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DOES GVC PARTICIPATION ENHANCE ECONOMIC PERFORMANCE? EVIDENCE FROM THE TURKISH MANUFACTURING SECTOR*

Küresel Değer Zincirine Katılım Ekonomik Performansı Artırır mı? Türkiye İmalat Sanayinden Bulgular

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Keywords:
Global Value Chains, Production Fragmentation, Trade in Value-Added, CS-ARDL

JEL Codes:
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Abstract

This study investigates the potential economic gains for the Turkish economy from increased participation in Global Value Chains (GVCs). Participation in GVCs enables more specialized production processes, enhancing economic efficiency and leading to increased exports, value added, and employment. This study uses the CS-ARDL method through a triple regression model to estimate the effects of forward and backward GVC participation on exports, the influence of increases in exports on the share of domestic value-added in exports, and the effects of export-driven domestic value-added on employment. The research employs OECD's Trade in Value Added (TiVA) data covering the period 1995-2020 and 17 manufacturing sub-sectors of Türkiye. Findings indicate that both forward and backward participation in GVCs positively influence export performance. Increases in exports decrease the share of domestic value-added while increasing the share of foreign value-added in exports, suggesting high foreign input dependency in Türkiye's exports. Although the share of domestic value-added in exports decreases, its overall size still increases. Rises in domestic value-added also increase employment. The research shows that policies aimed at Türkiye's deeper integration into GVCs can support exports and employment.

Anahtar Kelimeler:
Küresel Değer Zincirleri, Üretimin Parçalanması, Katma Değer Ticareti, CS-ARDL

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Öz

Bu çalışma Türkiye ekonomisinin küresel değer zincirlerine (KDZ) katılımını artırması yoluyla elde edebileceği ekonomik kazanımları araştırmaktadır. KDZ'ne katılım, üretime ilişkin görevlerde ileri uzmanlaşma sağlamaktadır. Bu ekonomik verimliliği artırmakta ve böylece ihracat, katma değer ve istihdam artışına yol açmaktadır. Bu çalışmada Türkiye'nin KDZ'ne ileri ve geri yönlü katılımının ihracata, ihracat artışlarının yurt içi katma değerin ihracattaki payına ve ihracata bağlı yurt içi katma değerin istihdama etkileri üçlü bir regresyon modeli üzerinden CS-ARDL yöntemi ile tahmin edilmiştir. Araştırmada Türkiye ekonomisi için 1995-2020 dönemini ve 17 imalat sanayi alt sektörünü kapsayan OECD'nin Katma Değer Ticareti verileri kullanılmıştır. Bulgulara göre KDZ'ne hem ileri hem de geri yönlü katılım ihracat performansını olumlu etkilemektedir. İhracattaki artışlar ihracattaki yurtiçi katma değerin payını azaltmakta ve yabancı katma değerin payını artırmaktadır. Bu bulgu Türkiye'nin ihracatta yabancı girdi bağımlılığının yüksek olduğuna işaret etmektedir. Yurtiçi katma değerin ihracattaki payı azalsa da büyüklüğü yine de artmaktadır. Yurt içi katma değerdeki artışlar da istihdamı olumlu etkilemektedir. Araştırma Türkiye'de KDZ'ne katılımı artırmaya yönelik politikaların ihracatı ve istihdamı destekleyebileceğini göstermektedir.

* This article is derived from the PhD dissertation by Ali Benli titled "Harnessing Global Value Chains in International Trade: Effects on Türkiye's Exports, Domestic Value Creation and Employment".

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1. Introduction

Global value chains (GVCs) refer to the worldwide division of production, where the different stages and roles involved in manufacturing are distributed across different countries. The international division of production has been facilitated by the liberalization of trade and investments, reductions in shipping costs, advancements in information technologies, and innovations in logistics. The expansion of GVCs since the 1990s has played a key role in accelerating the growth of global trade volume. Approximately 43% of global merchandise trade in 2020 occurred within GVCs (World Bank, 2024).

GVCs consist of highly complex production and trade relationships. In today's global economy, trade is not just about the exchange of final goods; trade in services, intermediate goods, and specific production tasks is also growing rapidly. In some advanced manufacturing sectors, final products and their associated services are not produced in a single location or simultaneously. In GVCs, various components of a product, including its service content, are produced in different locations in the world, resulting in the final product through a sequence of stages. The phenomenon of allocating production stages to different regions across the world is known as global production fragmentation. As with the production of final goods, firms may also hold comparative advantages in specific stages of the production process. The key determinant of the international fragmentation of production is the varying levels of comparative advantage that firms hold at different stages of production. Comparative advantages in production stages stem from advanced specialization levels in the respective stages. Such comparative advantage can also stem from critical natural resources that a country holds.

Consequently, the most specialized producers in those stages globally are assigned to critical production stages in GVCs. This lowers production costs while improving the quality of the final product. Strong international trade in intermediate goods and services is a result of this kind of production structure. Over the past three decades, the volume of international trade has grown at a never-before-seen rate as a result of this shift in production and trade. New methods were required because the nature of these intricate production patterns could not be adequately explained by traditional methods and tools of trade theory. There are important theories try to explain how GVCs appear. They are Baldwin's Unbundling Economies, Trade in Tasks, and the Production Fragmentation Theory.

The process of globalization has accelerated the fragmentation of production on a global scale, leading to the emergence and expansion of GVCs. This transformation has significantly changed countries' strategies for economic integration. Developed countries, benefiting from technological advantages and capital accumulation, have secured positions in the high value-added segments of the chain. In contrast, developing countries have sought entry into GVCs through their low-cost labor and production capacities. This has led to increasing competition between developed and developing countries for deeper integration into GVCs. While developing countries strive to move up to higher value-added stages, developed countries seek to maintain their existing advantages in these segments. Such competition affects not only trade and production structures, but also in efforts to attract investment, facilitate technology transfer, and generate employment.

Expanding GVCs benefits all nations economically. By accelerating economic growth, GVCs reduce poverty and increase incomes. The World Bank (2020) found that 1% GVC

participation increases per capita income by over 1%. The source of these economic gains primarily lies in productivity increases driven by the international fragmentation of production. For developing countries, being effective in GVCs and generating income is not solely dependent on engaging in high value-added activities within GVCs. Significant income can also be generated from GVCs by specializing in the lower value-added stages of the value chain. The crucial aspect is to integrate into GVCs at stages where a high level of comparative advantage is attained. The key is to integrate into GVCs at stages where a high level of comparative advantage is held. Countries with a comparative advantage in critical tasks and high productivity can become strong global suppliers in those activities. Thus, developing countries can increase their export revenues by benefiting from GVCs.

Due to the effects mentioned above, industrialization and trade specialization based on GVCs could present a significant opportunity for Türkiye's economy to achieve rapid growth, increase its share in global trade, and consequently boost employment. Today, approximately 42% of Türkiye's exports occur within GVCs. Türkiye has the potential to increase its share in GVCs due to certain characteristics and is a strong candidate to become a key supplier within GVCs. First, Türkiye's geopolitical position provides a significant advantage. Geographically, Türkiye is located at the intersection of Europe, the Middle East, and Africa, which together constitute a substantial global market. Moreover, Türkiye holds a strategic advantage due to its proximity to the European mainland and its Customs Union with the EU.

This study investigates the hypothesis that increased participation in GVCs will lead to exports, employment and domestic value-added in Türkiye. The literature contains numerous case studies examining the value chains of specific products. Case studies are limited analyses and do not provide information about the economy's position within GVCs. In GVC research, country-level studies are also frequently encountered. In this study, a more comprehensive approach has been adopted. Sector-level studies are quite limited. The hypothesis proposed in this study has been investigated within the scope of Türkiye's manufacturing sectors. Additionally, this study examines trade volumes using value-added trade data instead of gross trade data, providing a clearer understanding of the value Türkiye generates in international trade. Analyzing GVC effects at the sectoral level and focusing on value-added in trade enhances the originality of the study and it is believed to make a contribution to the literature.

2. Theoretical Backgrounds

Classical trade theory is built on three key assumptions: (i) constant returns to scale in production, (ii) firms operating within economies are homogeneous in terms of productivity, and (iii) economies focus on producing and exporting only the final goods in which they hold a comparative advantage. Advances in trade theory have emerged as these assumptions were progressively re-examined. First, Helpman and Krugman (1985) laid the foundation for the New Trade Theory by challenging constant returns to scale assumption and introducing the concept of increasing returns to scale in production. Second, studies led by Melitz (2003) revisited the assumption that all firms operating within the same industry are homogeneous in terms of productivity and technology. Unlike classical theory, the Melitz Model acknowledges that firms within the same industry can differ in their productivity levels, technological capabilities, and ability to compete in global markets.

According to the third assumption, global trade involves only final goods, which are consumed in the importing country and are not subject to re-export. However, this assumption no longer fully reflects the current structure of international trade. Today, trade in raw materials and intermediate goods accounts for approximately 43% of total merchandise trade (World Bank, 2024). Moreover, these inputs often cross borders multiple times. While the volume of global trade is rapidly increasing, its composition and direction are also changing. Trade theory continues to evolve in response to these practical changes. At the same time, each new approach is built upon traditional foundations. The principles of comparative advantage and specialization in production, introduced by Adam Smith and David Ricardo, remain valid. However, new explanations are being developed to better understand the causes and consequences of these concepts.

Recent studies in trade theory particularly focus on the increasing share of intermediates and raw materials in global trade. These approaches, which form the basis of the GVC paradigm, are also referred to as the New-New-New Trade Theory (Inomata, 2017). According to the GVC approach, significant advancements in transportation, information, and communication technologies enable the "slicing" of production processes into various stages (Krugman, 1995). These production stages include product design, component manufacturing, sourcing, assembly, and distribution. These stages are allocated across regions based on countries' comparative advantage characteristics. Accordingly, in reality, not only final goods move across borders as predicted by classical theory, but also intermediate goods, production stages, and consequently, value-added are transferred as well.

GVCs and deep specialization, which are based on the reconsideration of the third assumption of classical theory, were initially examined within the framework of Balassa's Revealed Comparative Advantage (RCA). Subsequently, the theoretical framework expanded with various concepts such as the production fragmentation (Jones and Kierzkowski, 1990), offshoring (Arndt, 1997), vertical specialization (Hummels et al., 2001), outsourcing (Grossman and Helpman, 2005), vertical specialization networks in GVCs (Feenstra and Hanson, 2001), Baldwin's (2006) unbundling economies, and trade in tasks (Grossman and Rossi-Hansberg, 2008). The following section will discuss the theoretical approaches explaining the formation of GVCs.

GVC paradigm emerged as a result of efforts to understand the nature of the globalization of production and trade. Gereffi (1994) first introduced "global value chain". Gereffi and Fernandez-Stark (2016) define a value chain as producers and workers' activities from product design to consumption. These include R&D, design, production, marketing, distribution, and after-sales services. The World Bank (2020) defines a value chain as a series of industrial stages that incrementally add value. A GVC has at least two stages in different countries.

2.1. Production Fragmentation

The fragmentation of production is one of the most significant impacts of globalization on production processes. This fragmentation is driven by various structural and economic factors. First, firms are relocating labor-intensive stages of production to developing countries to reduce production costs. Moreover, advancements in communication and transportation technologies have made it both technically feasible and economically advantageous to spread production

activities across multiple countries. At the same time, countries and firms aim to secure a position within GVCs by specializing in specific stages of production. Another factor accelerating this process is the ability of multinational corporations to establish global production networks. Altogether, these dynamics have led to the emergence of an increasingly fragmented and decentralized global production system.

Towards the end of the twentieth century, there was a significant decrease in the proportion of inter-industry trade within overall trade, whereas the proportion of intra-industry trade saw a substantial rise. The significant rise in intra-industry trade is largely attributed to the growth in intermediate goods trade (Ando, 2006). During the same period, it was observed that producers in developed countries segmented their production processes and relocated different stages of their production chains to various regions or countries. This phenomenon was first described by Jones and Kierzkowski (1990) as the "international fragmentation of production." Krugman (1995) referred to this phenomenon as "slicing up the value chain," while Feenstra and Hanson (1995) described it as "offshoring", Feenstra (1998) termed it "disintegration of production", Arndt (1998) called it "intra-product specialization" and Hummels et al. (2001) identified it as "vertical specialization". The necessary conditions for global production fragmentation are as follows: (i) The production of a good must occur in two or more sequential stages, (ii) Value must be added during production in two or more countries, and (iii) At a minimum one country must incorporate imported inputs into its manufacturing operation and export a portion of the resulting output (Hummels et al., 2001).

When international trade is evaluated solely based on final goods, it becomes difficult to explain intra-industry trade solely through Ricardian productivity differences or Heckscher-Ohlin factor endowment-based comparative advantage (Jones and Kierzkowski, 2001). However, if separate stages of production are treated as distinct products, applying H-O and Ricardian productivity theories to individual stages of production provides reasonable explanations for intra-industry trade. From this perspective, differences in countries' relative factor endowments can lead to the international fragmentation of production. Labor-intensive stages of production may take place in labor-abundant, low-wage countries, while capital-intensive stages are more likely to be conducted in capital-abundant countries. Thus, the emergence of intra-industry trade can be explained through Production Fragmentation Theory.

The international fragmentation of production allows industries to achieve a higher level of specialization. A country may specialize in the production of a specific final product. However, it does not necessarily have to hold a comparative advantage in every stage of its production process. The country may face comparative disadvantages in certain stages of the product's value chain. In such cases, it can either outsource these stages to countries with a cost advantage or procure them from those countries. Consequently, the production process can be geographically distributed according to countries' comparative advantages at different stages. Antràs (2020a) refers to the phenomenon where firms or industries achieve a high degree of specialization in specific tasks or production stages, resulting from production fragmentation as "hyper-specialization." Such specialization significantly reduces unit production costs, thereby enhancing comparative advantage and competitiveness in individual production stages. Moreover, since the 1990s, advancements in the services sector (Jones and Kierzkowski, 1990) and innovations in communication and information technologies (Acemoglu and Autor, 2011) have further accelerated the production fragmentation process.

Fragmenting production involves certain costs. Since production occurs in different locations and is carried out by various firms, it requires stringent coordination. Production coordination leads to additional costs in transportation, communication, and insurance. There is a trade-off between the costs incurred to coordinate production units located at distant points and the cost advantages provided by fragmenting production. Fragmenting production becomes economically viable when it sufficiently reduces unit costs to justify the associated coordination expenses. If coordination is required at an international level, these costs tend to be even higher. In summary, the decision to fragment production is made by evaluating the benefits against the incurred costs (Jones and Kierzkowski, 1990).

2.2. Baldwin's Unbundling Economies

Baldwin's concept of unbundling offers a distinct perspective on the phenomenon of international fragmentation of production. The unbundling concept underlines the declining need for economic activities to be carried out at the same site and simultaneously, due to cuts in transportation, communication, or face-to-face interaction expenses (Baldwin, 2016). Historically, Baldwin claims, global production has gone through three major phases; he credits changes between these phases to decreases in three major cost drivers. These are the expenses related to goods trade: transportation expenses, communication expenses required for coordinating among several sites, and the expenses connected with personal interaction, which entail physically gathering individuals.

The development of new transportation technologies and the associated logistical improvements have reduced the costs of goods trade, leading to the first unbundling. Advances in information and communication technologies, on the other hand, have reduced communication costs, which has led to the second unbundling, or the geographic spread of manufacturing operations. Currently, the costs associated with face-to-face interaction, which involve bringing people together to generate knowledge and innovation, are decreasing, facilitating the ongoing process of the third unbundling.

2.3. Trade in Tasks

Trade in tasks is another approach to explaining the fragmentation of production. In this approach, the concept of a task is defined as discrete jobs or processes within the production sequence of a product or service. Trade in tasks refers to firms purchasing certain activities in the production process from other firms. Previously, trade in tasks was limited to activities outside firms' core activities, such as human resources management, sales, and marketing. However, recent technological advancements have enabled the fragmentation of even core activities into distinct tasks across firms (Contractor et al., 2010). The trade in tasks approach was initially proposed by Grossman and Rossi-Hansberg (2008). They defined trade not merely as an exchange of goods, but as a process where value is added to the goods at different locations. Trade in tasks approach fundamentally offers those different stages of production require different labor qualifications. Grossman and Rossi-Hansberg (2008) developed a comprehensive theoretical model to analyze the effects of offshoring tasks on the relative demand for skilled and unskilled labor, and the subsequent impacts on wages and employment. The model suggests that firms can segment their production processes into specific tasks and

allocate these tasks to different regions based on comparative advantage, labor costs, and other factors. Trade in tasks also supports exports and economic growth through productivity increases (Baldwin and Robert-Nicoud, 2014). Overall trade in tasks facilitates countries' specialization in specific tasks, optimizes global production, and promotes the development of intermediate goods trade, thereby serving as one of the driving forces behind the evolution of GVCs (Gereffi et al., 2005; Baldwin and Venables, 2013).

Trade in tasks can also have some negative effects. It increases countries' dependency on each other, making them more sensitive to global shocks (Antràs, 2020b). The trade in tasks approach also implies that trading tasks will alter income distribution through its impact on labor markets. Trade in tasks raises the relative demand for skill-intensive tasks in advanced economies, while it results in greater demand for low-skilled tasks in developing economies. This situation can lead to unemployment in production factors experiencing demand decline and cause a deterioration in income distribution in the economy. The most negatively affected group is generally the unskilled labor force (Feenstra and Hanson, 1999; Hummels et al., 2018).

3. GVC Participation of Türkiye

Participation in GVCs is typically analyzed through two key components: forward and backward participation ratios. Backward participation refers to the share of foreign value added embedded in a country's gross exports, while forward participation captures the share of domestic value added that is embodied in other countries' exports through intermediate goods (OECD, 2023). These indicators are based on the decomposition method proposed by Koopman et al. (2014), and the data used in this study are sourced from the OECD's Trade in Value Added (TiVA) database. Participation data is directly provided as calculated ratios by the OECD. As such, they enable a comparative assessment of countries' positions within GVCs. These indicators provide insight into the extent to which national production processes are integrated into global networks and the degree of dependence on foreign inputs.

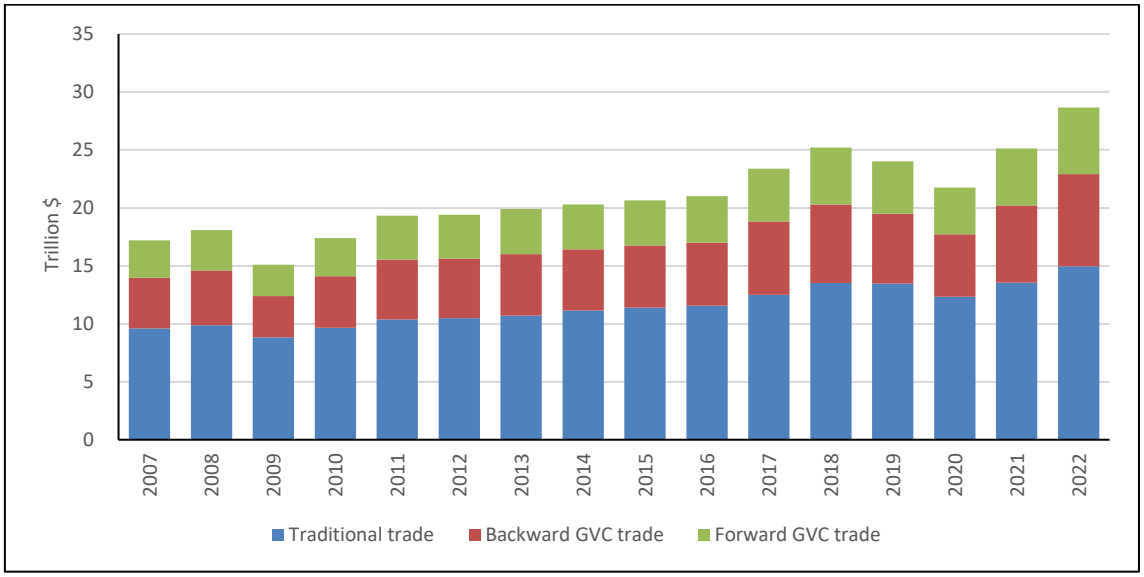

Figure 1. Composition of World Exports (in Trillion $)
Source: Asian Development Bank, MRIO Database

The size and share of GVCs in world trade are fast growing as production gets more globalized and trade restrictions fall. Global export volume rose from $17.2 trillion in 2007 to $28.7 trillion in 2022 (Figure 1). GVC trade in exports has also grown rapidly. Backward GVC trade rose from $4.3 trillion in 2007 to $8 trillion in 2022. Forward GVC trade also rose from $3.2 trillion to $5.7 trillion (ADB, 2024). The shares of these amounts within total exports serve as indicators of GVC participation. Forward and backward GVC participation indicators reveal the flow of intermediate goods among countries that are involved in GVCs (UNCTAD, 2013). In 2022, the backward GVC participation rate was approximately 27.9% ($8T / $28.7T), while the forward participation rate was around 19.9% ($5.7T / $28.7T). Combined, they indicate a total GVC participation rate of nearly 47.8% of global exports.

Türkiye's The Twelfth Development Plan (2024-2028) of Türkiye emphasizes the transformation into a technology-intensive, high-value-added, export-oriented production structure that meets global standards (Presidency of Strategy and Budget, 2023). To achieve the targeted production structure, it is crucial for Türkiye to monitor its participation in GVCs and design its production and foreign trade policies based on this information. Currently, GVCs account for approximately 40% of Türkiye's exports.

Figure 2 presents the basic GVC participation indicators for 25 economies with significant shares in the global economy for the year 2020. The countries are ranked based on their total GVC participation rates. According to this, the countries with the highest GVC integration are Belgium (55.5%), the Netherlands (54.7%), and Malaysia (54.3%). Türkiye's backward participation in 2020 is 21.6%, forward participation is 17.1%, and total participation is 38.7%. The countries with the highest backward participation are Mexico (35%) and Malaysia (33.8%). Those with the highest forward participation are Russia (35.2%), the USA (27%), and Japan (26.4%).

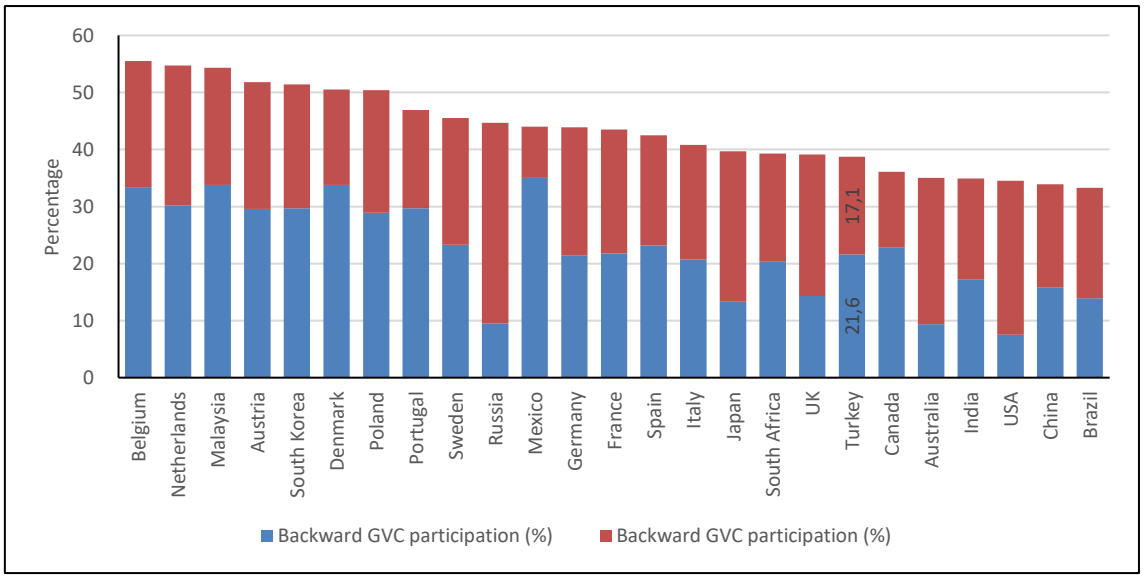

Figure 2. GVC Participation of Selected Countries, 2020
Source: OECD, TiVA

Türkiye's manufacturing exports amounted to approximately $120 billion in 2020 (Figure 3). The growth in manufacturing exports has been particularly notable since the year 2000. In recent years, backward participation stands at 28%, forward participation at 14%, and total GVC participation at around 42%. Accordingly, about 58% of Türkiye's exports fall under traditional foreign trade, while 42% are within the scope of GVCs. During this period, the proportion of GVCs in Türkiye's total exports has risen, while the share of traditional trade in exports has declined.

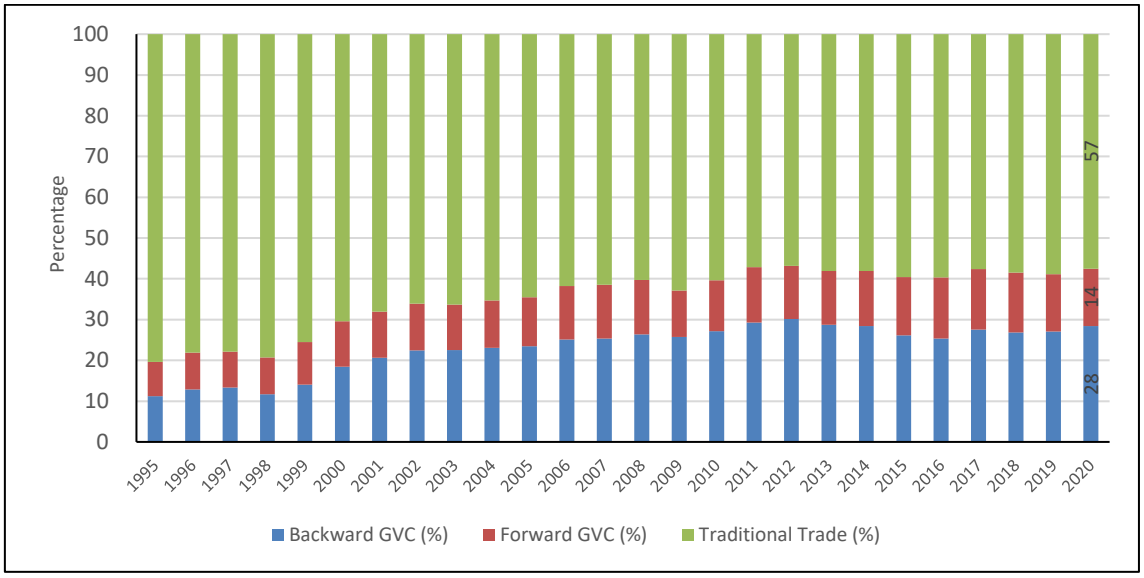

Figure 3. GVC Participation of Türkiye's Manufacturing Industry (% of Total Exports)
Source: OECD, TiVA

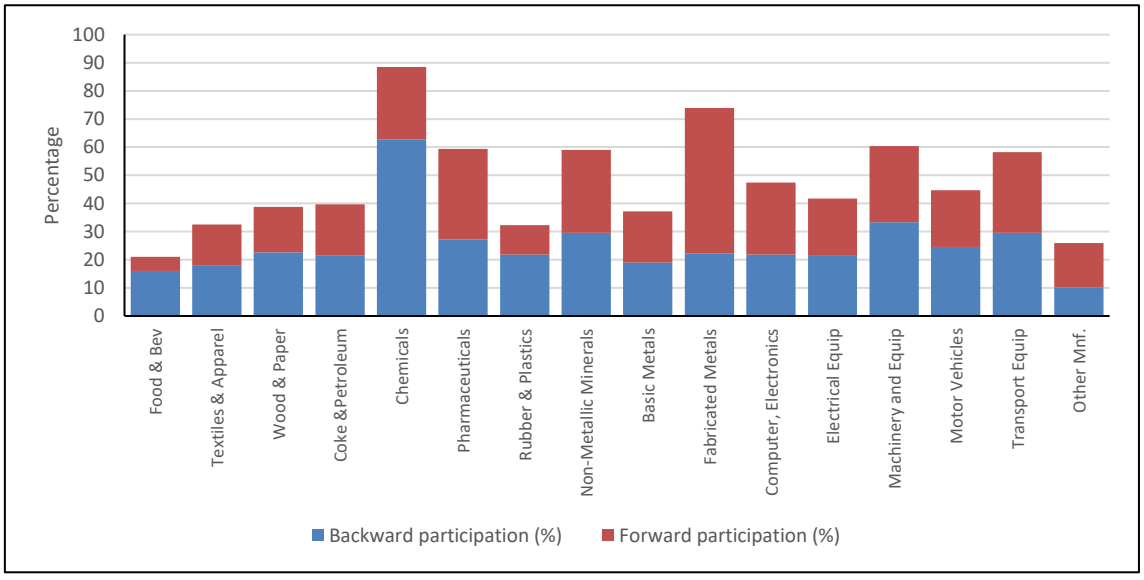

Figure 4. GVC Participation of Türkiye's Manufacturing Industry Sub-Sectors, 2018
Source: University of International Business and Economics, UIBE GVC Laboratory

Figure 4 displays forward and backward GVC participation for the sub-sectors of the Turkish manufacturing industry in 2018. The most recent data available for sub-sector GVC participation is from the year 2018. The sector with the highest total GVC participation in both 1995 and 2018 is the Coke and Petroleum industry. Despite Türkiye not being rich in fossil fuel resources, there is a significant dependency on the importation of these products for the production and exportation of the manufacturing industry. Therefore, the GVC participation level of this sector is notably high. In 1995, the sector with the lowest total GVC participation was the pharmaceutical industry, while in 2018, it was the food, beverage, and tobacco industries.

In 2018, the sector with the highest forward GVC participation was Basic Metals, accounting for 51%. In this sector, Türkiye exports significant industrial inputs for GVCs such as iron and steel. Conversely, the sector with the lowest forward participation was Food, Beverage, and Tobacco, at only 5%. This indicates that Türkiye is not a major food supplier in GVCs, with its food exports primarily involving traditional trade methods. The sector with the highest backward GVC participation in Türkiye was Coke and Petroleum, at 63%, which clearly reflects the country's dependency on imported energy. The sector with the lowest backward participation was Other Transport Equipment, at 10%, which includes ships, boats, locomotives, motorcycles, and military vehicles.

4. Effects of Türkiye’s Involvement in GVCs on Exports, Value Added, and Employment

In this study, the effects of the increase in the GVC participation of Türkiye's manufacturing subsectors on Türkiye's exports (X), domestic value added in exports (DVA), and employment levels (EMP) were examined using a triple regression model. In general, an increase in a country's GVC participation is expected to increase its total exports, the absolute size of DVA and employment in exporting and export-supporting sectors.

4.1. Literature Review

Participation in GVCs has significant effects on a country's economy, particularly in the manufacturing sector. Participation can contribute to GDP growth by increasing DVA in exports (Taguchi, 2014). In countries where productivity is relatively low, GVC participation can particularly help boost productivity in the manufacturing sector (Pahl and Timmer, 2020). However, the impact of GVCs on employment is more complex. For instance, Ma et al. (2019) reports positive effects on both employment levels and composition, whereas Kummritz (2015) finds no statistically significant impact. According to Kummritz et al. (2017), GVC participation helps all income levels, but middle- and high-income countries gain the most.

A country's export performance is affected in many ways by GVC involvement. According to Ndubuisi and Owusu (2021) and Nguyen and Park (2021), involvement in GVCs enhances the diversity and quality of exports. According to Pahl and Timmer (2020) and Urata and Baek (2021) the increase in production is the main driver of GVCs' contribution to export growth. GVC participation reduces costs, improves quality, and encourages product and market diversification, which reduces export uncertainty, according to Wang et al. (2022).

Studies in the literature generally find a positive link between backward GVC participation and exports. According to Nguyen and Park (2021), backward participation is especially successful in increasing export diversification. Likewise, Fauceglia et al. (2018) and Taguchi and Thet (2021) argue that backward GVC integration improves a country's logistics performance, so promoting export expansion.

The impact of forward GVC participation on export performance is also positive. Betai and Chanda (2020) argue that forward participation enhances export complexity, thereby contributing positively to export performance. However, Nguyen and Park (2021) emphasize that while forward GVC participation plays a role in improving export diversification, its impact is not as strong as that of backward participation. Considering both types of integration, Urata and Baek (2021) find that forward and backward participation alike contribute to productivity gains and help countries advance their manufacturing processes and technological capacity.

The literature generally suggests that greater GVC participation raises DVA, but the impact varies in degree across nations with varying income levels. According to Kummritz (2015), high-income nations' importation of inputs or intermediate products from lower-wage nations reduces their manufacturing costs, therefore boosting production. To the degree of their creative abilities, lower and middle-income nations can gain from the technology developments and externalities GVCs offer. According to Kowalski et al. (2015), policy-related variables like FDI openness have a greater impact in developed countries, but structural factors like logistics, infrastructure, and institutional quality are more important in facilitating GVC integration in developing nations. In the same way, Taglioni and Winkler (2016) note that while many African nations lag behind because of poor infrastructure and institutional capacity, developing nations in Southeast Asia have effectively made the shift from low-cost assembly hubs to producers of knowledge-intensive goods.

Kummritz (2016) and Park and Park (2020) have found that forward participation is more effective at creating DVA compared to backward participation. Solaz (2018) has stated that the impact of GVC participation on value added varies across different sectors. According to Taguchi (2014), GVC integration is a dynamic process. As GVC participation increases, the manufacturing industry is transformed and shifts to more value-added production. In the process of GVC integration, the share of DVA in exports initially decreases, but as a country progresses to more advanced stages of GVCs and domestic production capacities improve, the value-added increases again.

GVCs are causing a redistribution of production roles both within countries and across borders (Grossman and Rossi-Hansberg, 2008; World Bank, 2013). Therefore, participation in GVCs can lead to short-term unemployment in some sectors or professions. GVC trade can also enhance the quality of the national workforce through demand effects, educational effects, and labor turnover effects (Taglioni and Winkler, 2016). The studies by Farole et al. (2018) and Hollweg (2019) show that the effects of GVC participation on employment vary depending on the type of GVC involvement. Forward GVC participation, associated with an increase in the export of raw materials and intermediate goods, is expected to increase the magnitude of DVA in exports and have a positive impact on employment. However, understanding the effects of backward GVC participation on value addition and employment is more complex. With backward participation, the proportion of foreign value added (FVA) in total exports is expected to rise, while the share of DVA is expected to decrease. Nevertheless, within GVCs, the critical

determinant of domestic employment levels is the absolute size of DVA, not its share in exports. Due to the country's production being oriented toward global markets within the GVC, scale and productivity effects emerge in production. Therefore, although backward GVC participation may reduce the share of DVA in total exports, it positively influences the absolute size of DVA. Indeed, Mohamedou (2019) found that manufacturing industry employment in Türkiye is positively affected by participation in GVCs.

Constantinescu et al. (2019) have demonstrated that GVC participation has a significant and strong positive impact on domestic productivity. Consequently, GVC participation can help create more employment opportunities in participating countries (Grossman and Rossi-Hansberg, 2008; World Bank, 2020). The positive productivity effect resulting from GVC participation may also put upward pressure on domestic wages (Grossman and Rossi-Hansberg, 2008; Wright, 2014).

The studies examining the impact of GVC participation on wages can be summarized as follows. Ndubuisi and Owusu (2021) suggest that GVC participation and upward specialization may lead to wage increases in developed countries; however, the effect is more complex in developing countries. In developing countries, GVC participation generally tends to increase wages, whereas upward specialization puts downward pressure on wages. This leads to two contradictory consequences. Upward specialization is the term used to describe a country's or company's emphasis on the early phases of the manufacturing process, including primary processing operations or raw material extraction. While Paweenawat (2022) underlines the skill premium in GVC-oriented industries, Lu et al. (2019) stresses the significance of labor productivity.

Shepherd (2013) suggested that GVC participation may increase the relative wages of skilled workers, which could, in turn, worsen wage inequality. By contrast, Gonzalez et al. (2015) suggested GVC participation could reduce wage disparity, especially for low-skilled workers. GVC participation and wage remain controversial.

4.1.1. Empirical Research on the Integration of Türkiye into GVCs

Academic research on Türkiye's integration into GVCs is limited. These studies provide important insights into Türkiye's production structure, trade patterns, and position within GVCs. Ziemann and Guérard (2016) argue that Türkiye's GVC participation is below its potential. Türkiye's share of foreign value added in exports (backward participation) has increased over time, the share of domestic value added in other countries' exports (forward participation) is low. Limited integration into GVCs is attributed to structural weaknesses such as institutional inefficiencies, low R&D intensity, and inadequate human capital.

Studies examining the technological dimension of GVC participation highlight similar concerns. Gündoğdu and Saracoğlu (2016) find that Türkiye's integration has progressed particularly in medium-high and high-tech sectors, but partnerships with countries like China remain concentrated in low-tech industries, hindering upward movement in GVCs. Similarly, Altun et al. (2023) show that GVC engagement with developed countries significantly boosts high-tech exports, whereas such links with lower-income countries show no meaningful effect.

At the firm and sectoral level, Kılıçaslan et al. (2021) find that participation in GVCs improves productivity, especially for SMEs in final producer positions. Yanıkkaya et al. (2024)

show that backward linkages have a positive impact on total factor productivity but a limited effect on sectoral value added. Additionally, tariff-related trade barriers are found to negatively affect sectoral performance.

From a macroeconomic perspective, Shuabiu et al. (2021) find that maintaining a competitive exchange rate facilitates deeper integration into GVCs, thereby enhancing trade competitiveness and supporting economic growth. Altun et al. (2025), concentrating on the COVID-19 era, contend that global vaccine shortages and mobility restrictions considerably decreased Türkiye's GVC participation, particularly in high-tech industries. The research emphasizes the significance of supply chain diversification and enhancements in information and communication technology and logistics infrastructure to foster resilience against such disruptions. Yanıkkaya et al. (2022) study the impact of complex GVCs participation on productivity and output growth. The "learning by trading" hypothesis is supported by their findings that forward and backward linkages improve economic performance. Türkiye's participation in GVCs has increased, but the literature suggests structural reforms, improved technological competencies, and more strategic trade policies are needed to advance.

4.2. Hypotheses, Model Specification and Data

The following section describes the empirical research that tested the hypothesis that increased participation in GVCs in Türkiye increases employment, exports, and domestic value added. The study uses a panel dataset from 1995 to 2020 to examine how deeper integration into GVCs affects exports, DVA, and employment in 17 manufacturing subsectors.

As a sector's involvement in GVCs increases, its exports (x_j) are expected to increase. With the expansion of the sector's exports, the domestic value-added (DVA) in those exports will likely go up as well. Nevertheless, if export production necessitates a substantial inflow of intermediate goods imports, the absolute value of Domestic Value Added (DVA) may rise, while its proportion of total exports could diminish. Finally, an increase in DVA volume may contribute to higher export-related employment due to scale and productivity effects. To test these hypotheses, a triple regression model has been designed following the econometric approach of Veeramani and Dhir (2022).

$$lnx_{jt} = \alpha_0 + \alpha_1 GVCb_{jt} + \alpha_2 GVCf_{jt} + \alpha_3 lnrprio_{jt} + \alpha_4 lngdem_{jt} + \varepsilon_{jt} \quad \text{Model 1}$$

$$dva\_sh = \beta_0 + \beta_1 lnx_{jt} + \beta_2 lnrpriv_{jt} + \beta_3 lndomact_{jt} + \mu_{jt} \quad \text{Model 2}$$

$$lnemp_{jt} = \theta_0 + \theta_1 lndva_{jt} + \theta_2 lor_{jt} + \theta_3 lnwg_{jt} + \sigma_{jt} \quad \text{Model 3}$$

The notations j, t and ln represent the sector, year, and natural logarithm, respectively. The endogenous dependent variables in the system are as follows: (i) The value of Türkiye's exports from sector j to the rest of the world in US dollars (x_{jt}). (ii) Domestic value-added share of Türkiye's gross exports from sector j (dva_sh_{jt}). (iii) The direct plus indirect employment associated with Türkiye's exports from sector j (emp_{jt}). The key coefficients that the research focuses on are α_1, α_2, β_1 and θ_1.

The variable GVC_b in Model (1) represents the indicator of backward GVC participation. It refers to the share of foreign value-added within the total value of exports from j sector. The coefficient of this variable, α_1 , is expected to be estimated with a positive sign. This is due to

the expectation that increased backward GVC participation will result in a rise in total exports, quantified in US dollars. The variable GVC_f represents the indicator of forward GVC participation. Forward participation involves DVA produced in Türkiye being exported to third countries. It is measured as the share of DVA going to third countries in total exports. It is anticipated that the coefficient alpha will be estimated to have a positive sign, indicating that an increase in forward GVC participation is predicted to positively affect the measured outcome.

In Model (2), the sign of the coefficient β_1 associated with the total export variable (lnx) could be either positive or negative. If increases in exports require significant imports of intermediate goods or inputs, the share of DVA in exports (dva_sh) may decrease, and the share of FVA (fva_sh) could increase. It is important to remember that it should not be forgotten that even if the share of DVA in exports decreases, the quantity of DVA can still increase. In Model (3), the hypothesis that a rise in domestic value-added within exports ($lndva$) will increase total employment ($lnemp$) is being tested.

The models also include control variables. The selection of control variables is based on their theoretical relevance and empirical use in sector-level studies of trade, value-added, and employment (Veeramani and Dhir, 2022). Model 1 is an estimation of an export function. A country's or sector's export performance is primarily determined by relative prices and external demand conditions; hence, control variables are selected to reflect these fundamental drivers. In this context, $rprio$ represents the relative prices in the relevant sector, and $lngdem$ represents the level of global demand. The $rprio$ variable is obtained by dividing Türkiye's sectoral output level by the output level of the same sector in the US. US prices are considered a proxy for global prices. Increases in this ratio indicate a deterioration in Türkiye's price competitiveness in the relevant sector. $lngdem$ represents the total global imports in a sector (in US dollars), weighted according to the proportion of each country in Türkiye's exports. In Model 2, the effect of export expansion on domestic value-added is analyzed. Relative value-added prices are included to control for cost competitiveness (Bems and Johnson, 2015), while the domestic activity variable captures potential substitution or complementarity between domestic sales and exports. The variable $relpriv$ is a relative price variable calculated in terms of value added. It is derived by dividing the amount of value added produced in a manufacturing sub-industry in Türkiye by the value added produced in the same sector in the USA. Since the dependent variable is expressed in terms of value added, calculating relative prices in terms of value added is more meaningful. Increases in this ratio indicate a decrease in Türkiye's price competitiveness. The variable $lndomact$ represents domestic activity. It is the difference between the gross value added produced by sector j and the domestic value added in the exports of the relevant sector. The coefficient of the variable indicates whether production for the domestic market complements or substitutes production for export. When capacity constraints are present, if an increase in domestic sales requires a decrease in exports, a substitution effect is at play, and a negative coefficient is obtained. On the other hand, if there are increasing returns to scale, or if production for the domestic market can facilitate penetration into global markets, a complementary effect exists. Therefore, the sign of the coefficient for the $lndomact$ variable depends on which effect is strong.

Model 3 is an estimation of an employment function. According to economic theory, wage levels and labor productivity are considered key determinants of sectoral employment; therefore, control variables are selected to capture these influences. In Model 3, the labor-output

ratio (***lor***) is used to account for the effect of labor intensity on employment generation within a sector. The inverse of this variable represents labor productivity. $lnwg$ variable is a proxy that represents the nominal wage level. It is calculated by dividing the total labor payments in the relevant sector by the sector's total employment (Veeramani and Dhir, 2022).

The value-added trade data used in this study are drawn from the OECD's TiVA database, released in 2023. This dataset provides a long panel structure covering the period from 1995 to 2020, enabling robust country-sector level analysis for instance C10T12 Food & Beverages. In TiVA, sectors are defined based on the ISIC Rev.4 classification, and certain sectors are aggregated by grouping activities with similar production processes, input structures, and trade characteristics. Within this framework, the manufacturing sector is reported under 17 aggregated sub-sectors (Table 1). All 17 manufacturing sub-sectors have been included in the analysis, and there are no missing observations for Türkiye in the dataset. For a detailed overview of the variables, including descriptive statistics and their correlation structure, please refer to Appendix.

Table 1. Manufacturing Industry Sub-Sector Codes and Names

ISIC Rev4	Sector Abbreviations
C10T12	Food, Beverages & Tobacco
C13T15	Textiles & Apparel
C16T18	Wood & Paper
C19	Coke &Petroleum
C20	Chemicals
C21	Pharmaceuticals
C22	Rubber & Plastics
C23	Non-Metallic Minerals
C24	Basic Metals
C25	Fabricated Metals
C26	Computer, Electronics
C27	Electrical Equipment
C28	Machinery and Equipment
C29	Motor Vehicles
C30	Transport Equipment
C31T33	Other Man., repair and inst. of mach. and eq.

Source: OECD, TiVA

4.3. Preliminary Tests

The data used in the analysis are structured as panel data. According to the panel data analysis procedure, the time period (T) is compared with the number of cross-section units (N). In this study, since T is greater than N, traditional models such as fixed effects and random effects cannot be used (Zoundi, 2017). To determine the appropriate analytical method, the following steps are taken: First, cross-sectional dependence is assessed in the residuals, and slope homogeneity is examined. Second, unit root tests are conducted to determine whether the series is stationary. Third, cointegration tests are performed to establish the existence of a long-term relationship among the series. Finally, an appropriate estimator is selected to analyze both the long-term and short-term dynamics.

4.3.1. Cross-Sectional Dependency and Slope Homogeneity Tests

Externalities or unobserved common effects between cross-sections cause cross-sectional dependence (CSD). CSD test helps to decide whether first- or second-generation unit root and co-integration test is used. CSD in residuals was investigated using the Breusch and Pagan (1980) LM test, the Pesaran (2004) scaled LM test, the Pesaran (2004) CD test, and the Baltagi et al. (2012) bias-corrected scaled LM test. According to the findings presented in Table 2, the null hypothesis, which states that there is no CSD in all series, has been statistically significantly rejected, indicating that cross-sectional dependence (CSD) exists among the series.

Table 2. CSD Test Results

Variable	Breusch-Pagan LM	Pesaran Scaled LM	Bias-corrected Scaled LM	Pesaran CD
lnx	3192.16***	185.31***	184.97***	56.34***
dva_sh	2065.17***	116.97***	116.63***	44.64***
lnemp	2361.60***	134.95***	134.61***	28.85***
GVC_b	1667.91***	99.92***	99.57***	39.11***
GVC_f	1532.84***	91.20***	90.85***	30.03***
lngdem	3209.72***	186.37***	186.03***	56.50***
relprio	2440.67***	139.74***	139.40***	35.84***
lndva	2924.65***	169.09***	168.75***	52.38***
relpriv	2035.01***	115.14***	114.80***	32.63***
lndomact	1952.83***	110.16***	109.82***	39.02***
lor	2532.80***	145.33***	144.99***	47.45***
lnwg	2197.54***	125.00***	124.66***	39.29***

Note: *** denotes statistical significance level of 1%.

The slope homogeneity in the model has been tested using the delta tests by Pesaran and Yamagata (2008) and Blomquist and Westerlund (2013). According to the findings presented in Table 3, the null hypothesis stating that the slope coefficients have a homogeneous structure has been statistically significantly rejected, leading to the conclusion that the slope coefficients in the panel exhibit a heterogeneous structure.

Table 3. Slope Homogeneity Test Results

	Pesaran, Yamagata (2008)		Blomquist, Westerlund (2013)	
	Delta	Adj. Delta	Delta	Adj. Delta
Model 1	16.245***	18.758***	10.355***	11.957***
Model 2	21.783***	23.681***	15.187***	16.510***
Model 3	21.947***	24.421***	12.499***	13.907***

Note: *** denotes statistical significance level of 1%.

4.3.2. Second-Generation Unit Root Tests

Due to the presence of cross-sectional dependence (CSD) in the residuals, second-generation unit root tests that account for CSD, specifically the Pesaran (2007) CIPS and CADF tests, have been conducted. According to the findings presented in Table 4, it has been concluded that all series, except for lngdem and GVC_b, are integrated of order one.

Table 4. Second-Generation Unit Root Test Results

	Pesaran (2007) CIPS				Pesaran (2007) CADF			
	Level		First Difference		Level		First Difference	
Variables	Constant	Constant & Trend	Intercept	Constant & Trend	Intercept	Constant & Trend	Intercept	Constant & Trend
lnx	-1.302	-1.821	-4.497***	-4.865***	-1.447	-1.800	-4.554***	-4.968***
dva_sh	-1.448	-1.856	-5.030***	-4.989***	-1.452	-1.916	-5.025***	-4.921***
lndva	-1.762	-1.998	-4.965***	-5.223***	-1.726	-1.981	-4.916***	-5.160***
lnemp	-1.534	-2.009	-4.353***	-4.654***	-1.534	-2.009	-4.495***	-4.827***
GVC_b	-2.212**	-2.388	-4.424***	-4.510***	-2.212**	-2.388	-4.424***	-4.510***
GVC_f	-2.157*	-2.555	-4.399***	-4.517***	-2.055	-2.555	-4.399***	-4.399***
lngdem	-2.733***	-3.243***	-5.539***	-5.596***	-2.624***	-3.133***	-5.539***	-5.596***
relprio	-1.940	-2.364	-4.487***	-4.659***	-1.843	-2.261	-4.487***	-4.591***
relpriv	-2.038	-2.795**	-4.905***	-5.080***	-2.055*	-2.800**	-5.018***	-5.118***
lndomact	-1.976	-2.530	-5.295***	-5.353***	-2.050	-2.530	-5.295***	-5.353***
lor	-1.511	-2.486	-4.930***	-4.990***	-1.651	-2.509	-4.930***	-4.990***
lnwg	-1.809	-2.846**	-4.443***	-4.615***	-1.764	-2.664*	-4.305***	-4.485***

Note: ***, **, and * denote statistical significance levels of 1%, 5%, and 10%, respectively.

4.3.3. Second-Generation Co-Integration Test

According to the results presented in Table 2, after detecting CSD in residuals, the use of second-generation cointegration tests is considered appropriate. Due to its ability to account for both CSD and slope heterogeneity, the Westerlund (2008) Durbin-Hausman (DH) Panel Cointegration Test was conducted. Another advantage of the Westerlund (2008) DH test is that it can be applied regardless of whether the explanatory variables are integrated. Considering that the explanatory variable lngdem is stationary at the level, the Westerlund (2008) DH test is expected to provide consistent and unbiased results. According to the findings presented in Table 5, the null hypothesis stating that there is no cointegration among the series has been statistically significantly rejected in all models based on both the DH panel and DH group statistics. This finding indicates the presence of cointegration relationships among the series.

Table 5. Westerlund (2008) Cointegration Test

	Durbin-H Group	Durbin-H Panel
Model 1	2.122**	2.144**
Model 2	3.995***	7.967***
Model 3	2.013**	1.675**

Note: *** and ** denote statistical significance levels of 1%, 5%, respectively.

As a result of the conducted tests, CSD and slope heterogeneity were identified in the dataset. Additionally, it was determined that one of the explanatory variables is stationary. Additionally, it has been confirmed that there is a cointegration relationship, indicating a long-term relationship in all models to be estimated. However, there is concern that there may endogeneity problem in the estimates. Considering all these factors, the use of the Cross-sectionally Augmented Autoregressive Distributed Lag (CS-ARDL) estimator is considered both compatible with the objectives of the study and effective in overcoming some potential econometric issues. The CS-ARDL estimator accounts for heterogeneity and endogeneity, and can also operate with series at different levels of stationarity. For these reasons, it allows for the execution of consistent and unbiased estimates.

4.3.4. CS-ARDL: Methodology and Results

CS-ARDL is designed to address both short-term dynamics and long-term relationships. It can be considered the ARDL variant of the "Dynamic Common Correlation Estimator." (Carvelli, 2023). The Dynamic Common Correlated Effects (DCCE) method was initially developed by Pesaran (2006) and later expanded by Chudik and Pesaran (2015). Subsequently, Chudik et al. (2016) developed the CS-ARDL model, which incorporates the cross-sectional averages of variables into the analysis. The CS-ARDL model can be expressed in the form of a regression equation that depends on both the current and lagged values of dependent and independent variables. Cross-sectional averages are also included in the regression to account for cross-sectional dependence. The general form of the model is as follows:

$$y_{it} = \alpha_i + \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \beta_{ij} X_{i,t-j} + \sum_{j=0}^{q} \gamma_{ij} \bar{X}_{t-j} + \varepsilon_{it} \quad (1)$$

Here; y_{it} : The value of the dependent variable at time t in cross-section i, α_i : Cross-section specific intercept, λ_{ij} : Coefficients for lagged values of the dependent variable, $X_{i,t-j}$: Values of the independent variables at time $t-j$ in cross-section i, $\bar{X}_{t-j}$: Cross-sectional averages of the independent variables, β_{ij}, γ_{ij} : Short and long-term coefficients of the independent variables, ε_{it} : Error term.

The CS-ARDL model can capture short-term dynamics through the short-term coefficients β_{ij} and γ_{ij}. Long-term relationships are typically expressed as the sum or ratio of these coefficients. Cross-sectional averages ($\bar{X}_{t-j}$) also help capture the impact of external factors. The error correction form of the CS-ARDL model illustrates how imbalances between short-term dynamics and long-term relationships are adjusted. The error correction form of the CS-ARDL model is as follows:

$$\Delta y_{it} = \alpha_i + \sum_{j=1}^{p-1} \lambda_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q} \beta_{ij} \Delta X_{i,t-j} + \theta ECT_{i,t-1} + \varepsilon_{it} \quad (2)$$

The symbol Δ denotes the first-difference operator (for example, $\Delta y_{it} = y_{it} - y_{i,t-1}$). $ECT_{i,t-1}$, is the error correction term, representing the value of the long-term disequilibrium from the previous period. This term indicates deviations from the long-term relationship. θ, is the coefficient of the error correction term. It represents the speed at which short-term imbalances adjust back to the long-term equilibrium. This coefficient is expected to be negative, indicating that deviations from the long-term equilibrium are expected to decrease over time.

The CS-ARDL model offers significant advantages. The first benefit is that it estimates short-term and long-term dynamics simultaneously. Second, it can predict stationary variables at different levels. Third, the model takes into account cross-sectional dependence by considering global shock patterns and economy-to-economy interactions. The model also accounts for heterogeneity, which can cause panel cross-section parameter differences. By considering independent variable endogeneity, the CS-ARDL model manages bidirectional causality. Finally, the CS-ARDL model addresses cross-sectional dependence, heterogeneity, and endogeneity. It makes the results more consistent and unbiased.

Table 6 shows the coefficients of Model 1, which examines the hypothesis regarding the relationship between GVC participation indicators and export volume. According to the long-term coefficients, both forward (GVC_f) and backward (GVC_b) participation in GVCs have a statistically significant positive impact on export performance (lnx). This finding supports the studies by Koopman et al. (2014), Taglioni and Winkler (2016) and, Ndubuisi and Owusu (2021). The impact of forward GVC participation on exports is stronger compared to backward participation. This finding indicates that integration into GVCs through domestically produced specific inputs is likely to generate higher export revenues. The sign of the $lngdem$ variable, which represents global demand conditions, is positive and statistically meaningful. This finding implies that Türkiye's export performance is sensitive to global demand conditions. The coefficient of the relative price variable ($relprio$) is insignificant. This finding suggests that Türkiye's export performance is not sensitive to changes in relative prices. The error correction term (ECT) has a negative coefficient (-0.710), and it is statistically significant. This finding indicates that short-term deviations are rapidly corrected, restoring equilibrium. From an economic perspective, it suggests that export mechanisms function efficiently and that sectors are resilient to shocks.

Table 6. Relationship between GVC Participation and Exports (Model 1)

Dependent Variable: Δlnx	**Coefficient**	**Standard Error**	**Probability**
Short run			
Δlnx(-1)	0.290***	0.050	0.000
ΔGVC_b	0.195	0.467	0.677
ΔGVC_f	4.630***	1.368	0.001
ΔGVC_b(-1)	-0.044	0.467	0.925
ΔGVC_b(-2)	1.617***	0.320	0.000
ΔGVC_f(-1)	-1.186	1.026	0.248
Δrelprio	0.126***	0.046	0.006
Δrelprio(-1)	-0.007	0.032	0.813
Δrelprio(-2)	0.004	0.017	0.806
Δlngdem	0.514***	0.071	0.000
Long run			
GVC_b	2.788**	1.101	0.011
GVC_f	4.683***	1.700	0.006
lngdem	0.735***	0.107	0.000
relprio	0.120	0.089	0.174
ECT	-0.710***	0.050	0.000
Number of obs.	336		
R^2 (MG)	0.58		
Number of groups	17		

Note: ***, **, and * denote statistical significance levels of 1%, 5%, and 10%, respectively.

Table 7 shows the estimated coefficients of Model 2, which investigates the impact of export growth on the share of domestic value added (dva_sh) in exports. According to the long-term coefficients, increases in exports result in a decrease in the share of domestic value added (dva_sh) in exports. This also implies that increases in exports lead to a rise in the share of FVA in exports. This indicates that greater exports in Türkiye's manufacturing industry require more foreign inputs and intermediate goods, consistent with empirical results observed in developing countries. This finding is similar to the studies by Antràs and Chor (2013) and Koopman et al. (2014).

Table 7. Relationship between Exports and the Share of DVA (Model 2)

Dependent Variable: Δdva_sh	Coefficient	Standard Error	Probability
Short run			
Δdva_sh(-1)	0.150***	0.031	0.000
Δlnx	-5.239***	1.111	0.000
Δlndomact	-0.022	1.187	0.985
Δlndomact(-1)	3.256***	0.879	0.000
Δrelpriv	0.817	0.675	0.226
Δrelpriv(-1)	-1.354*	0.766	0.077
Long run			
lnx	-6.248***	1.384	0.000
lndomact	3.964**	1.571	0.012
relpriv	-0.561	1.091	0.607
ECT	-0.850	0.031	0.000
Number of obs.	391		
R^2 (MG)	0.75		
Number of groups	17		

Note: ***, **, and * denote statistical significance levels of 1%, 5%, and 10%, respectively.

The sign of $relpriv$, the relative price variable calculated in terms of value added, is insignificant. This implies that the share of domestic value added in exports is insensitive to changes in relative prices. The coefficient of $lndomact$ is positive and statistically significant. This finding suggests that accelerations in domestic activity led to an increase in the share of domestic value added. The positive coefficient also indicates that domestic sales and exports are complementary rather than substitutes. In other words, production for the domestic market is accompanied by an increase in production for exports.

Table 8 presents the coefficients of Model 3, which examines the hypothesis regarding the relationship between employment and domestic value added in exports. According to the long-term results, the coefficient of $lndva$ has been found to be positive and statistically significant. Although increases in exports decrease the share of DVA within total exports, the total size of DVA still increases. This finding, as also identified by Mohamedou (2019), shows that increases in export-driven domestic value-added (DVA) positively affect employment in the Turkish manufacturing sector.

The labor-output ratio, denoted by lor, has a positive and significant sign. This finding indicates that an increase in the labor intensity of the sector generates more employment. Considering that Türkiye is a labor-intensive country and that labor intensity is typically high in manufacturing industry production, it is reasonable to estimate a positive coefficient. The inverse of the labor-output ratio also represents labor productivity. Accordingly, increases in labor productivity reduce employment. In economic theory, the relationship between labor productivity and employment is generally considered negative. If a company or economy has high labor productivity, it can produce more with fewer workers. In this case, increased efficiency can directly lead to a need for fewer employees. Finally, the variable $lnwg$ represents the nominal wage level and its coefficient is significantly negative, consistent with economic theory.

Table 8. Relationship between DVA and Employment (Model 3)

Dependent Variable: Δlnemp	Coefficient	Standard Error	Probability
Short run			
Δlnemp(-1)	0.037	0.030	0.218
Δlnemp(-2)	0.044*	0.027	0.095
Δlndva	0.088***	0.023	0.000
Δlndva(-1)	0.018	0.023	0.443
Δlndva(-2)	0.057***	0.010	0.000
Δlor	0.156**	0.063	0.014
Δlnwg	-0.200***	0.038	0.000
Δlnwg(-1)	0.012**	0.012	0.339
Long run			
lndva	0.184***	0.035	0.000
lor	0.172**	0.079	0.029
lnwg	-0.222***	0.052	0.000
ECT	-0.918***	0.045	0.000
Number of obs.	391		
R^2 (MG)	0.71		
Number of groups	17		

Note: ***, **, and * denote statistical significance levels of 1%, 5%, and 10%, respectively.

4.3.5. Robustness Test

Table 9 presents the results from FMOLS, DOLS, and 3SLS estimations conducted for robustness checks. FMOLS and DOLS are frequently used for robustness checks of CS-ARDL estimates (Kuo et al., 2022; Deka et al., 2023; Uddin et al., 2023). In this study, 3SLS is preferred over 2SLS in this study due to control for both endogeneity and cross-equation error correlations. The 3SLS method estimates the three equations simultaneously, thereby addressing both endogeneity and cross-equation error correlations in a unified framework (Yap and Allen, 2011; Silpachai, 2023).

Table 9. Robustness Tests: FMOLS, DOLS and 3SLS

	3SLS			FMOLS			DOLS		
Variable	**Coef.**	**Std. Error**	**Prob.**	**Coef.**	**Std. Error**	**Prob.**	**Coef.**	**Std. Error**	**Prob.**
Dependent Variable: lnx									
GVC_b	1.837	0.430	0.000	1.604	0.304	0.000	3.042	0.818	0.000
GVC_f	3.902	0.543	0.000	4.362	0.503	0.000	5.153	1.655	0.002
relprio	0.027	0.002	0.000	0.159	0.018	0.000	0.120	0.041	0.004
lngdem	0.636	0.046	0.000	0.699	0.046	0.000	0.518	0.014	0.000
Dependent Variable: dva_sh									
lnx	-7.040	0.457	0.000	-5.798	0.544	0.000	-6.039	0.621	0.000
lndomact	0.238	0.032	0.000	2.023	0.639	0.017	2.077	0.866	0.017
relpriv	6.282	0.580	0.000	-0.029	0.038	0.452	-0.040	0.035	0.255
Dependent Variable: lnemp									
lndva	0.666	0.014	0.000	0.145	0.031	0.000	0.519	0.087	0.000
lor	0.661	0.033	0.000	0.071	0.046	0.128	0.170	0.114	0.136
lnwg	-0.318	0.040	0.000	-0.134	0.036	0.000	-0.182	0.075	0.017

The empirical model comprises three equations estimated simultaneously, with exports (lnx), domestic value-added share (dva_sh), and employment ($lnemp$) treated as endogenous

due to simultaneity and potential reverse causality. Since these sectoral outcomes are shaped within a common economic environment and subject to shared macroeconomic shocks, their interdependence and correlated error terms must be taken into account. Each equation includes theoretically informed exogenous regressors—such as GVC_b, GVC_f, relative prices, global demand, wages, and productivity—which also function as instruments for the endogenous variables. Unlike 2SLS, 3SLS jointly estimates the system while exploiting its covariance structure, thereby producing more efficient and reliable estimates. This makes 3SLS particularly well-suited for capturing the complex interactions underlying sectoral dynamics in the context of GVC participation. The results of the robustness checks are generally consistent with the CS-ARDL outcomes. Specifically, the focal variables $GVC\_b, GVC\_f, lndva$, and lnx coefficients are complied with the CS-ARDL findings in the robustness checks.

In the robustness tests, contrary to the CS-ARDL estimates, the coefficient for $relprio$, which represents relative prices, is estimated to be positive and significant. In Model 2, the estimation for $lndomact$ is consistent with the CS-ARDL findings. The relative price variable, $relpriv$, calculated based on added value and the labor-output ratio, lor, are significantly positive in the 3SLS estimations, but insignificant in the FMOLS and DOLS estimations. Finally, the coefficient for the proxy variable representing nominal wages, $lnwg$, is negatively significant in all checks and consistent with the CS-ARDL estimates.

In conclusion, the findings from the CS-ARDL estimates are generally consistent with those obtained from robustness checks. While the signs of the variables focused on in the research are directly consistent with CS-ARDL estimations, a few control variables' coefficients differ. Based on this information, it can be concluded that the estimated coefficients are robust.

5. Discussion

The findings of this study are generally consistent with the existing literature, although they show limited divergence at certain points. Results show that both forward and backward GVC participation have a statistically significant and positive impact on Türkiye's exports. This finding aligns closely with the expanding literature emphasizing how GVC integration can enhance trade performance in developing economies. In this regard, the current findings are consistent with the key studies which emphasize the role of backward participation in improving export diversification and quality (Veeramani and Dhir, 2022; Nguyen and Park (2021); Ndubuisi and Owusu, 2021). Similarly, Betai and Chanda (2020) argue that forward participation enhances export sophistication and contributes to the growth of export volumes. Research focused on Türkiye offers parallel results. For instance, Altun et al. (2023) highlight that GVC integration with developed countries supports high-tech exports, while Ziemann and Guérard (2016) observe that increasing backward participation has strengthened Türkiye's export capacity over time. However, some studies contend that the impact of forward participation is weaker than that of backward participation (Nguyen and Park, 2021). These discrepancies may stem from differences in model specifications, country samples, or measurement approaches to GVC participation.

The results also show that backward GVC participation increases domestic value added by stimulating exports. This supports the argument that GVCs expand production scales and promote DVA through trade channels, as suggested by Taguchi (2014), Urata and Baek (2021),

and Pahl and Timmer (2020). A particularly noteworthy finding of this study is that while the share of DVA in exports tends to decline with increased exports, the absolute level of DVA still rises. This indicates a high dependency on imported inputs in Türkiye's export sectors. Similar patterns have been noted in the literature. For example, Kummritz (2015) and Taglioni and Winkler (2016) argue that backward integration can lead to a higher share of foreign value added (FVA), thereby reducing the relative share of DVA, even as the total amount of DVA increases due to rising export volumes.

Findings of the study indicate that GVC participation supports domestic employment by influencing exports and DVA. This result is consistent with the findings of Farole et al. (2018) and Hollweg (2019), who emphasize the role of demand-side and scale-related mechanisms in creating jobs through GVC integration. In the context of Türkiye, Mohamedou (2019) provides evidence of a positive link between GVC participation and employment in the manufacturing sector. However, Yanıkkaya et al. (2024) argue that while GVC integration enhances total factor productivity, its impact on sectoral employment remains limited. In this regard, the present study contributes to the literature by highlighting the indirect and compound channels through which GVCs can influence employment in developing economies.

6. Conclusion

This study empirically tests the hypotheses that Türkiye's increased participation in GVCs will enhance export revenues, that an increase in exports will raise the share of DVA in exports, and that an increase in DVA will boost employment. These hypotheses have been estimated using the CS-ARDL method on a panel data set covering the period 1995-2020 and 17 manufacturing sub-sectors of the Turkish economy.

The findings of this study are consistent with those of other key studies. According to the results, increases in forward and backward participation in GVCs both positively impact Türkiye's exports. Increases in exports reduce the share of DVA in exports and increase the share of FVA. This indicates that the production of export goods is highly dependent on foreign inputs. This finding is consistent with research conducted on developing countries which generally require more foreign inputs to increase their production. As the share of domestic value added in exports increases, its impact on export-based employment is positive. Conversely, increases in labour productivity have been observed to negatively affect employment. Additionally, the impact of nominal wage levels on employment has been identified as negative. In summary, GVC participation positively affects exports, value-added, and employment in the Turkish manufacturing industry through the scale and efficiency effects it generates.

The findings suggest that Türkiye's export policy should focus on GVCs. Greater integration into GVCs presents a significant opportunity for the Turkish economy to increase its export revenues. Türkiye should design its industrial and trade policies with a GVC-focused approach to capitalize on this opportunity. Firstly, Türkiye should identify the industrial sectors and specific production tasks where it has a comparative advantage. Secondly, the key products or tasks demanded by GVCs should be identified. Priority sectors can be determined by matching GVC demands with the sectors in which Türkiye holds a comparative advantage. By providing the necessary incentives to priority sectors, production growth and higher levels of

specialization in these sectors can be achieved. Greater specialization leads to higher productivity. Productivity increases lead to cost reductions, thereby enhancing Türkiye's competitiveness in global markets. Increases in exports can support Türkiye's economic growth and employment. Thirdly, steps can be taken to remove trade barriers in strategic markets identified for GVC participation. This would reduce trade costs and enhance export potential. For instance, the possibility of expanding the scope of the Customs Union between Türkiye and the EU can be reconsidered. While GVC participation improves export performance and employment through scale and efficiency effects, it also shapes the structural transformation of the domestic economy. As a developing country, for Türkiye, integration into GVCs can serve as a catalyst for industrial upgrading, technological learning, and international collaboration. However, these benefits are contingent on the Türkiye’s capacity to move toward higher value-added segments within GVCs and to retain sufficient domestic value in its exports.

Despite the economic gains, increased backward integration into GVCs also raises concerns regarding dependency on foreign inputs. As observed in the findings rising exports have coincided with a decline in the share of domestic value added, highlighting Türkiye’s reliance on imported intermediates. This dependency can increase vulnerability to external shocks, such as global supply chain disruptions, energy price volatility, or geopolitical tensions. Therefore, Türkiye’s GVC strategy should be balanced with policies to strengthen domestic input production and supply chain resilience.

Recent global developments—such as the COVID-19 pandemic, rising geopolitical fragmentation, and shifts in global trade architecture—have prompted countries to reassess their positions in GVCs. Concepts like reshoring, nearshoring, and friendshoring are becoming increasingly prominent, especially in Europe and North America. Türkiye, with its geographic proximity to EU markets and its established manufacturing base, is well-positioned to benefit from these shifts. To secure a competitive and resilient role within reconfigured value chains, policymakers should actively align Türkiye's trade and industrial strategies with these evolving global dynamics.

In conclusion, this study has reconfirmed the positive effects of GVC participation on exports, value added, and employment using a unique dataset. Türkiye should increase its integration into strategic areas of GVCs to benefit from the potential gains. The methods for determining the sectors and tasks where Türkiye has an advantage in GVCs, the products and tasks needed by GVCs, and how the identified sectors can be incentivized, are potential topics for future GVC research.

Declaration of Research and Publication Ethics
This study, which does not require ethics committee approval and/or legal/specific permission, complies with the research and publication ethics.

Researcher’s Contribution Rate Statement
The authors declare that they have contributed equally to the article.

Declaration of Researcher’s Conflict of Interest
There are no potential conflicts of interest in this study.

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APPENDIX

Table A1. Descriptive Statistics of Variables

	lnx	**dva_sh**	**lnemp**	**GVC_b**	**GVC_f**	**lngdem**
Mean	7.55	74.76	4.92	0.22	0.16	11.33
Median	7.55	76.55	5.07	0.22	0.15	11.40
Maximum	10.14	93.80	7.26	0.63	0.52	13.44
Minimum	3.92	14.50	1.65	0.02	0.02	9.04
Std. Dev.	1.28	11.16	1.22	0.11	0.08	0.97
Skewness	-0.19	-1.58	-0.56	1.23	1.22	-0.25
Kurtosis	2.52	7.57	3.07	5.87	6.01	2.38
Jarque-Bera	6.95	569.17	22.90	227.96	239.91	11.81
Probability	0.03	0.00	0.00	0.00	0.00	0.00
Sum	3338	33043	2174	86	62	5006
Sum Sq. Dev.	728	54946	655	4	3	414
Observations	442	442	442	384	384	442
	relprio	**lndva**	**relpriv**	**lndomact**	**lor**	**lnwg**
Mean	9.85	7.72	9.03	7.25	2.41	9.13
Median	4.98	7.64	4.40	7.16	2.46	9.23
Maximum	123.29	9.89	116.59	9.92	4.48	11.06
Minimum	0.27	5.18	0.43	3.81	-1.04	6.56
Std. Dev.	18.75	0.96	17.69	1.27	1.02	0.85
Skewness	4.73	-0.09	4.57	-0.06	-0.97	-0.61
Kurtosis	26.04	2.70	24.42	2.41	4.79	3.35
Jarque-Bera	11423	2.28	9989	6.75	129	30
Probability	0.00	0.32	0.00	0.03	0.00	0.00
Sum	4354	3411	3991	3203	1065	4036
Sum Sq. Dev.	155085	403	137976	706	458	321
Observations	442	442	442	442	442	442

Table A2. Correlation matrix of the variables for Model 1

Model 1	**lnx**	**GVC_b**	**GVC_f**	**relprio**	**lngdem**
lnx	1.000	0.237	0.399	0.519	0.666
GVC_b	0.237	1.000	0.455	-0.088	0.330
GVC_f	0.399	0.455	1.000	0.000	0.354
relprio	0.519	-0.088	0.000	1.000	0.259
lngdem	0.666	0.330	0.354	0.259	1.000

Table A3. Correlation matrix of the variables for Model 2

Model 2	dva_sh	lnx	relpriv	lndomact
dva_sh	1.000	-0.229	0.161	0.259
lnx	-0.229	1.000	0.514	0.525
relpriv	0.161	0.514	1.000	0.415
lndomact	0.259	0.525	0.415	1.000

Table A4. Correlation matrix of the variables for Model 3

Model 3	lnemp	lndva	lor	lnwg
lnemp	1.000	0.625	0.607	-0.586
lndva	0.625	1.000	-0.154	0.130
lor	0.607	-0.154	1.000	-0.843
lnwg	-0.586	0.130	-0.843	1.000