 | Mexico | 27,841.17 | 34,255.26 | 33,290.30 |
| Colombia | 28,065.29 | 42,014.65 | 37,410.07 | Netherlands | 30,287.96 | 37,026.80 | 39,503.19 |
| Costa Rica | 25,103.86 | 30,394.17 | 34,450.37 | New Zealand | 29,410.95 | 38,670.89 | 41,237.13 |
| Czechia | 27,259.60 | 34,351.31 | 36,394.46 | Norway | 39,998.05 | 55,759.62 | 48,318.93 |
| Denmark | 31,447.70 | 38,283.14 | 40,315.58 | Poland | 25,432.01 | 33,005.21 | 35,154.14 |
| Estonia | 25,745.58 | 34,086.97 | 36,072.30 | Portugal | 25,722.12 | 33,265.31 | 34,830.80 |
| Finland | 30,202.33 | 38,863.15 | 40,711.57 | Rep. of Korea | 27,835.94 | 34,824.19 | 39,343.71 |
| France | 30,251.64 | 38,487.30 | 40,858.16 | Slovakia | 26,590.75 | 32,561.57 | 34,535.07 |
| Germany | 30,096.90 | 37,664.14 | 39,716.57 | Slovenia | 27,844.80 | 36,044.71 | 38,666.20 |
| Greece | 26,947.12 | 35,847.96 | 39,308.22 | Spain | 28,280.59 | 36,296.59 | 37,934.08 |
| Hungary | 26,878.79 | 33,371.92 | 36,056.58 | Sweden | 30,035.53 | 37,876.60 | 39,506.26 |
| Iceland | 43,402.35 | 45,407.72 | 55,493.90 | Switzerland | 36,124.88 | 47,873.49 | 48,634.21 |
| Ireland | 36,337.21 | 43,095.94 | 49,146.07 | Turkey | 23,854.18 | 34,277.96 | 35,270.62 |
| Israel | 27,961.82 | 37,166.82 | 43,555.58 | United Kingdom | 31,488.68 | 39,467.06 | 41,692.38 |
| Italy | 28,724.09 | 37,096.76 | 38,806.42 | USA | 30,223.81 | 38,052.82 | 40,620.21 |

Sources: Author's calculations, UN Comtrade Database and Worldbank Database

In summary, it is seen that the product groups with the highest productivity are some intermediate goods used in the production of important products. Looking at the results of export sophistication, it is seen that Northern European countries are successful.

4.2. Results of GMM

In this section, necessary tests before and after GMM and GMM results are mentioned. In the following sections of this section, unit root test, model results and autocorrelation test results are given in order.

4.2.1. Unit Root Test

Appropriate tests should be used in stagnation analyses, taking into account the size of the panel data set (T=15). In this context, the Fisher (1932) test is preferred. When performing Fisher-type analysis, extended Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests are applied to each panel.

Table 3: Unit Root Test

| Variables | ADF (Fisher-chi-square) | ADF (Choi Z statistic) | PP (Fisher -chi-square) | PP (Choi Z statistic) |
|---------------|-------------------------|------------------------|-------------------------|-----------------------|
| lnexpy | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| lnrlaw | 0.0835 | 0.0531 | 0.0195 | 0.0331 |
| lngovs | 0.4061 | 0.0796 | 0.0004 | 0.0004 |
| lnreg | 0.4191 | 0.3158 | 0.0000 | 0.0000 |
| lnopm | 0.0001 | 0.0002 | 0.0000 | 0.0000 |
| grw | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| fdi | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| pop | 0.0000 | 0.0000 | 0.0838 | 0.7792 |

The probability values are given in Table 3. For the series to be stationary, the probability value must be less than 0.05. According to the unit root test results, all variables are stationary at least two types of tests.

4.2.2. Model Result

$$\ln expy_{it} = \beta_0 + \beta_1 \ln expy_{it-1} + \beta_2 \ln rlaw_{it} + \beta_3 \ln gov_s_{it} + \beta_4 \ln reg_{it} + \beta_5 \ln opm_{it} + \beta_6 grw_{it} + \beta_7 fdi_{it} + \beta_8 pop_{it} + u_{it} \quad (10)$$

The model of our study, seen in Equation 10, was estimated by first difference and system GMM methods. In addition, fixed effects least squares (LSQ) method is used for robustness control and comparison. The results of the estimations are shown in table 4 and values in parentheses indicate probabilities.

Fixed effect and random effect models are estimated, in order to decide which of these two models is statistically valid applying Hausman (1978). In the Hausman's test the null hypothesis is that the Random Effect Model is appropriate for the estimation of the model whereas the alternative hypothesis is that the Fixed Effect Model is appropriate. According to the Hausman test in table 4, it is decided that estimating the fixed effects would be more accurate.

The results of the three estimators are similar. Rule of Law (lnrlaw), Government Size (lngovs) and Open Markets (lnopm) positively affect export sophistication. However, Regulatory Efficiency (lnreg) isn't a statistically significant. When we look at the effect of control variables on export sophistication, growth rate is positive and significant, population is positive and significant for two estimators, and FDI is positive and insignificant for both estimators.

Table 4: GMM Result

| Variables | Fixed Effects LSQ | First-Difference GMM | System GMM |
|---|-----------------------|-----------------------|-----------------------|
| Inexpy(-1) | - | 0.529262 (0.0000) | 1.220914 (0.0128) |
| Inrlaw | 0.576060 (0.0000) | 0.376671 (0.0293) | 0.557862 (0.0000) |
| Ingovs | 0.310709 (0.0002) | 0.267136 (0.0000) | 0.791445 (0.0301) |
| Inreg | -0.225074 (0.2964) | 0.202357 (0.1870) | -2.210413 (0.2426) |
| Inopm | 0.342234 (0.0069) | 0.915868 (0.0000) | 0.240923 (0.0000) |
| grw | 0.005787 (0.0082) | 0.007870 (0.0000) | 0.020922 (0.0000) |
| fdi | 0.000168 (0.8212) | -0.002207 (0.0335) | 0.004009 (0.0180) |
| pop | 0.100690 (0.0000) | 0.005824 (0.6359) | 0.194499 (0.0014) |
| Hausman (1978) test statistics (Chi-Sq.) | 29.3155 (0.0001) | - | - |
| Sargan (Hansen J-statistics) | - | 36.487 (0.192) | 37.925 (0.258) |
| Wald test | | 62.431 (0.000) | 10.3829 (0,034) |
| AR (1) | - | -2.949 (0.003) | -2.048 (0.040) |
| AR (2) | - | -1.212 (0.225) | -1.042 (0.297) |

In the GMM analysis, a final check should be made whether a valid estimate has been produced. The first condition for generating a valid estimate is the presence of first-degree autocorrelation in the error terms of the series and the absence of second-degree autocorrelation. Table 4 indicates the autocorrelation test results. According to results the model estimated satisfies both conditions in the autocorrelation criterion. The probability value of AR (1) should be less than 0.05 and the probability value of AR (2) should be greater than 0.05. In addition, according to the Sargan test results, the instrumental variables used in the model are valid. the Hansen-J statistic should take a value that will result in the acceptance of the hypothesis in the null hypothesis that excessive definition constraints are valid. In this way, a valid tool is used. Values less than 0.10 and greater than 0.25 indicate that there is a problem due to the risks it carries (Roodman, 2009). In the table 4, it means that the value of 0.192 and 0.25 is in the band of 0.10-0.25, so the ADs are valid and do not exceed the N dimension. According to the Wald test results, the model is generally significant.

5. Conclusion

In this study, it is aimed to empirically analyze the effect of sub-indices of economic freedom namely rule of law, public sector size, regulatory efficiency and open markets on export sophistication in OECD countries using 2005-2019 annual data. The method of the study is determined as GMM.

The GMM panel results indicate that the rule of law, government size and open market positively and significantly affect export sophistication. On the other hand, regulatory efficiency affects export sophistication negatively. However, the result is statistically insignificant. These results show that improving rule of law, government size and open market in OECD countries also improves export sophistication.

The positive effect of the rule of law on export sophistication consistent with Hwang & Rodric (2007), Zhang & Yang (2016), Hüseyini & Çakmak (2019), Zarzoso & Ramos (2019), Atasoy (2020) and Seyoum & Abraham (2022). Rule of law includes property rights and corruption prevention. The rule of law, in the presence of a reliable legal system, contributes to the increase of trade and investments, thus increasing export sophistication. A strong legal system creates an environment of economic stability and trust, which can increase the quality and value of the products and services the country exports.

Government size is another factor that positively affects export sophistication. The positive effect of public sector size on economic sophistication is also found in Nguea & Fotio (2022) and Nguea et al. (2022). The size of the government can be thought of as the size of the state's investments in the economy and infrastructure projects. Infrastructure investments such as education, health, transportation and communication can affect the competitiveness and sophistication level of exports. Well-developed infrastructure helps exporters reduce production costs, improve the quality of products and services, and gain competitive advantage in international markets. Alichii et al. (2019), Dempere & Pauceanu (2022) and Bolkvadze (2022) also support this idea. In addition, the public sector can support innovation through investments in R&D. Government investment in R&D activities can increase export sophistication by contributing to the development of new technologies and products. It is also found in Wang & Wei (2008).

Open markets positively and significantly affect export sophistication. Open markets include commercial freedom, investment freedom and financial freedom. It is expected to have a positive effect on export sophistication, as the removal of measures such as tariffs and quotas affects this variable positively. The direct effect on export development is not examined in the literature. However, there are studies on open markets (or its sub-indices) and economic growth. Positive relationship between them is found by Hussain & Haque (2016) and Singh & Gal (2020). To increase the export development of countries, measures such as tariffs, quotas, export taxes, direct trade bans that deter trade should be used less or not at all. It also provides opportunities and incentives for a free investment climate, greater productivity and entrepreneurship. An enabling environment like this brings benefits not only to companies that take entrepreneurial risks in search of higher returns but also to society as a whole. However, for these benefits to be realized, it is essential to have an accessible and well-functioning formal financial system that offers a range of savings, credit, payment, and



Öztürk, F. & Topcu, Y. (2024). The Effect of Economic Freedom on Export Sophistication in OECD Countries. *Fiscoeconomia*, 8(1), 126-148. Doi: 10.25295/fsecon.1345968

investment services to individuals and businesses. In a free banking environment, there is an expansion of financing opportunities, fostering an atmosphere of encouragement for entrepreneurship. It is also supported by Helpman et al. (2007), Arisman et al. (2021) and Torres et al. (2022).

Economic freedoms play a crucial role in influencing the sophistication of exports within a country. The level of economic freedom directly affects a nation's ability to engage in diversified and advanced export activities. When a country enjoys high economic freedom, characterized by minimal government intervention, low regulatory burdens, and open market competition, it creates an environment conducive to innovation and specialization. This, in turn, fosters the development of more sophisticated and value-added export products. Economic freedom empowers businesses to make independent decisions, invest in research and development, and adapt to changing market demands. By encouraging entrepreneurship and market-driven forces, economic freedom contributes significantly to enhancing a country's export sophistication, ultimately leading to a more competitive and resilient economy on the global stage.

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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 Fiscaeconomia Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazarlarına aittir.

Yazar Katkısı: Yazarların katkısı aşağıdaki gibidir;

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Introduction: 1. author

Literature: 2. author

Methodology: 1. author

Conclusion: 2. author

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