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Participation of Turkey in Global Value Chains: An Analysis Based on World Input Output Database

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PARTICIPATION OF TURKEY IN GLOBAL VALUE CHAINS: AN ANALYSIS BASED ON WORLD INPUT OUTPUT DATABASE*

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Abstract

This study examines the trends in Turkey's participation in Global Value Chains (GVCs), particularly through backward integration (i.e. vertical specialization-VS or the foreign content of value added in exports) between 1995 and 2011 utilizing the World Input Output Database (WIOD), and this is the first attempt to adopt WIOD for analyzing VS in Turkish exports at sectoral and trade partner dimensions. The findings show that Turkey's VS has increased between 1995 and 2011. Considering the sectoral trends in manufacturing with respect to technological classification, especially in the 2000's, Turkey's VS share in mid-high and high-tech sectors has increased faster than that in mid-low as well as low tech sectors. At individual partner level, Germany, China, Italy and France play important roles in VS of Turkish exports. Although Germany sustained the largest contribution to Turkey's VS up to 2010, in 2010 China became the top contributing country; however this contribution is chiefly in a low-tech industry such as textiles, thus is not necessarily conducive to Turkey's upgrading her position in GVCs. In that respect, integration into the GVCs through technology-intensive sectors via the technology imported from developed countries might better help improve Turkey's position in the world markets.

JEL Classification: F10, F13, F60

Keywords: Global Value Chains; Backward participation; Vertical Specialization; WIOD; Turkey

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1 Introduction

Globalization has been a crucial issue in economics and politics since the mid-20th century. Considering the economic aspect of globalization, it has a strong relation with international trade that makes it possible to exchange economic factors such as capital, and labor, as well as goods and services across countries. In this regard, global trade volume has increased in the last few decades. To put into perspective, according to the World Bank World Development Indicators, the share of volume of trade in world GDP has more than doubled from 25 percent in 1960 to 59.2 percent in 2014.

With the end of the Uruguay Rounds held during 1986-1995 and the subsequent establishment of the World Trade Organization (WTO) in 1995, reduction in tariff barriers and improvements in transportation and communication technologies rendered capital, labor and goods more global. These developments led to changes in the production process, and hence altered the nature of international trade. Increasingly, international trade, investments and production became to be governed through Global Value Chains (GVCs) where a good is produced in a number of different stages located across different economies, adding a little bit of value at each stage (Krugman 1995; de Backer and Yamano 2011). GVCs involve the production of intermediate goods like parts and components in one country, and then the export of these goods to other countries for further production and /or assembly into final goods (de Backer and Yamano 2011). It has also been argued that such fragmentation of production processes across the world has led to a reduction in export performance and employment generation of countries involved in international trade (Chen et al. 2004; Cappariello 2012). Correspondingly, the discussion of how much domestic value added is created by countries involved in international trade has become popular. In particular, China's

rapid exports have been examined in terms of domestic value added and employment generation (for example see Chen et al. 2004; Chen et al. 2012; Koopman et al. 2008, 2012).

Through transformations in international trade, the way by which trade, export performance and international competitiveness are measured began to change. According to Beltramello et al. (2012), export performance alone cannot measure the participation of a country into the GVCs since exports have both domestic and foreign contents, hence, the source of value added in exports must be identified. The concept of vertical specialization (VS) i.e. foreign content in a country's exports has been introduced for this purpose. Following the pioneering work of Hummels et al. (2001) which decomposes the foreign content and domestic content in exports, a large body of literature has emerged which measures countries' integration into the GVCs by using national input-output tables. To illustrate, Koopman et al. (2012), Dean et al. (2008) and Zhang and Sun (2007) adopted the Hummels, Ishii and Yi (HIY) method introduced in Hummels et al. (2001) to calculate VS shares for China. Similarly, using the HIY method, Breda et al. (2008) estimated the import content of exports for seven European Union (EU) countries. Other notable studies such as Chen and Chang (2006) for Taiwan and South Korea, Amador and Cabral (2008) for Portugal, and Hwang et al. (2011) for Northeast Asian countries also applied the HIY method.

In today's economic system, international trade can be regarded as a leading component of an economy in order to sustain economic growth for many countries. The integration of countries to the global economy via international trade used to be measured by their export and import shares in total world trade when the conventional trade indicators were considered. In that sense, Turkey, as an emerging economy, has attracted attention with an increasing growth rate in exports. Turkey's role in world trade with regards to export and import volumes has increased since 1980 when the focus of policy shifted from import substitution

industrialization to export-led growth and the implications of current account liberalization began to emerge. In fact, Turkey's export share in global exports has increased from 0.14 percent in 1980 to 0.75 percent in 2000 and to 0.85 percent in 2014, gaining an increasingly larger share in global demand. Turkish exports grew at double digits in the post-1980 period, with an even higher pace from 2001 to 2008 at 21.7 percent per year, until the global financial crisis in 2009. Although exports recovered in 2010, nevertheless the annual average rate of growth of exports remained slightly below 10 percent up to 2014. During the last decade or so, market diversification towards Middle East and North Africa and other markets, particularly at a time when the EU suffered from weak demand, helped Turkey recover from the negative effects of the global financial crisis. During this period, Turkey's exported product range also changed significantly, in addition to the traditionally dominant export item like apparel, products of the metals, machinery, and, to some degree, agri-food industries have taken an increasingly eminent position in the export basket. Moreover, Turkey has established revealed comparative advantage in new products such as transport equipment and by and large has shown a larger degree of export diversification than many of her peers like Brazil, Russia, India, China and South Africa, or the BRICS countries (The World Bank 2014).

As Turkey has increased her integration in the global economy through trade, Turkish firms in key sectors of the economy have successfully participated into GVCs and Turkey's presence in GVCs is stronger than some of her peers such as South Africa and Brazil (The World Bank 2014, OECD 2013a). According to OECD (2013a), based on OECD-WTO Trade in Value Added (TiVA) database, Turkey's GVC participation index[1] as of 2009 is just below 40 percent, and the index reveals that the use of foreign intermediaries in Turkish exports (i.e.

[1] This index shows what percentage of a country's exports are part of GVCs, either through upstream links (measuring foreign inputs/value added included in a country's exports, looking backwards along the value chain) or downstream links (measuring the domestic inputs/value added of the country contained in the exports of other countries, looking forward along the value chain) (OECD 2013a).

backward participation in the GVCs) is higher than the use of Turkish intermediaries in other countries' exports (i.e. forward participation in the GVCs). In fact, with the provision of intermediaries from abroad, Turkey strongly participates in manufacturing GVCs for chemicals, basic metals, textiles and transport equipment (OECD 2013a). Although Turkey has increased her integration in the GVCs, nevertheless she specializes in assembly and low value added i.e. standardized labor-intensive segments of the GVCs; however, as Turkey contributes strongly in sectors with longer than average value chains, such as motor vehicles, she still represents a good opportunity for upgrading her position along the chain (The World Bank 2014).

In order to assess Turkey's position in global production chains, particularly in textiles and apparel, food, motor vehicles, machinery, and TV production, Taymaz et al. (2011) use the UN-Comtrade international trade database for the 1970-2009 period. Benefiting from the Revealed Comparative Advantage index, they show that Turkey primarily specializes in slow growing sectors, and also maintains competitiveness in low-priced commodities. Despite these adversities, they claim that Turkey has been able to use the advantage of her geography and open up to new markets such as Russia, Ukraine, and Eastern Europe, nevertheless has not been able to ameliorate her position in global markets since she has not been competitive in fast growing or technologically advanced commodities. Mıhçı et al. (2016), on the other hand, examine the employment creation capacity of Turkish exports by calculating the domestic and foreign value added content of exports utilizing the input-output methodology and firm level data. Mıhçı et al. is the first study to use the OECD-WTO TiVA database for the period 1995-2008 to estimate the employment generation potential of sectoral exports of Turkey, and finds that due to falling domestic value added component of exports, between 1995 and 2008 the employment generation potential of exports has decreased.

Apart from Mıhçı et al. which uses the OECD-WTO TiVA database, to the best of our knowledge, there are no studies decomposing the domestic value added and foreign value added of Turkish exports using the more comprehensive World Input Output Database (WIOD). Following the method developed by Hummels et al. (2001), in this study we assess the foreign value added content in Turkish manufacturing exports i.e. vertical specialization / backward participation into GVCs. Employing WIOD and World Input output Tables (WIOT) available for 40 countries and 14 manufacturing sectors for the years 1995-2011, sector level contribution of each partner country to foreign value added in Turkish manufacturing exports is determined. In order to better understand Turkey's position in the GVCs, i.e. whether Turkey is involved at the low or high value-added segments of the chains, we also aggregate the 14 manufacturing sectors into low technology, mid-low technology, mid-high and high technology categories, as identified by the OECD (2011).[2]

The results of the analysis reveal an upward trend in Turkey's backward participation into GVCs. In fact, backward linkages of Turkey i.e. imported content in exports has increased from 13.9 percent to 22.3 percent between 1995 and 2011. Although this is a positive indication of a higher degree of integration in the GVCs, it is also crucial to see in which sectors the integration increases: in fact, Turkey is increasingly integrated into the GVCs via the mid-high and high technology sectors such as transport, electrical and optical equipment. Furthermore, the main contributor countries to Turkey's vertical specialization in exports are listed as China, Germany, France and Italy in the last two decades.

In Section 2, a brief literature review on GVCs and their role in changing the international trade patterns are presented. Section 3 includes an account of the evolution and general trends in Turkey's international trade since the 1980's, when export-led growth strategy took effect.

[2] The full technology intensity categorization by the OECD is given in Table A2 in the Appendix.

In Section 4, the methodology and data used in measuring the vertical specialization of Turkish manufacturing exports for the years 1995-2011 are introduced. Section 5 presents the vertical specialization analysis results and comments. Section 6 concludes the study.

2 Global Value Chains and Trends in International Trade

Increasing integration in the world markets has led to a course of disintegration in the production process where activities can be performed domestically or outsourced abroad by firms seeking to increase their profitability (Feenstra 1998). Although cost reduction appears to be the main driving motivation to engage in GVCs, which can be thought of as comprising all activities of firms' value chains including production, distribution, sales and marketing, R&D, innovation, etc., there are other incentives in firms' involvement in GVCs, such as entry into new emerging markets and the access to strategic assets and foreign know-how (de Backer and Yamano 2011). With the emergence of GVCs, countries have become more dependent on each other's demand, capital and production while they competed to attract investment and job opportunities. With the increasing outsourcing practices, i.e. the practice to subcontract non-core activities to independent suppliers, competition between companies has changed from being horizontal to vertical; horizontal competition refers to firms' competition in the same sector for the same customer-base, while the vertical one implies that firms in the same value chain compete to perform specialized tasks in the manufacturing processes. Consequently, firms choose different combinations of in-house production, offshoring (transfer of certain tasks to a foreign location) and outsourcing (purchase of intermediate goods and services from outside specialist providers) strategies in order to enhance their production performance. These different strategies implemented by companies have led to the fragmentation of the production processes across the world (de Backer and Yamano 2011; The World Bank 2014).

There is a well-known example to illustrate the fragmentation of the production process by the Apple Company (Linden et al. 2009). The iPod, an innovative product released to the market by Apple, is designed in the U.S., assembled in China by the manufacturers from Taiwan, and the key components are embodied by Japanese, South Korean and American suppliers. In that sense, monitoring which country has the most value added this production process helps to understand the indicators to measure the international trade competitiveness.

Measuring countries' international trade competitiveness along with their participation into GVCs has long been an important issue, moreover the increase in the globalization of trade and the geographic distribution of the production stages make the measurement even more complex. The conventional measurement of international trade competitiveness has been the export and import shares of the countries in the world trade but the conventional measurement and the one which takes GVCs into account may deliver different results. When the GVCs are considered, the specialization of the countries with respect to diverse production activities need to be analyzed thoroughly in order to get a more accurate measurement of trade competitiveness (Beltramello et al. 2012). For instance, when the bundle of exported intermediate goods is taken as a measure of trade competitiveness, it can be argued that emerging markets contribute more in low-tech industries to the world's trade. However, based on the analysis of export performance in terms of GVCs, it has been shown that emerging economies also have attained large shares of world's exports in high and medium-high technology industries (Kowalski et al. 2015). Furthermore, emerging markets have gained a considerable amount of export shares in final as well as in intermediate goods.

The specialization in production activities can be explained by the position in the production chain, such as upstream or downstream phases. The countries upstream produce the raw materials or the knowledge (e.g. research, design) involved at the beginning of the production

process, while the countries downstream assemble the processed products or specialize in customer services (The World Bank 2014). In general, upstream activities refer to the production of the intermediate inputs while downstream activities imply assembling of products at final stage. The position of a country in the production chain determines the benefits of participating in GVCs. For instance, although that benefit depends on the subject of the industry, research and development activities tend to create higher value added than assembly activity (OECD 2013b). When emerging markets are considered, they have been able to integrate rapidly into the global operations and enter new export markets thanks to GVCs, but this does not mean that these emerging markets necessarily are able to upgrade their position in world trade in the later stages of the production (Beltramello et al. 2012).

The determinants of the participation of countries in GVCs vary by the structure of the countries' production systems. The types of linkages in GVCs, i.e. backward and forward linkages, have been influential in the advance of a country's international trade competitiveness (Kowalski et al. 2015). In general sense, the backward linkage of a sector reflects the sector's dependence on local inputs within the production process of the economy. A strong backward linkage suggests a weak sectoral independence (Song et al. 2006). From the perspective of foreign trade, backward linkage into the GVCs involves foreign intermediate good contents in a country's exports, i.e. the dependence of a country's exports on imported intermediate goods. In other words, backward linkages into the GVCs indicate the extent of imported intermediate goods used in the production of the output that is exported (Banga 2014).

On the other hand, forward linkage of a sector implies the dependence of the rest of the sectors in the economy on this particular sector's supplies (Song et al. 2006). As far as the GVCs are concerned, forward linkage has the same pattern by reflecting the countries'

exported intermediate goods used in other countries' exports, i.e. other countries depend on the country's exports to continue their production processes. To illustrate, Turkey exports silk (as an intermediate good) to UK and a textile firm produces shirts using the silk imported from Turkey. After that process, the textile firm operating in UK exports shirts to Germany. In that case, while Turkey has forward contribution to the GVCs, UK has backward contribution.

According to Kowalski et al. (2015), the modes of contribution in the GVCs, i.e. backward or forward, have different effects according to the dominant determinants on the integration into the GVCs. These factors are divided into two groups as non-policy (or structural) and policy factors. The former refers to the policies which do not easily influence the integration into the GVCs in at least short or medium term, while the latter has an obvious effect via the investment and openness in trade. The non-policy or structural policies can be listed as market size, remoteness to the markets, level of development and degree of industrialization. Regional trade agreements and tariffs; openness to inward Foreign Direct Investment (FDI); other policies of interest; logistic performance border related procedures and infrastructure; education and training, intellectual property rights protection and research and development, and the quality of institutions and other policies related to GVC participation are policies that have an effect on the integration into the GVCs .

Kowalski et al. examines the integration into GVCs of the developing countries especially in Asia, Africa and Middle East regions, and provides some policy recommendations to increase their participation in the GVCs. The main outcome of the study is that regardless of whether countries participate in GVCs via backward or forward linkages, they will benefit from being a part of the production chain. Moreover, the authors have disagreed with the idea that the sophistication i.e. having high domestic value added is the most effective way for upgrading

an economy. They claim that the volume of the activity might matter as much as the domestic value added share.

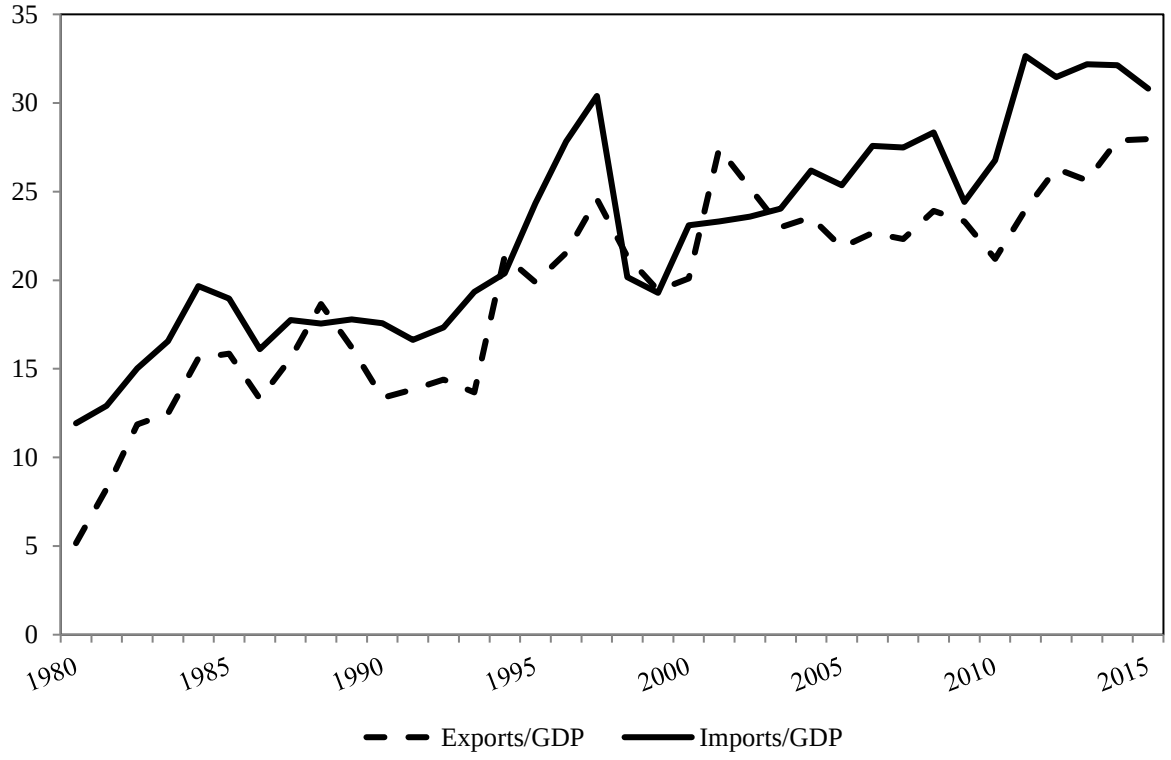
Although Banga (2014) has agreed with Kowalski et al. with respect to the definition of backward and forward linkages, she diverges from them in terms of benefits of being a part of GVCs; she claims that the benefit of participation into the GVCs might be measured by the net value added gains represented by the difference between forward and backward linkages. The analysis shows that countries like Japan, U.S. and UK have participated in GVCs more through forward linkages than backward linkages. On the other hand, backward linkages (i.e. foreign value in other countries' exports) are more dominant compared to forward linkages in case of China, South Korea, India, Malaysia, the Philippines, Thailand and Vietnam. Therefore, it can be said that developed countries create higher domestic value added in other countries' exports compared to foreign value added in own exports, while the case for developing countries is vice versa. When the sectoral distribution of value added in exports is investigated, it can be said that the benefits of participation into the GVCs can be gained via activities which involve more of marketing, managing and R&D. For instance, services share in the value added of exports is larger than that in other sectors for developed countries. However, the manufacturing sector still plays an important role in the value added contribution in export in developed countries.

In brief, the measurement of trade competiveness along with GVCs is a major issue in the GVCs analysis. Through conducting an analysis by applying a reasonable measurement, it is easier to determine policies related to countries' integration in GVCs: countries' position in global production chains i.e. whether they participate in the GVCs through backward or forward linkages, whether they are at the low or high-value added segments of the chains, and

the extent to which they participate play a crucial role in their integration to the global markets.

3 The Evolution and General Outlook in Turkish Foreign Trade

Since the foundation of the Republic of Turkey up until the 1980's, annual increases in Turkish foreign trade volume have been meager. In fact, the share of volume of trade in Turkish GDP was less than six percent in 1960, and only after the adoption of structural reforms aiming at export-led growth and abandonment of import substitution industrialization policies in 1980, volume of trade has shown considerable increases and its share in GDP has improved. Essentially, most significant improvements were observed during the 1990's, with an acceleration during the 2000's. On average, the growth of Turkish exports and imports in the 1980-2015 period was at 13.2 percent and 12.8 percent per annum, respectively, while the average annual GDP growth rate was about four percent. Accordingly, as Figure 1 shows, the share of exports in Turkish GDP has increased from 5.2 percent in 1980 to 20 percent in 2000 and to 28 percent in 2015, and the share of imports has increased from 12 percent of GDP in 1980 to 23 percent in 2000 and to 31 percent in 2015.



Source: The World Bank World Development Indicators

Figure 1. Exports and imports of goods and services as a share of GDP, Turkey (%)

One of the fundamental objectives of the structural adjustment program put into effect in 1980 was to transform the Turkish economy from being an inward oriented economy to an outward oriented one (Ersel 1991). At the start of the program in 1980, export promotion policies were prioritized, followed by significant liberalization steps in import regime starting in 1984. The basic ingredients of the outward oriented and export-led growth strategy were a stepwise liberalizing import regime, real devaluations, export incentives such as export tax rebates and subsidized export credits, and macroeconomic policies towards contracting the domestic demand (Taymaz et al. 2011). Signing of the Customs Union agreement between the EU and Turkey in 1996 and subsequent national and international developments led to a substantial transformation in the Turkish economy, particularly in terms of international trade. Unlike anticipated, industries which were initially against the Customs Union were not negatively

affected thanks to the major devaluation of the TL in 1994, and the implementation of several temporary measures. In fact, manufacturing sectors like the automotive sector gained significant competitiveness and export potential as they were forced to increase investments to cope with the fierce competition after the Customs Union agreement took effect (Yükseler ve Türkan 2008; Taymaz et al 2011).

Nevertheless, Turkey's post-1990 decade can be described as a period of instability, ending up with the economic and political crisis of 2001, which may qualify as the most intense crisis experienced in the Turkish economy. Implementation of the structural stabilization program in the post-2001 crisis period brought about relative stability and a major transformation in the economy. However this transformation process has also led to an increasing trade deficit, an increasing unemployment rate despite a high growth rate, and significant losses in competitive power in international markets, matched with the real appreciation of the domestic currency (Yükseler and Türkan 2008). In fact, according to Yükseler and Türkan (2008) and Aysan and Hacıhasanoğlu (2007), the post-2001 crisis period can be characterized as a period of "*importization, internationalization,* and *Asianization*" for the Turkish manufacturing industry. During the same period, China's increasing integration to the world economy also has led to new tendencies in manufacturing sector production across the world.

One notable observation from the Turkish economy in the post-2001 period is that import dependency in the manufacturing sector has increased as the sectoral composition of production has shifted in favor of sectors which intensively utilize imported inputs, particularly the exported goods sectors (Yükseler and Türkan 2008, Taymaz et al. 2011). Looking back at the post-1980 period more closely using the TurkSTAT database, one can observe that a steady rise in the share of import of capital goods in total imports, which continued in the 1990's a well, is accompanied with a steady fall in the share of imported raw

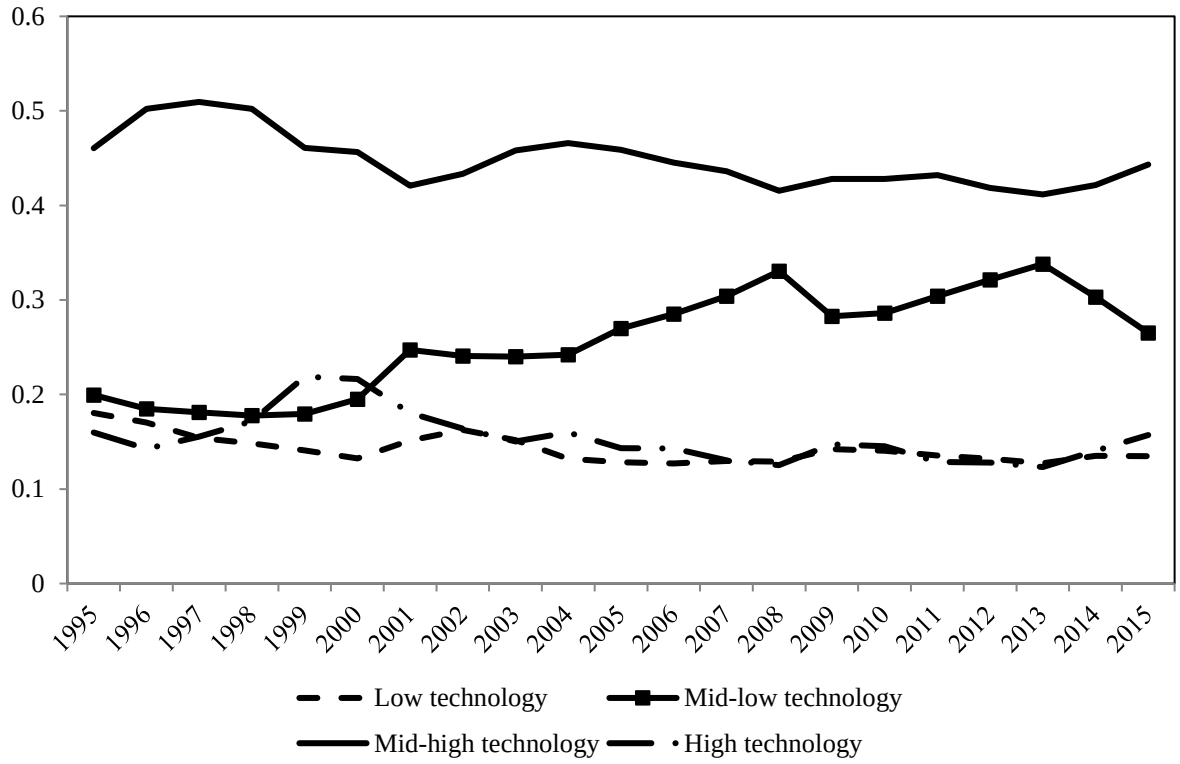
materials. However this trend is reversed in the post-2001 period as now raw materials make up for a higher share of imports with a fall in the share of capital goods. On average, the share of capital goods in total imports has increased from 16 percent in 1980's to 22 percent in 1990's, and again fell back to about 16 percent in 2000's. On the other hand, the share of raw materials in total imports fell from 79 percent in 1980's to 67 percent in 1990's, and increased again to about 72 percent in 2000's. All through the post-1980 period, we observe a steady rise in the share of consumer goods imports, from 5.5 percent of imports in 1980's to 8.8 percent in 1990's and to 12.6 percent in 2000's.

Examination of the exports for the same time intervals reveals that the share of capital goods in total exports has increased considerably from an average of 2.2 percent in 1980's to 10 percent of exports in 2000's (which kept consistently at about 10 percent per year all through the 2000's, with no significant increase or decrease). Still, Turkey remains to be an economy prominently exporting raw materials and consumer goods: although there was a slight decline in the share of raw materials in total exports from 53 percent in 1980's to 43 percent in 1990's, particularly in the post-2008 period, it has increased back to 50 percent, most likely thanks to accelerating export of raw materials to China. During this time the share of consumer goods exports declined from 53 percent in 1990's to slightly less than 40 percent in the post-2008 global crisis period. The steady decline in the share of capital goods in imports and the increase in the share of raw materials and consumer goods imports, together with the rapid rise in share of raw materials exports from the 1990's to the 2000's give us clues about the shifts in the structure of foreign trade, and therefore the value added in production and Turkey's participation in the GVCs (Taymaz et al 2011).

Recognizing that manufacturing sector exports make up more than 90 percent of all exports and manufacturing imports constitute about 80 percent of all imports since the mid-1990's in

Turkey, it becomes essential to examine the manufacturing sector trade in more detail. When we categorize the manufacturing sectors with respect to their technological intensities[3] based on trade data from TurkSTAT, we observe that from the 1990's into the 2000's, consistently the most prominent import category has been the mid-high technology category, which comprises of machinery and equipment, chemicals and transportation equipment with about 45 percent of total manufacturing imports, on average (Figure 2). Import of mid-low technology manufacturing goods, which are manufactured intermediate goods, like rubber and plastics, basic and fabricated metals as well as refined petroleum, has been in a slightly increasing trend from 20 percent of manufacturing imports in 1990's to as high as 34 percent by 2013. Imports of low technology (mainly food, textiles and apparel) and high technology (i.e. electronical and optical equipment, and pharmaceuticals) products, which are predominantly consumer goods, each remained at about 10 percent of total manufacturing imports from the 1990's into the 2000's.

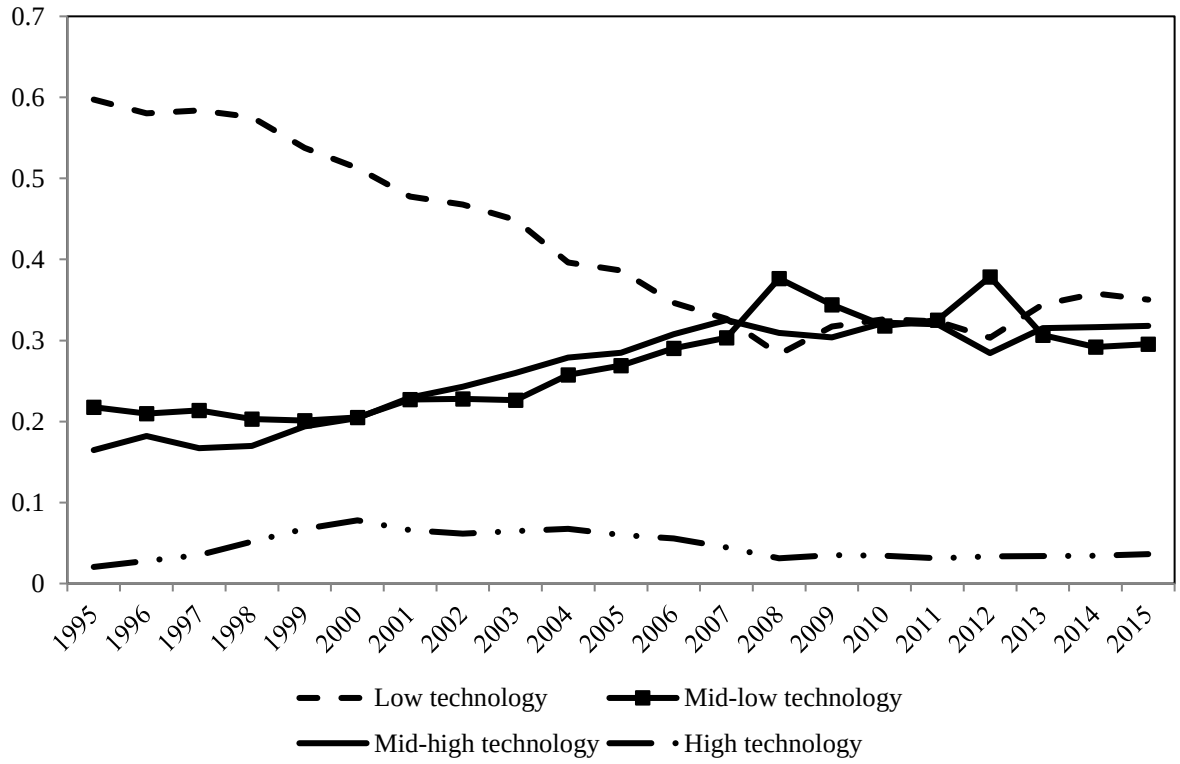
[3] The OECD technology classifications are given in Table A2 of the Appendix.



Source: TurkSTAT database and authors' calculations based on OECD technology classification

Figure 2. Import shares by technology category in manufacturing total

Manufacturing exports on the other hand, depict more significant shifts across technological categories from the 1990's into the 2000's (Figure 3). In particular, while the share of low technology manufacturing exports has been on a decline from 60 percent in mid-1990's to about 35 percent by 2015, the shares of mid-low and mid-high technology exports have been on a consistent rise, each from about 20 percent of total manufacturing exports in the 1990's to each about 30 percent by 2015. Additionally, high technology exports have remained at about 5 percent of total manufacturing exports during the period from the 1990's into the 2000's, not showing any particular upward or downward trend.



Source: TurkSTAT database and authors' calculations based on OECD technology classification

Figure 3. Export shares by technology category in manufacturing total

Considering the top six trading partners of Turkey with respect to trade volume, as given in Table 1, we observe that China has consistently increased her share in Turkish imports in all technology categories particularly rapidly in the 2000's. While Germany and the US appeared to be the top two trading exporters to Turkey (US in low and high technology, Germany in mid-low and mid-high technology categories in 1995) China has taken the leading role in low and high technology categories in the 2000s. In the imports of mid-high technology goods, Germany has maintained her top position although China has shown a notable increase in that category as well, taking the second leading position. Import of goods in mid-low technology category, on the other hand, is dominated by the Russian Federation in the 2000's mainly due to the imports of coke, refined petroleum and nuclear fuel from this country.

In exports, Germany holds the top partner position in all categories in all years, except for Italy in mid-low technology products in 1995 and 2000, but loses the top partner position

again to Germany afterwards. [4] Despite being a leading partner in imports, China does not appear to be an important partner in exports of Turkey in manufacturing, since China heavily imports raw materials from Turkey, more specifically products of the mining and quarrying industry. In that respect, currently about 60 percent of Turkish exports to China consist of mining and quarrying products.

Table 1. Manufacturing imports, country shares of top trading partners of Turkey (%)

	1995	2000	2005	2010	2011	2015
Low technology						
China	5.8	6.6	13.6	20.1	20.9	18.5
Italy	7.7	12.4	10.7	7.0	6.8	7.0
Russian Fed.	5.5	4.9	2.5	2.3	2.1	6.1
Germany	9.0	11.1	8.1	6.9	6.8	5.5
USA	9.1	8.3	5.1	5.7	5.3	4.8
UK	5.0	5.0	2.5	1.2	1.5	1.5
Mid-low technology						
Russian Fed.	9.1	13.5	16.2	23.3	12.7	14.0
China	1.1	2.3	3.2	5.7	5.6	9.8
Germany	13.3	11.3	8.2	5.6	5.2	6.7
Italy	11.1	8.4	5.5	6.3	7.0	5.8
USA	3.2	2.3	1.9	2.0	3.0	2.7
UK	3.5	3.4	2.1	1.1	1.1	2.0
Mid-high technology						
Germany	24.7	22.3	20.1	18.6	19.2	19.3
China	0.7	1.5	4.9	9.9	10.0	12.1
Italy	14.5	11.6	9.5	8.2	8.6	7.6
UK	6.5	5.5	6.6	4.2	4.0	4.1
US	7.1	4.6	3.7	4.0	3.9	3.8
Russian Fed.	2.3	1.4	1.4	1.3	1.3	1.1
High technology						
China	1.5	4.5	15.4	20.7	22.3	27.8
USA	30.6	15.6	9.4	19.0	18.3	13.5
Germany	13.7	10.1	12.4	8.5	11.0	10.1
Italy	4.7	5.3	5.3	3.9	3.8	2.9
UK	8.5	10.6	5.5	3.5	2.7	2.2
Russian Fed.	2.0	0.1	0.0	0.0	0.1	0.0

Source: TurkSTAT database and authors' calculations based on OECD technology classifications.
Note: In each category, countries are sorted with respect to their shares in total as of 2015.

[4] The country shares of top trading partners of Turkey in exports is provided in Table A1 in the Appendix.

Observing the shift in Turkey's exported manufacturing products across technology categories, mainly from low technology towards mid-low and mid-high technology categories since the mid-1990's, one may also expect a shift in the imported content of exports, as exports move up to higher technology levels. In fact, one can claim that the shift in the sectoral composition of exports favors the sectors which intensively use imported inputs. Accordingly, the degree to which "*importization, internationalization, and Asianization*" in Turkish manufacturing occurs can be analyzed by decomposing the domestic and foreign value added content of exports. To do so, in the next section we introduce the methodology by Hummels et al. (2001) and the data used in our analysis.

4 Data and the Methodology

In order to assess the progress of Turkey's integration into the GVCs over time by implementing the HIY method, consistent input-output tables for multiple years, multiple sectors and countries are needed. For this purpose, we resort to the input-output tables in the WIOD as they provide the transactions for 35 sectors and 40 countries[5] (plus the Rest of the World account) for the period 1995-2011.[6] In the current study, using the WIOD and the HIY methodology, we measure the share of foreign value added in Turkish exports for the period 1995-2011 for each partner country and 14 manufacturing sectors. In order to further determine Turkey is engaged in whether the low-value-added or the high-value-added segments of the chains, we aggregate the 14 manufacturing sectors into three main technological categories, low-technology, mid-high technology, and mid-high and high technology sectors based on OECD (2011) technology classification. In the analysis using WIOD, we had to aggregate mid-high and high technology categories into one since the sector

[5] The complete lists of sectors and countries included in the WIOD are given in the Appendix, Tables A3-A5.
[6] Other notable input-output databases are provided by the GTAP and OECD-WTO ICIO, but none of them are as comprehensive as the WIOD in analysing the progression of cross-country linkages in GVCs as a time series.

definifitons in the WIOD do not allow us to disaggregate mid-high and high technology sectors. The classification is provided in Table A4 in the Appendix.

In the literature measuring foreign value added content of exports (i.e. vertical specialization or backward integration) of individual countries or regions, one of the most prominent methodologies is by Hummels et al. (2011), known as the HIY methodology. Applying the HIY method for the 35 sectors and 40 partners of Turkey (39 partner countries and the RoW), we construct the vertical specialization vector as given in equation (1),

$$VS = uA^M[I - A^D]^{-1} \qquad (1)$$

where VS is a 1×35 vector that represents the foreign content in production of 35 industries, A^D is a 35×35 square matrix which denotes the share of the domestically produced intermediate goods, the matrix ($[I - A^D]^{-1}$) is a 35×35 square Leontief matrix that reflects the coefficients for the total domestic output requirement; while A^M is a 35×35 square matrix that shows the share of imported intermediate goods in the total output (i.e. the ratio of the value of imported intermediate goods used from sector i to produce goods for sector j to total output produced in sector j, $\frac{M_{ij}}{Y_j}$), and finally u is a 1×35 vector of ones. Therefore the uA^M is the column sum of the share of imported intermediate goods, i.e. it shows the sectoral share of the imported intermediate goods in total output. In the HIY method, it is assumed that the imported intermediate goods used for the domestic production and those used for exports have the same intensity. Therefore, VS represents the coefficient for foreign value added. Since the aim of this study is to measure the foreign value added in Turkish exports, the VS coefficients multiplied by exports of a given year yield the foreign value added of exports of that year. Accordingly, *the foreign value added content* in Turkish exports is obtained as in equation (2):

$$VSX = uA^M[I - A^D]^{-1}X \quad (2)$$

where X is a 1×35 vector of exports for a given year, while VSX is the value of the foreign content of exports for that year. Then, the overall VS share in exports is equal to the ratio of the value of the foreign content of exports to total export value of the subjected year (Equation (3)):

$$Overall\ VS\ share\ in\ total\ exports = \frac{VSX}{X} = \frac{uA^M[I-A^D]^{-1}X}{X} \quad (3)$$

Additionally, in order to measure individual countries' share in foreign content of Turkish exports, the "Countries vs Turkey" matrix[7] was constructed, so that Turkey's use from other countries' intermediate goods can be obtained. The "Countries vs Turkey" matrix was separated into 40 parts by 39 countries and the RoW. In that way, it is easier to observe the use of the intermediate goods from each country in the gross output. Therefore, there were 40 square matrices each with the dimension of 35×35. By using these matrices, the coefficient matrix for each country was obtained. Recall that the total imported intermediates coefficient matrix, A^M, is the ratio which the value of imported intermediate goods used from sector i to produce goods for sector j to total output produced in sector j $\equiv \frac{M_{ij}}{Y_j}$. In this case, the ratio of the value of imported intermediate goods from each country c used from sector i to produce goods for sector j to total output produced in sector j $= A_c^M \equiv \frac{M_{ij}^c}{Y_j}$ where c is an index of partners from 1 to 40. Accordingly, the VS of each country c in total exports is given by

$$VSX_c = uA_c^M[I - A^D]^{-1}X \quad (4)$$

[7] Turkey in the supply part (rows) was excluded.

Since the coefficient matrix A^M of the total imported intermediate goods is equal to the sum of the coefficient matrices from each country, i.e.

$$A^M = \sum_{c=1}^{40} A_c^M \tag{5}$$

one can find that the total value of foreign content of Turkish exports is equal to the sum of the contents from each country in Turkish exports:

$$\sum_{c=1}^{40} uA_c^M[I - A^D]^{-1}X = \sum_{c=1}^{40} VSX_c = uA^M[I - A^D]^{-1}X = VSX \tag{6}$$

Finally, in equation (7), it is depicted that the overall VS share in Turkish exports is equal to the sum of all countries' value added shares in Turkey's exports:

$$\sum_{C=1}^{40} \frac{VSX_c}{X} = \frac{uA^M[I - A^D]^{-1}X}{X} = \frac{VSX}{X} \tag{7}$$

5 Results

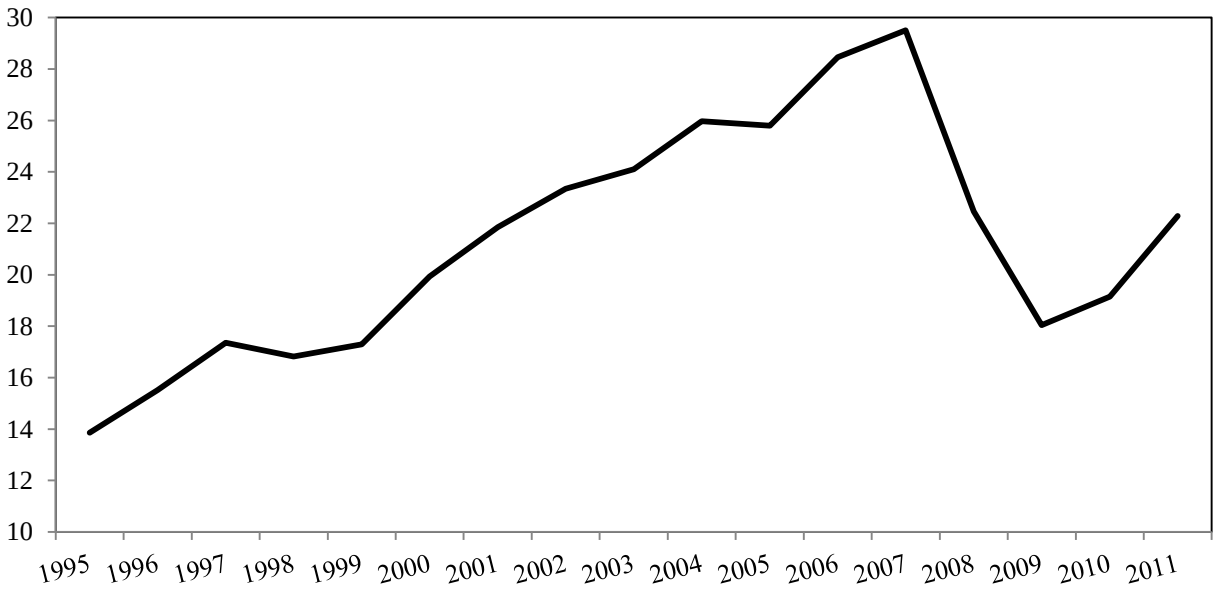
In this section we firstly report and analyze Turkey's overall integration into GVCs as measured via backward linkages. Secondly, results from the analysis focus on manufacturing sectors classified according to their technology intensities. Finally, countries' shares in foreign value added content of Turkish exports are assessed and investigated.

As mentioned before, manufacturing sector is the focus of this study in order to analyze the recent developments in foreign trade, as the majority of Turkish trade is in manufacturing:

although the share of services sectors in total exports has begun to rise in recent years, the manufacturing sector still makes up a substantial part of Turkish exports as a structural feature of Turkish foreign trade. Another reason that we focus on the manufacturing sector is because the intermediate goods are primarily utilized by this sector.

5.1 Turkey's Backward Participation to GVCs

Based on the results of our analysis, an increasing trend in overall vertical specialization share in Turkish exports ($\frac{VSX}{X}$) is observed (Figure 4), implying that the value of foreign content in exports is rising faster than the value of exports. After reaching a peak in 2007, a sharp decrease can be detected in the share of vertical specialization in total Turkish exports. The average share of vertical specialization of Turkey is 21.3 percent between 1995 and 2011. Although the increase in the integration to GVCs has been interrupted between 2007 and 2009, there is nevertheless a 8.4 percentage point increase from 1995 to 2011.



Source: WIOD, and authors' own calculations

Figure 4. Vertical Specialization Share of Turkish Exports (%)

In order to make sense of this dramatic fall in backward participation of Turkish exports from 2007 to 2009, recall that the vertical specialization share is calculated as the ratio of the foreign value added content of exports to total exports. Mathematically, this dramatic fall could be stemming from a decrease in foreign value added content of exports or an increase in exports: total exports increased by 23.4 percent from 2007 to 2008, while the value of imported intermediate goods used for exports decreased by 6 percent. Therefore, it can be stated that the fall in vertical specialization share between 2007 and 2008 mostly originated from an increase in exports. On the other hand, when the fall between 2008 and 2009 is examined, a different factor can be noticed: the value of imported intermediate goods used in the production of exported goods and the total exports have both decreased however, the decrease in the foreign value added content of exports was more than that of total exports. In that sense, it can be said that the main reason of fall in vertical specialization share between 2008 and 2009 is the decrease in the foreign value added of exports. That is, while the foreign demand for Turkish manufactured products decreased with the global crisis, the Turkish demand for imported intermediate goods used in exported manufacturing goods fell even more, implying that Turkish producers shifted their demand towards domestic intermediate goods during the crisis.

As known, the global economic crisis has started in 2008 but the impacts of crisis became more prominent by 2009; imports, exports, and industrial production all fell and hence 2009 is the year that the Turkish economy has contracted[8]. Since the industrial production shrunk, the decline in backward participation of Turkey in GVCs is not a surprising result. One can attribute this decline to the overall decrease in share of intermediate goods in total imports in Turkey during the global crisis. In fact, the share of intermediate goods in total imports was

[8] In 2009 compared to 2008, based on TurkSTAT database, a 30.2, 22.6, 10.4 and 3.6 percent decrease in imports, exports, seasonally and calendar adjusted industrial production index and growth rate based on constant prices, respectively, can be observed.

83.6 percent in 2007, it has decreased first to 61.2 percent in 2008, and then to 55.4 percent in 2009 (WIOD). Nevertheless, vertical specialization of Turkey has started to pick up after 2009 with the increase in industrial production as well as the volume of exports. The other reason of the fluctuation can be the shift in the sectoral composition of exports during the global economic crisis. Table 2 demonstrates that the export share of sectors which heavily use imported intermediate goods in their production such as machinery, transport, electrical and optical equipment all experienced a decrease in 2008, while an increase can be observed in the export share of textiles and textile products from 2008 to 2009.

Table 2. The Shares of Exports by Manufacturing Sectors (%)

	1995	2000	2005	2006	2007	2008	2009	2010	2011
Textiles and textile products	36	36	25	23	21	15	17	17	16
Basic metals and fabricated metal	11	10	13	15	16	19	16	15	15
Transport equipment	5	10	16	17	18	15	13	13	13
Machinery, nec	3	5	6	7	7	6	6	7	7
Food, beverages and tobacco	10	7	6	5	5	5	5	6	6
Electrical and optical equipment	5	7	7	7	7	5	5	5	5
Coke, ref. petroleum and nuclear fuel	1	1	3	4	5	5	3	3	4
Rubber and plastics	2	3	3	3	4	3	3	4	4
Manufacturing, nec	2	2	3	3	3	3	3	4	4
Chemicals and chemical products	5	5	4	4	4	3	3	3	3
Other non-metallic mineral	3	4	4	3	3	3	3	3	3
Pulp, paper, printing and publishing	1	1	1	1	1	1	1	1	1
Leather, leather and footwear	1	1	1	1	1	0	0	1	1
Wood and products of wood and cork	0	0	0	0	0	0	0	0	0

Source: WIOD
Note: The sectors are sorted with respect to their shares in total as of 2011.

5.2 Manufacturing Sectors and Technology Classification Based Analysis

As emphasized previously, the manufacturing industry is the focus of this study since it has a dominant role in Turkish exports. Based on WIOD, the share of manufacturing sector exports in total exports is 86.9 and 81.6 percent in 1995 and 2011, respectively.

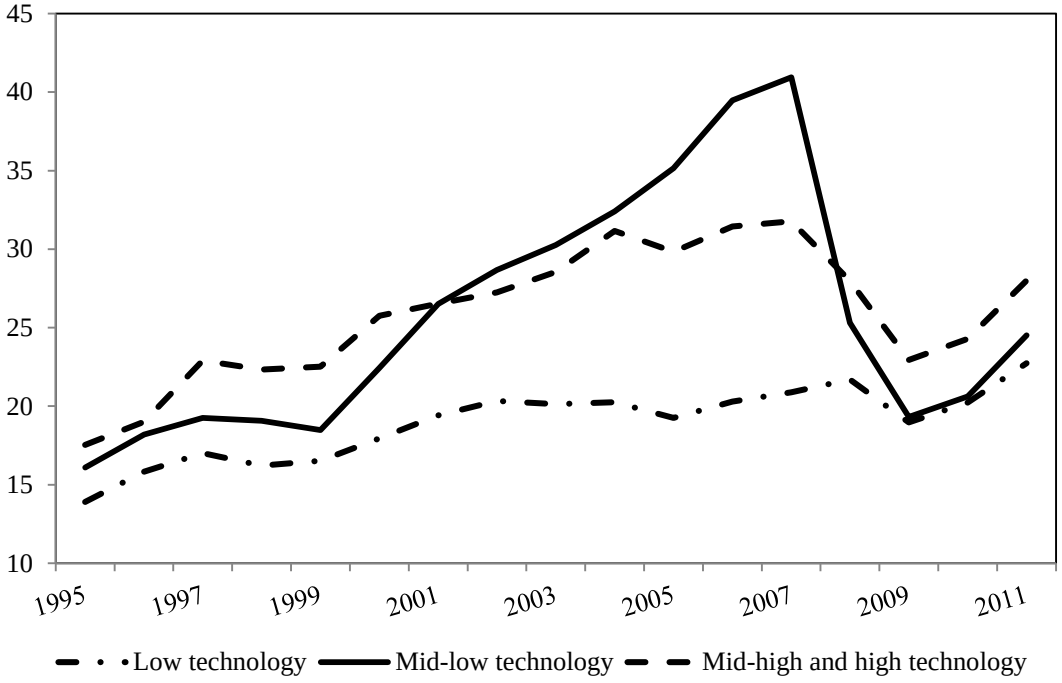
Backward participation of Turkey into GVCs in manufacturing exports is higher than that in total exports. In fact, as the manufacturing sector is relatively more capital-intensive than

agriculture and services and requires more intermediate goods to maintain the production process, and as the Turkish manufacturing sector predominantly uses imported intermediate goods (the share of imported intermediate goods used in manufacturing is on average 56 percent of all intermediate goods used in manufacturing between 1995 and 2011), the higher vertical specialization share in this sector is an expected outcome.

Based on technology classification by the OECD (2011), manufacturing sectors are categorized into four groups such as low, medium low, medium high and high level of technology (please see Appendix Table A2). OECD divides medium-high and high level technology sectors by three and four digit ISIC codes. However, the WIOD provides only two digits of ISIC codes. Therefore, sectors included the medium high and high technology level sectors are aggregated and there are three technology levels such as low (low-tech), medium low (mid-low-tech), and medium-high and high tech in what follows (please see Appendix Table A4 for the list of manufacturing sectors and the technology categories).

Figure 5 depicts that consistently for all years, the share of foreign value added content in low technology manufacturing sector is lower than that of both mid-low and mid-high and high technology manufacturing sectors, and most of the time, rises at a slower pace than the other two technology categories. These is an expected outcome since the low technology manufacturing sectors are relatively more labor-intensive and require low technology intermediate goods which can be manufactured in Turkey. On the other hand mid-low, mid-high and high technology sectors such as plastics, metals, chemicals, machinery and transport, electrical and optical equipment necessitate more imported intermediates in production. As Turkey's exports particularly in mid-low and mid-high technology products increased by mid-1990's, Turkey's dependence on imported intermediate goods also increased in the process in order to sustain production and exports. However this dependence on imported intermediate

goods for exports reduced Turkey's competitive power at the time of the global crisis (Yükseler 2011).



Source: WIOD, and authors' own calculations

Figure 5. Vertical Specialization Shares in Exports by technology classifications (%)

Overall, the mid-high and high technology sectors (except for chemicals) all have an upward trend in vertical specialization between the years 1995 and 2011. In Figure 5, it can be observed that the foreign value added content in exports of mid-high and high technology sectors has been affected by the global economic crisis occurred during 2007 and 2009. On the other hand, as given in in Table 3, the least affected sector was the transportation equipment. Unlike the other mid-high and high technology sectors, the vertical specialization share of transport equipment exports continued to rise after 2008. Moreover, among the mid-high and high technology sectors, the vertical specialization share in transportation equipment exports has the highest growth rate with 3.9 percent growth between the years 1995 and 2011.

Accordingly, export share of transportation equipment has also increased in the relevant period (Table 2).

Table 3. Vertical specialization shares in manufacturing exports (%)

	1995	2000	2005	2010	2011
Low technology					
Food, beverages and tobacco	9.1	13.8	13.0	11.3	14.6
Textiles and textile products	15.4	18.4	19.3	23.0	25.3
Leather, leather and footwear	17.9	20.1	17.5	13.2	15.9
Wood and products of wood and cork	9.2	21.5	25.4	13.1	15.7
Pulp, paper, printing and publishing	11.6	17.9	21.1	11.1	12.9
Manufacturing, nec; recycling	11.1	21.1	30.3	25.6	30.1
Mid-low technology					
Coke, ref. petroleum and nuclear fuel	26.1	42.6	68.2	9.9	12.0
Rubber and plastics	22.1	26.1	28.5	14.7	17.5
Other non-metallic mineral	9.5	12.8	16.2	11.8	14.0
Basic metals and fabricated metal	15.8	22.9	33.7	26.3	31.5
Mid-high and high technology					
Machinery, Nec	14.0	20.2	26.2	19.0	22.9
Chemicals and chemical products	18.9	23.3	24.5	12.2	14.8
Transport equipment	18.6	27.0	32.2	31.3	35.6
Electrical and optical equipment	17.4	29.7	30.4	20.9	24.3

Source: WIOD, and authors' own calculations

To summarize, as given in Table 3, the foreign value added content in exports has increased in 10 out of 14 manufacturing sectors from 1995 to 2011. The analysis based on technological intensity of sectors shows that vertical specialization shares of mid-low technology and mid-high and high technology exports are equal to each other at 26 percent considering the average of 17 years. As expected, mid-high and high technology sectors have higher VS shares since they require more imported intermediate products which are not produced in Turkey (production of intermediate goods used in mid-high and high technology sectors are relatively more technology intensive and require more R&D activities). Likewise, the mid-low technology sectors such as basic and fabricated metals and coke, refined petroleum and nuclear fuels use considerable amounts of imported intermediate goods, and in fact the fast

increase in the VS share of mid-low technology sectors in the 2000's originates from the coke, refined petroleum and nuclear fuel sector (Table 3).

Turkey's participation into GVCs via backward linkages (i.e. imported content in exports) has been mainly via the mid-high and high technology sectors. As expected, the trend observed in the sectoral compositions of vertical specialization is closely related to the export shares of these technology categories. Therefore, this outcome is consistent with the results of the study conducted by Kowalski et al. (2015) that the emerging economies have gained a larger share in high technology sectors along the GVCs. However it must still be noted that although Turkey has increased her vertical specialization, the share of high technology exports in total exports of Turkey is nevertheless rather low at about 4-5 percent, and Turkey is integrating to the world markets mostly through the mid-high technology products, which are predominantly transport equipment (which implies that Turkey participates through assembly into final good at the low-end of the production chain) as well as intermediate and capital goods such as machinery and chemicals.

5.3 Countries' Shares in Foreign Content of Turkish Exports

Methodology for the assessment of the distribution of countries in foreign value added content in Turkish exports was presented in Section 4. In this subsection, we present the results of the country level analysis. In Table 4, the contribution shares of top eight countries and the RoW[9] to Turkey's vertical specialization in manufacturing are exhibited.

[9] RoW represents all countries in the world except those 40 included in the WIOD.

Table 4. Contribution shares to the VS of Turkish manufacturing exports, 1995-2011[10]

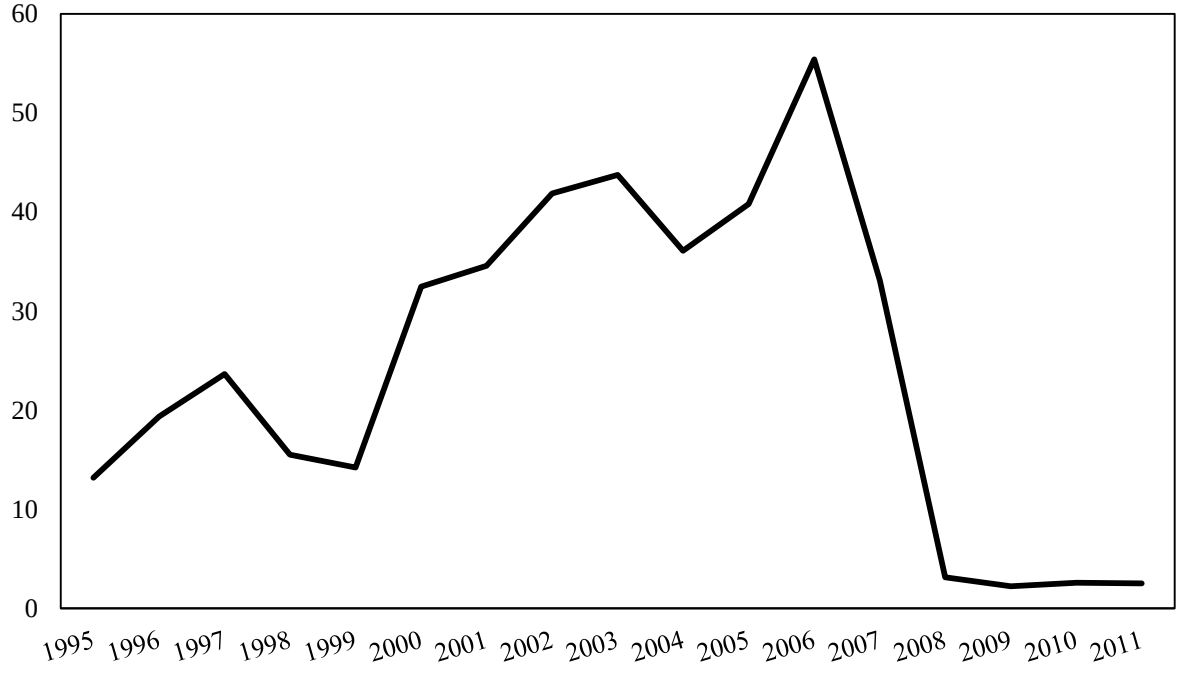
Countries	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011*
RoW	18.3	19.5	17.1	16.2	17.2	23.1	27.2	28..4	29.7	29,8	34.3	37.1	34.5	28.8	18.6	19.1	19.4
China	5.9	3.4	3.3	3.6	3.1	3.2	2.6	3.0	3.7	4.0	4.4	4.8	5.4	8.5	10.9	13.0	13.2
Germany	15.7	16.6	16.4	15.8	16.0	13.6	12.8	12.9	12.6	12.4	10.5	10.1	9.1	11.0	12.1	11.2	11.0
Italy	10.6	11.5	10.9	10.5	9.4	9.5	10.2	9.0	8.6	6.8	5.8	5.2	4.9	6.5	7.5	7.1	6.7
Spain	2.0	2.5	2.9	2.7	3.1	3.2	3.0	3.0	2.6	3.6	3.2	3.0	2.7	4.2	5.0	5.1	5.5
Russian Fed.	8.5	6.7	4.4	5.7	7.1	5.1	6.7	5.9	5.5	7.8	9.7	9.7	14.0	5.6	5.1	4.9	5.2
France	6.0	6.3	7.3	7.2	8.8	7.3	5.8	6.2	6.4	6.1	4.8	4.5	4.0	5.4	6.5	5.1	4.8
UK	4.4	4.9	5.3	5.2	5.1	4.9	4.8	4.7	5.8	4.0	3.2	2.7	2.3	3.7	3.9	4.4	4.4
USA	4.4	3.9	5.3	4.4	3.8	3.6	4.2	2.7	2.2	1.9	1.8	1.6	1.7	1.6	2.1	1.8	2.2

Source: WIOD, and authors' own calculations
**Note:* Table is sorted with respect to 2011 shares.

[10] The shaded cells refer to the top five countries and RoW, which contribute most to foreign content of Turkish Manufacturing exports in each year.

The share of RoW in foreign value added in Turkish manufacturing sectors has always been the highest between the years between 1995 and 2011. Although the RoW's share in foreign content of Turkish manufacturing exports is the highest among all countries through 17 years, and it has increased until 2006, then a sharp decrease has been observed between 2007 and 2009 (Table 4).

The important part of the foreign value added in Turkish manufacturing exports generated by the RoW in the sectors basic metals and fabricated metal, machinery, and other manufacturing in 2011. However, in 1995 foreign content share of coke, refined petroleum and nuclear fuel sectors is the highest among the sectors contributed by RoW. As a matter of fact, the value added created by RoW in coke, refined petroleum and nuclear fuel exports of Turkey has a fluctuating trend similar to the backward participation of that sector during the 17 years (Figure 6).



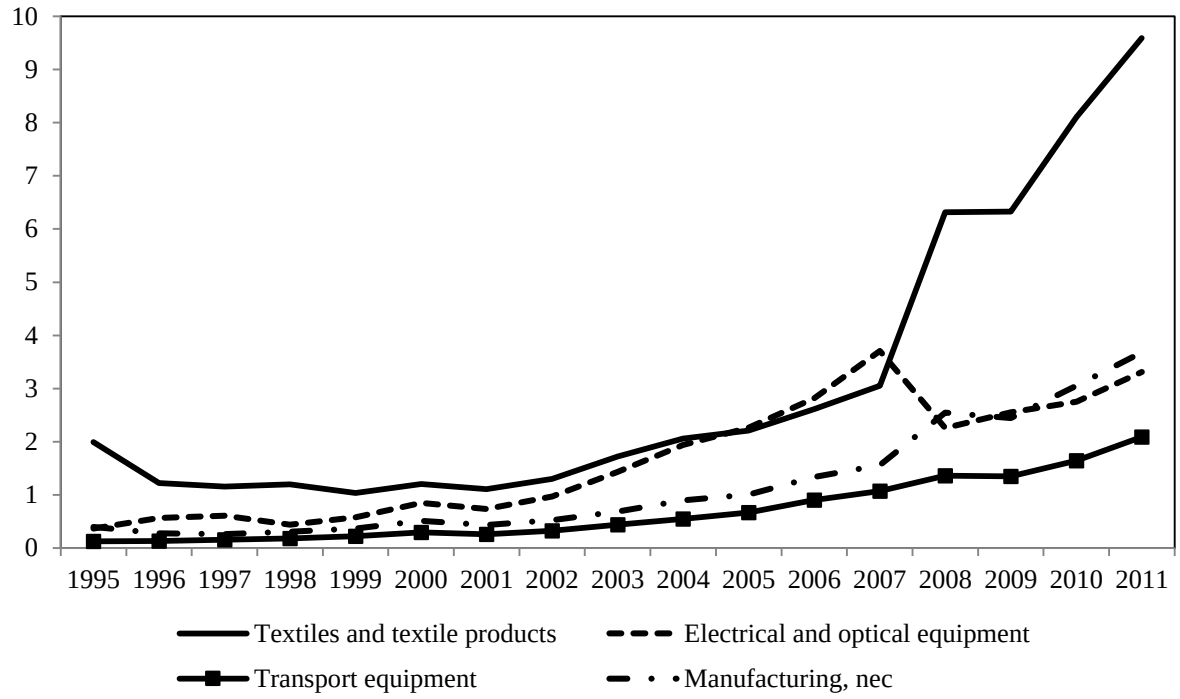
Source: WIOD, and authors' own calculations

Figure 6. The contribution of RoW to foreign value added share in Coke, Refined Petroleum and Nuclear Fuel exports of Turkey (%)

Considering the factors behind this dramatic fall, we investigate the country distribution of petroleum imports in detail, which is dominates Coke, Refined Petroleum and Nuclear Fuel imports. First of all, share of countries involved in the RoW classification such as Libya, Saudi Arabia and Algeria in petroleum imports has decreased between 2006 and 2011. While the petroleum import shares of these countries were decreasing, the share of countries not included in RoW such as India, USA and Italy has increased in the same period. Hence, RoW's share in foreign content of Turkish exports between 2006 and 2011 can be explained by the decreasing amount of petroleum imports of the countries included in RoW category.

While the share of RoW in foreign value added embedded in Turkish exports has begun to fall after 2006, China's contribution has increased. As can be seen in Table 4, a continuous upward trend has been observed after 2001, especially between 2007 and 2010, a sharp rise is attracted attention. Moreover, it can be stated that China's contribution has replaced RoW's contribution to the foreign value added in Turkish exports.

When the role of China in foreign content of Turkish manufacturing exports on a sectoral basis is examined, it can be said that textile sectors, which is included in low-tech category, has had an important role in import of China for all years. In particular, the contribution of China to vertical specialization share in Textile exports increased sharply from 2007 to 2011 (Figure 7). As was mentioned, these years correspond to the global economic crisis period. Therefore, it can be said that the contribution of China to foreign value added in textile exports of Turkey has begun to increase in the period of global economic crisis.



Source: WIOD, and authors' own calculations

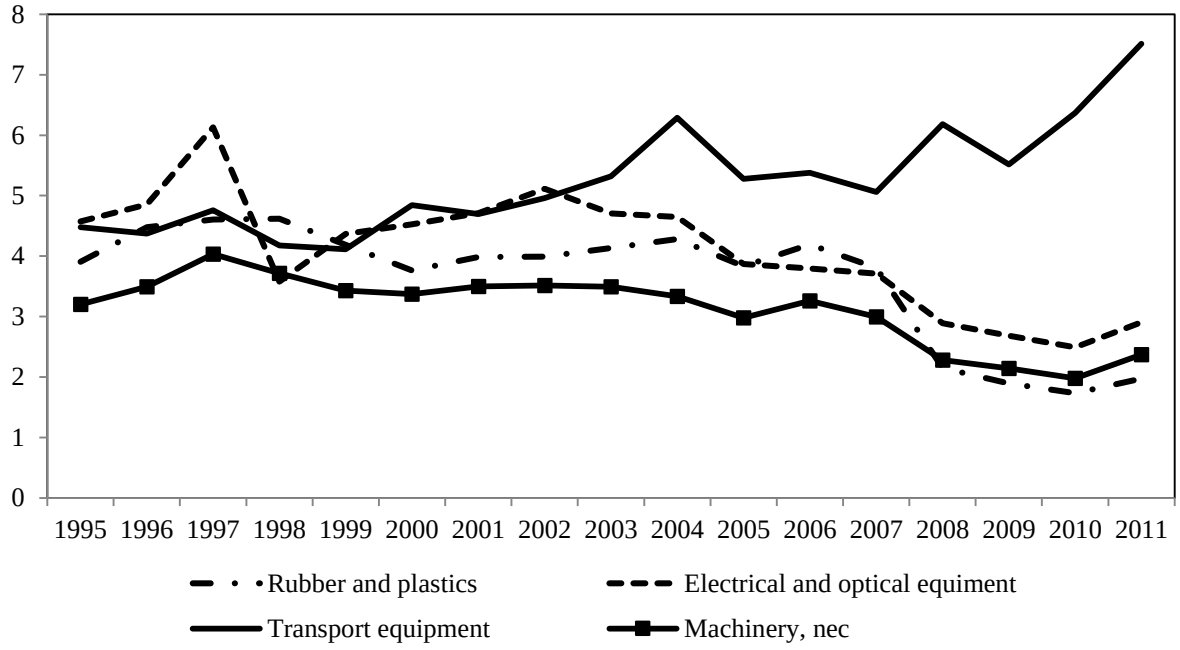
Figure 7. China's contribution to foreign value added share in sectoral exports of Turkey (%)

The composition of sectors to which China contributes to vertical specialization has changed over time. Figure 7 shows the contribution of China to vertical specialization of the sectors; electrical and optical equipment and transport equipment (both included in mid-high and high tech level) and textiles other manufacturing (both included in low tech, other manufacturing mostly comprising of toys, musical instruments and furniture), respectively.

As mid-high and high-tech sectors, the contribution of China to the vertical specialization in transport and electrical-optical equipment has increased over time except for a fluctuation in electrical-optical equipment in 2007-2008. In other words, Turkey's imported intermediate goods in these sectors from China have increased. On the other hand; one of the low-tech sectors, which is other manufacturing such as furniture, toys, musical instruments etc., has a similar pattern with the abovementioned mid-high and high-tech sectors by having upward trend in contribution of China to vertical specialization (Figure 7).

The contribution of Germany to imported content in Turkish exports was higher in 1995 than in 2011 (Table 4). A continuous downward trend in the share of foreign value added of Germany can be observed between the years 1999 and 2006. In the period of global economic crisis, the increase in the contribution of Germany to vertical specialization of Turkey's exports is remarkable.

When the contribution of Germany to vertical specialization of Turkish exports is investigated on sectoral basis, findings show that the contribution of Germany to share of vertical specialization in transport equipment remains to be the highest among all other sectors.



Source: WIOD, and authors' own calculations

Figure 8. Germany's contribution to foreign value added share in sectoral exports of Turkey (%)

As seen in Figure 8, Germany's contribution to foreign value added share in transport equipment exports shows an upward trend particularly after 2000. Moreover, the contribution of Germany to the share of vertical specialization in electrical and optical equipment was higher in 1995 than in 2011. As was mentioned, these two sectors are included in mid-high and high-tech category. Importing high tech products from the countries which have a high

R&D expenditure and share of high tech production in their manufacturing sectors like Germany can be beneficial to importer country in terms of technology transfers and spillover effects.

Although the contributions of Italy and France to foreign value added have decreased in the relevant period, they nevertheless have an important position in the imported content of Turkish exports. Similar with Germany, the contribution of these countries to the share of vertical specialization in Transport Equipment is the highest among all other sectors.

To sum up, results revealed that RoW and China's contribution are the highest in foreign value added content of Turkish exports. As mentioned before, although domestic value added in Chinese exports has increased, Chinese foreign trade mainly focuses on processing trade (Koopman et al. 2012). Since processing trade means assembling imported intermediate goods and exporting them, the value added and technology transfers of this type of trade is not high. Moreover, the expenditure on R&D activities and the share of high tech production are lower in China compared to Germany and France[11]. Therefore, a high contribution of countries like Germany and France to vertical specialization is beneficial for technology transfers and improves knowhow. Although the vertical specialization (i.e. imported content in export) shows the measure for backward linkages into GVCs, trade partners produced goods in at high level of technology could led to enhance the benefits from GVCs.

6 Concluding Remarks

According to results of our analysis that measures the backward contributions to GVCs, in the 2000's, the highest contribution to Turkish exports' vertical specialization is by mid-high and high-tech sectors such as transport, electrical and optical equipment. Although it is considered

[11] The share of R&D expenditures in GDP is 1.8, 2.9 and 2.2 for China, Germany and France, respectively (The World Bank World Development Indicators).

that foreign direct investments (FDIs) have a substantial effect on inducing technology transfers (World Bank 2014), vertical specialization of countries might also have an important role on the improvement of technologies. At this point, which sectors are vertically specialized might have an effect on the degree and nature of technology transfers from abroad. Higher vertical specialization in high-tech sectors could lead to a higher level of technology transfers from abroad and subsequent spillover effect. By importing products and intermediate goods for use in high tech exports, the benefits obtained from participating into GVCs are relatively more than importing intermediate goods for low-tech exports. This transfer of knowledge could be a positive side of increasing backward participation into GVCs. However, it should not be ignored that if the imported intermediate goods are mainly for the export of low-tech and mid-low-tech goods, it is similar to assembling rather than technology transfers like Chinese in processing trade.

Similarly, the nature of countries' contributions to vertical specialization is important to observe the benefits from being a participant of the GVCs. The results show that the top contributor countries to Turkish vertical specialization are China, Germany, France, Italy and the RoW, listed according to their shares as of 2011. Germany, France and Italy have relatively higher R&D expenditures and high-tech shares in total manufacturing exports than China. Therefore, it can be said that the technology-intensive and developed countries might help to improve technology in production of goods. According to results of the analysis, the contribution of China to Turkish vertical specialization has increased in recent years. Since the Chinese exports mainly consist of low-tech products, this increase might not be beneficial for Turkey to upgrade its position in GVCs.

As stated before, although the backward participation of Turkey into GVCs has increased over time, Turkey still needs to upgrade its position in GVCs in terms of the production

activity stages i.e. upstream and downstream activities. Turkey tends to operate the production activities mainly in downstream segments, i.e. in assembly activities (World Bank 2014). In order to change the production stages from downstream to upstream, and improve the technology level in production, it is essential for Turkey to increase investment into human capital in order to be able to absorb and use the technology transferred through the import of technology-intensive goods and simultaneously increase the expenditures on R&D activities.

The contribution of this study to the literature is to analyze the trends in backward participation (i.e. vertical specialization) of Turkey into GVCs between the years 1995-2011 by utilizing WIOD. Manufacturing sectors are assessed with respect to technology classification and sectorial inferences are made. Furthermore, countries' contributions in foreign value added of Turkish exports are analyzed on sectorial bases. The limitations of this study can be related to the database used in the analysis, the WIOD. The most recent input output table released by TURKSTAT is for the year 2002. Input-output tables for Turkey available in the WIOD are projected by using appropriate methods to construct a time series until 2011. Although projections are consistent with the trade data, there might be some years that the estimations do not fit the actual values.

This study can be extended by measuring the forward linkages of Turkish foreign trade into GVCs. Recall that forward linkages of Turkey refer to Turkey's intermediate goods exports which are used other countries exports. By using the WIOD, Turkish contribution to other countries' vertical specialization can be calculated and the results are compared to backward linkages. Moreover, bilateral contributions of countries to vertical specializations of each other can be calculated and an index can be constructed. Hence, the benefits from being a part of GVCs can be measured at bilateral level.

Appendix

Table A1. Manufacturing exports, country shares of top trading partners of Turkey (%)

	1995	2000	2005	2010	2011	2015
Low technology						
Germany	31.1	25.4	18.1	14.8	14.0	10.8
UK	5.9	9.5	10.4	7.9	7.2	7.0
USA	8.4	14.0	8.1	3.4	3.2	3.8
Italy	3.8	4.0	5.1	4.8	4.9	3.7
Russian Fed.	7.1	2.3	3.3	4.8	4.8	2.1
China	0.0	0.1	0.2	0.5	0.6	0.7
Mid-low technology						
UK	4.0	4.9	4.1	4.1	4.4	6.6
Germany	9.0	8.4	6.6	5.7	6.7	6.0
USA	6.1	10.4	10.1	3.4	3.7	5.3
Italy	9.9	11.1	7.0	4.2	5.2	3.3
Russian Fed.	3.8	1.7	2.1	2.0	2.2	1.5
China	0.2	1.0	0.7	0.4	0.4	0.4
Mid-high technology						
Germany	15.5	15.7	11.2	10.2	10.8	11.0
UK	5.3	5.1	8.2	7.3	6.7	9.4
Italy	12.2	8.7	9.9	8.3	7.4	6.5
USA	3.3	4.4	2.0	2.6	2.9	3.7
Russian Fed.	6.6	2.6	3.8	4.0	5.1	2.1
China	0.9	0.2	0.7	1.2	1.3	1.0
High technology						
Germany	26.6	11.6	19.4	13.2	14.1	13.8
USA	3.2	18.4	6.1	10.8	10.0	12.5
UK	7.8	10.0	16.2	14.5	14.9	10.7
Italy	0.9	2.3	7.0	5.0	5.0	4.6
China	0.1	0.1	0.1	0.4	0.4	1.2
Russian Fed.	4.2	0.7	1.0	0.7	1.4	0.8

Source: TurkSTAT database and authors' calculations based on OECD technology classifications.
Note: In each category, countries are sorted with respect to their shares in total in 2015.

Table A2. OECD technology intensity definitions

ISIC Rev. 3 Code	
	Low technology
15-16	Manufacture of food products and beverages, tobacco products
17-19	Manufacture of textiles, wearing apparel, dressing and dyeing of fur, tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20-22	Manufacture of wood and of products of wood and cork, except furniture, articles of straw and plaiting materials, paper and paper products; Publishing, printing and reproduction of recorded media
36-37	Manufacture of furniture; manufacturing nec
	Mid-low technology
23	Manufacture of coke, refined petroleum products and nuclear fuel
25	Manufacture and rubber and plastic products
26	Manufacture of other non-metallic mineral products
27-28	Manufacture of basic metals, fabricated metal products, except machinery and equipment
351	Building and repairing of ships and boats
	Mid-high technology
24 except 2423	Manufacture of chemicals and chemical products, except pharmaceuticals
29	Manufacture of machinery and equipment nec
31	Manufacture of electrical machinery and apparatus nec
34	Manufacture of motor vehicles, trailers and semi-trailers
352-359	Manufacture of railway and tramway locomotives and rolling stock
	High technology
2423	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
30	Manufacture of office, accounting and computing machinery
32	Manufacture of radio, TV and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
353	Manufacture of aircraft and spacecraft

Source: OECD (2011)

Table A3. Industries included in the WIOD

ISIC Rev.3 Code	Industry Name
AtB	Agriculture, Hunting, Forestry and Fishing
C	Mining and Quarrying
15t16	Food, Beverages and Tobacco
17t18	Textiles and Textile Products
19	Leather, Leather and Footwear
20	Wood and Products of Wood and Cork
21t22	Pulp, Paper, Paper Printing and Publishing
23	Coke, Refined Petroleum and Nuclear Fuel
24	Chemicals and Chemical Products
25	Rubber and Plastics
26	Other Non-Metallic Mineral
27t28	Basic Metals and Fabricated Metal
29	Machinery, Nec
30t33	Electrical and Optical Equipment
34t35	Transport Equipment
36t37	Manufacturing, Nec; Recycling
E	Electricity, Gas and Water Supply
F	Construction
50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
51	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
52	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
H	Hotels and Restaurants
60	Inland Transport
61	Water Transport
62	Air Transport
63	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
64	Post and Telecommunications
J	Financial Intermediation
70	Real Estate Activities
71t74	Renting of M&Eq and Other Business Activities
L	Public Admin and Defence; Compulsory Social Security
M	Education
N	Health and Social Work
O	Other Community, Social and Personal Services
P	Private Households with Employed Persons

Table A4. Classification of WIOD Manufacturing Industries Based on OECD Technology Intensity Definitions

ISIC Codes	Industries	Tech. Class	Notes
15t16	Food, Beverages and Tobacco	Low	
17t18	Textiles and Textile Products	Low	
19	Leather, Leather and Footwear	Low	
20	Wood and Products of Wood and Cork	Low	
21t22	Pulp, Paper, Printing and Publishing	Low	
36t37	Manufacturing, nec; Recycling	Low	
23	Coke, Refined Petroleum and Nuclear Fuel	Mid_low	
25	Rubber and Plastics	Mid_low	
26	Other Non-Metallic Mineral	Mid_low	
27t28	Basic Metals and Fabricated Metal	Mid_low	
29	Machinery, Nec	Mid_high	
24	Chemicals and Chemical Products	Mid_high+High	mid-high: 24 exc. 2423; high: 2423
34t35	Transport Equipment	Mid_high+High	mid-high: 34+352+359; high: 353
30t33	Electrical and Optical Equipment	Mid_high+High	mid-high:31; high: 30+32+33

Source: WIOD and OECD (2011)

Table A5. Countries included in the WIOD

Australia	Estonia	Japan	Romania
Austria	Finland	Korea	Russia
Belgium	France	Latvia	Slovak Republic
Brazil	Germany	Lithuania	Slovenia
Bulgaria	Greece	Luxembourg	Spain
Canada	Hungary	Malta	Sweden
China	India	Mexico	Taiwan
Cyprus	Indonesia	The Netherlands	Turkey
Czech Republic	Ireland	Poland	UK
Denmark	Italy	Portugal	USA

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