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Positioning of Türkiye in Global Value Chains (GVCs)

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Abstract

We investigate Türkiye's current position in global value chains and offer an export diversification strategy index based on economic complexity methodology. Our indices ranks products with respect to their complexity levels, Türkiye's know-how and the demand by giving each of them different weights under three different scenarios: "Easier to go" targeting products nearer to our current capabilities to achieve short term results, "interim advantage" guaranteeing rapid revenue gains from high income countries so that Türkiye can be able to allocate resources more efficiently to start required long-term investment, and consequently "long term gains" enhancing complexity with needed costly investment which can be achieved in a longer horizon. Our results suggest that Türkiye is near to many opportunities to increase its economic complexity particularly due to its current know-how in machinery and electrical equipment. In particular, intermediate products related to electrical apparatus could facilitate Türkiye's transition to more complex products with higher value added requiring higher technology.

Keywords: Global Value Chains, Trade, Export Sophistication, Economic Complexity, Export Diversification

JEL Classification: F10, F43, F63, O14, O24, O43

Global Value Chains: Türkiye

1. Introduction

The globalization, technological advancements in information and communication and decline in the costs of logistics have led to the distribution of factors of production across borders, paving the path to the emergence of global value chains (GVCs). Although there have been evidence for positive impact of global integration in trade with production efficiency, ie. total factor productivity, the recent pandemic experience revealed fragilities of value chains, thereby necessitating rethinking on current trade relations across borders (World Bank, 2022; UNCTAD, 2022). Lately, geopolitical factors have also begun to play an important role on differentiating trade routes and rules. Therefore, new trends have emerged and countries with certain advantages start to benefit from the current circumstances. Türkiye, being located very close to the Western world and having the potential to substitute China's manufacturing supplier role with its young and qualified human capital, suggests great benefit areas. The aim of this analysis is to reassess Türkiye's position and capabilities in global value chains that have been reshaped in recent years and detect opportunities that could ignite higher value added along the value chains.

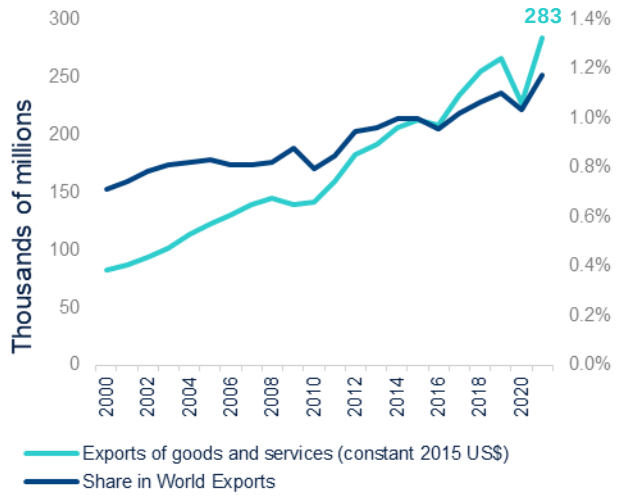
Locating Türkiye's position in global value chains require understanding the trends in its exports and imports of intermediate and final goods, while also spotting the value added of its trade partners in its exports and conversely examining Türkiye's input in exports of the rest of the world. Following this motivation, Section 2 and 3 seek to lay out the backward and forward linkages of Türkiye's trade by countries and sectors. Section 4 evaluates Türkiye's export competitiveness by introducing global value chain perspective on Revealed Comparative Advantage, subtracting the foreign value added component from gross exports and calculating Türkiye's relative advantage in exports using information on domestic value added component. Section 5 introduces sophistication of Turkish exports exhibiting the productivity level associated with Türkiye's exports. Having established Türkiye's current position and capabilities in value chains, Section 6 looks forward coming up with an export diversification strategy which puts forth products and sectors that are near Türkiye's know-how and that could provide higher value added in trade.

2. Trends in Trade along GVCs: Türkiye's Position

Türkiye's exports of goods and services have shown a considerable improvement after the pandemic reaching $283.5 billion in volume in 2021. Accordingly, Türkiye's share of total exports increased from 0.7% to 1.2% since the beginning of 2000s. Exports growth performance of Türkiye over the past decade (55% increase between 2012-2021) have been almost the double of world export growth (25%).

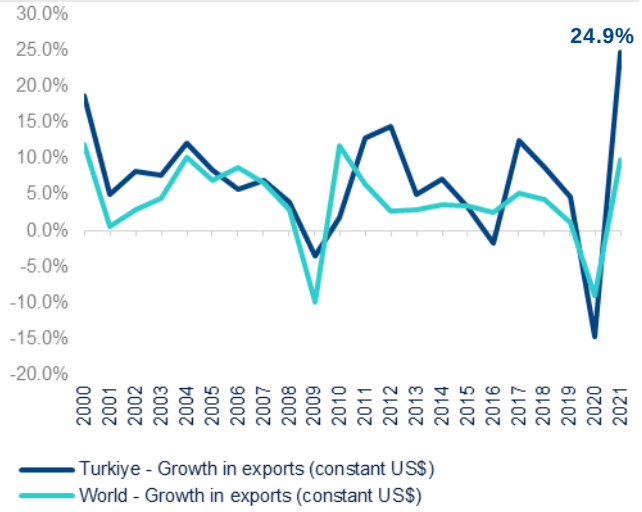
The geographical composition of Turkish exports reveals that Europe continent together accounts for almost 55% of total Turkish exports. Europe is followed by Near and Middle East regions (16.8% of total exports) and North America (7.4% of total exports). North Africa also stands out as an emerging destination for our exports with 5.7% share.

Figure 1. **TÜRKİYE'S EXPORTS OF GOODS AND SERVICES** (CONSTANT 2015 US$)



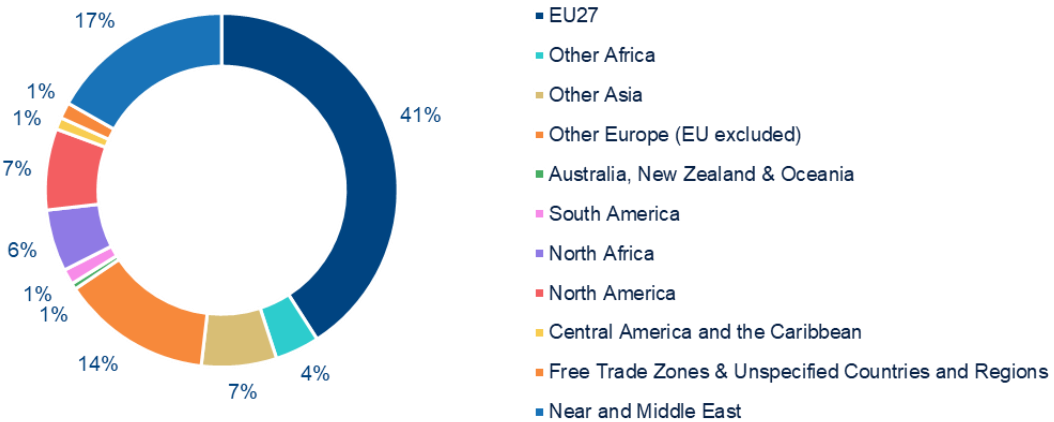
Source: World Bank, BBVA Research

Figure 2. **GROWTH IN EXPORTS OF GOODS AND SERVICES** (YoY)



Source: World Bank, BBVA Research

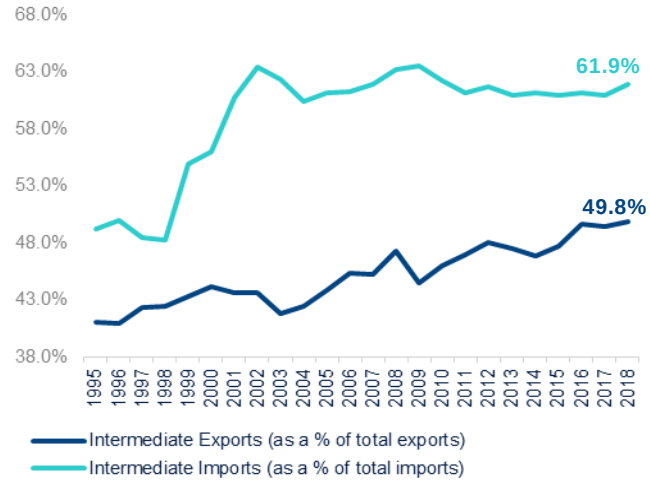
Figure 3. **TÜRKİYE'S EXPORTS OF GOODS BY REGION** (Nominal US$, %, Jan-Oct 2022)



Source: Turkstat, BBVA Research

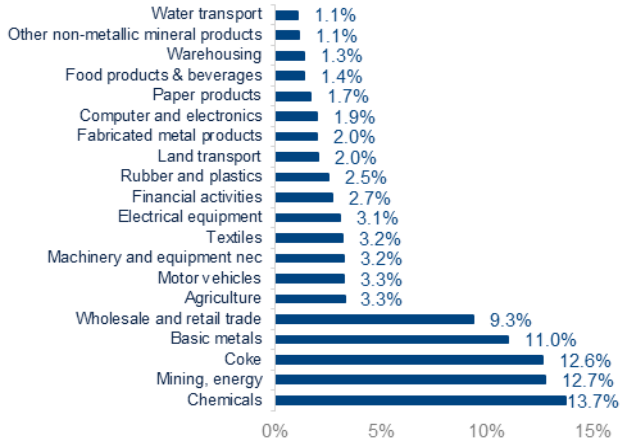
Türkiye has become more prominent in trade of intermediate goods and services as it is becoming more integrated into global value chains. Intermediates cover the majority of Türkiye's imports (up from 49% in 1995 to 61.9% in 2018), while also being half of total exports as of 2018. Sectorally, top 5 sectors (chemicals, mining, coke and refined petroleum products, basic metals and wholesale & retail trade) in terms of their share in total intermediate goods imports together accounts for more than half (59.4%) of total intermediate imports.

Figure 4. **TÜRKİYE'S TRADE OF INTERMEDIATE GOODS**



Source: OECD TiVA, BBVA Research

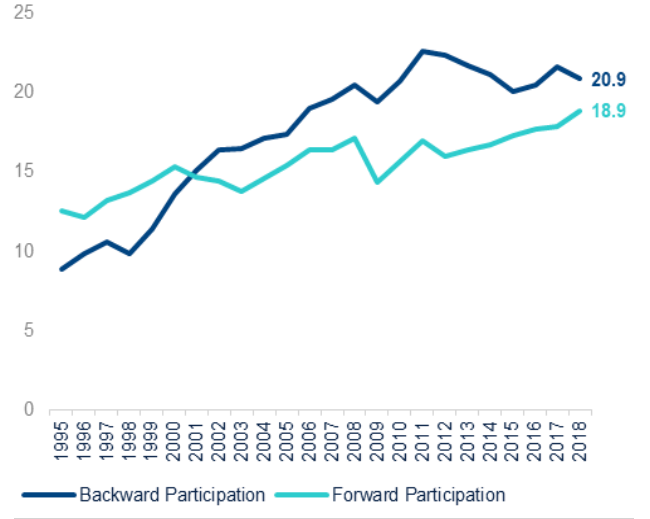
Figure 5. **TOP 20 SECTORS WITH THE HIGHEST SHARE IN TOTAL INTERMEDIATE IMPORTS** (2018)



Source: OECD TiVA, BBVA Research

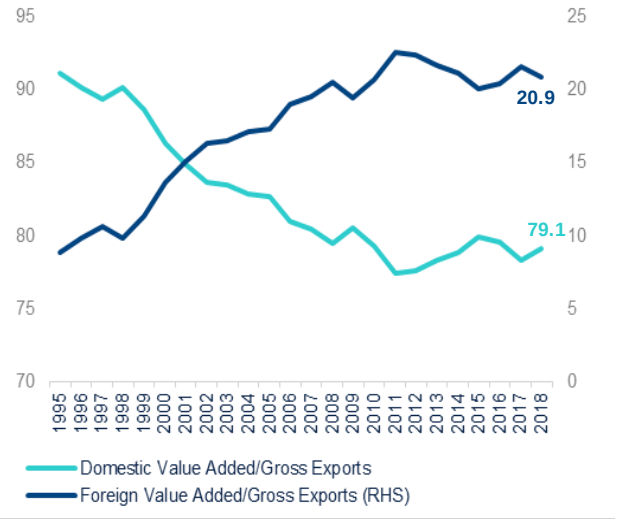
The trade flows of intermediate goods show that Türkiye becomes more integrated along the GVCs with stronger backward and forward linkages in trade. Here, backward linkages are characterized by the backward participation in GVCs which is calculated as foreign value added embodied in exports as a share of total gross exports of Türkiye. Similarly, the forward participation in GVCs is characterized as the domestic value added embodied in foreign exports as a share of Türkiye's gross exports. Both forward and backward participation have shown an increasing trend with backward participation having a higher share (20.9% as of 2018). In total, backward and forward linkages in GVCs account almost 40% of Türkiye's total exports (Figure 6). As a result of Türkiye's increasing reliance on imported intermediate inputs, the domestic value added in total exports declined from 91% to 79% (Figure 7).

Figure 6. **BACKWARD AND FORWARD PARTICIPATION OF TÜRKİYE IN GVCs**



Source: OECD TiVA, BBVA Research

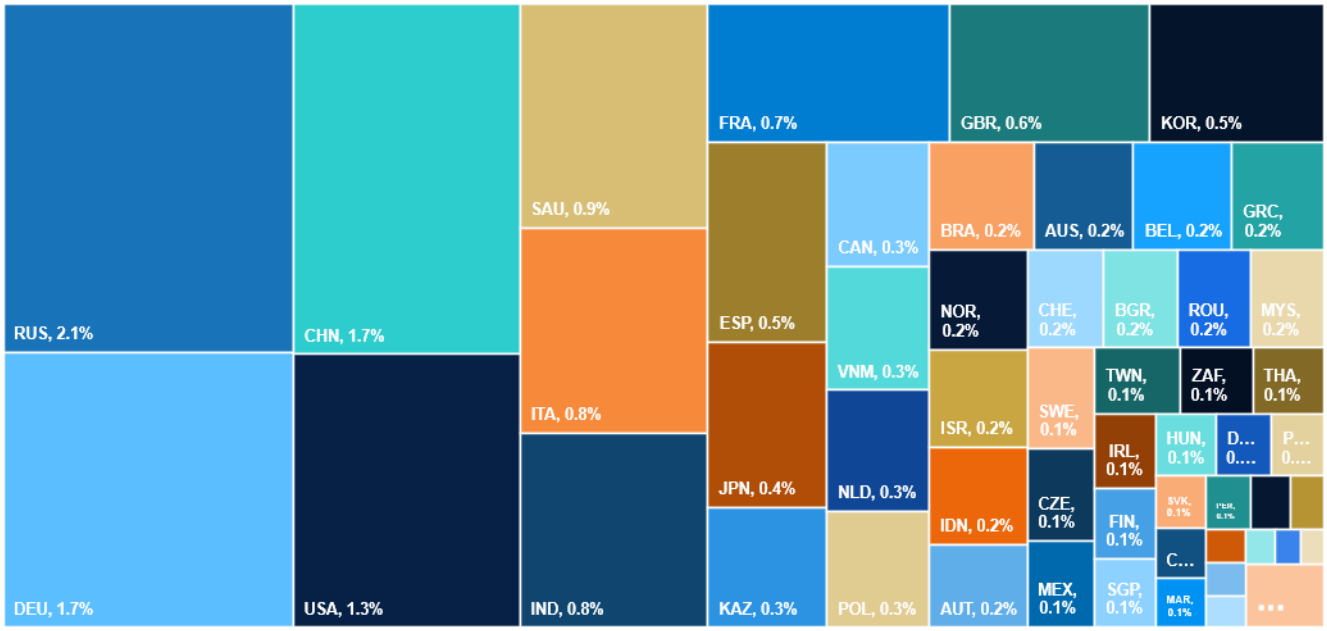
Figure 7. **DOMESTIC AND FOREIGN VALUE ADDED IN GROSS EXPORTS OF TÜRKİYE**



Source: OECD TiVA, BBVA Research

Having established that the foreign value added corresponds to 20.9% as of 2018, we can further dissect this into countries, thereby understand which countries play important role in Türkiye's exports. Origin of value added in gross exports show that Russia reports the highest the value added accounting 2.1% of Turkish gross exports in 2018 (Figure 8). Germany (1.7%), China (1.7%) and USA (1.3%) follow Russia in terms of value added. Geographically, foreign value added is highly concentrated with top 10 countries reporting highest value added, contributing almost half of total foreign value added in Turkish exports.

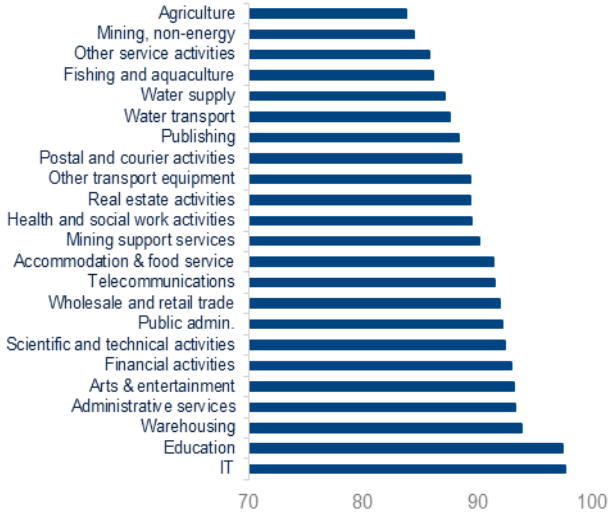
Figure 8. **ORIGIN OF VALUE ADDED IN GROSS EXPORTS** (2018)



Source: OECD TiVA, BBVA Research calculations

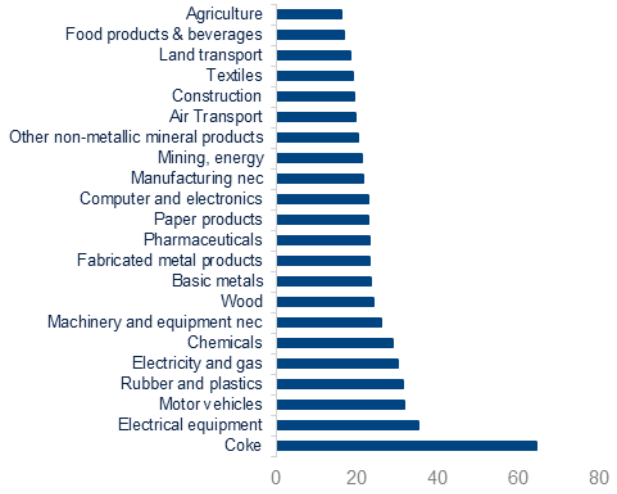
The sectoral composition of domestic and foreign value added show that services sectors tend to have relatively higher domestic value added along with relatively lower foreign value added. Conversely, foreign value added seem to be more concentrated in manufacturing related sectors. This phenomenon is almost natural considering that manufacturing production is relatively more prone to globalization, being distributed across different locations along the GVCs. Top 3 sectors with the highest domestic value added share are warehousing, education and IT; all of which have more than 90% of their exports originating from domestic production, while top 3 sectors with the highest foreign value added are coke & refined petroleum (probably due to high reliance of oil and petroleum imports), electrical equipment and motor vehicles.

Figure 9. **TOP 22 SECTORS WITH THE HIGHEST DOMESTIC VALUE ADDED SHARE IN GROSS EXPORTS** (2018, %)



Source: OECD TiVA, BBVA Research

Figure 10. **TOP 22 SECTORS WITH THE HIGHEST FOREIGN VALUE ADDED SHARE IN GROSS EXPORTS** (2018, %)



Source: OECD TiVA, BBVA Research

3. Length Indicator: Proxy for Vertical Fragmentation of Production

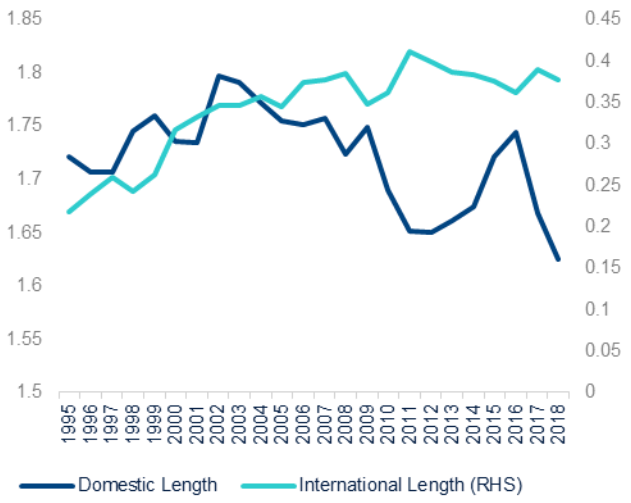
Higher share of backward linkages as well as increasing dependence on imported intermediate goods, especially in the manufacturing sectors, brings the backward linkages of value chains of Türkiye's production into question. Length indicator is extensively used in the literature to quantify the length of chains, which would give an idea of the backward linkages in trade. In order to quantify the length of value chains, we compute the production stages of sectors which could be calculated using ICIO database by the methodology of Backer and Miroudot (2014):

$$N = u(I - A)^{-1}$$

where N is a column vector with the indexes for all countries i and industries k, u is a vector of ones and $(I - A)^{-1}$ is the Leontieff inverse where I is an identity matrix and A is the matrix of technical coefficients in the ICIO. Since ICIO tables are provided for both country and industry dimensions, length of value chains of a country could be dissected into its domestic and international components.

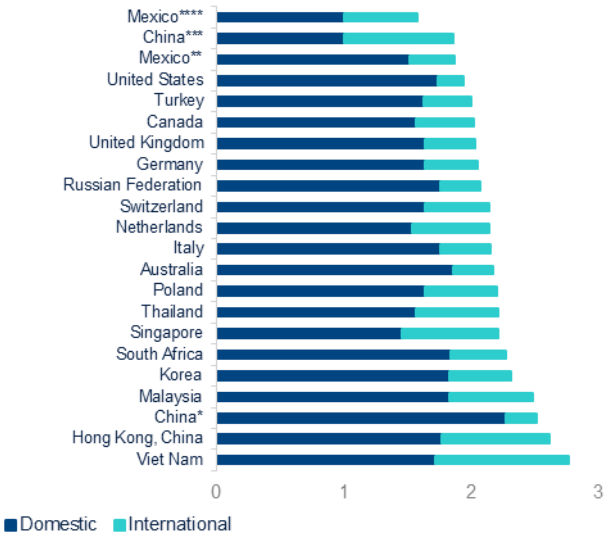
The construction of the length indicator focuses on the fragmentation of the production across many plants in many countries. Increasing vertical fragmentation of production across the globe could be confirmed by the increasing volume of intermediate goods trade, which is also the case for Türkiye. In accordance with this trend, the average international length of Türkiye across industries is seen to be increasing over time, while domestic value chains shortened since the beginning of 2000s (Figure 11). Comparing the length between various countries, Vietnam has the highest international length, followed by Hong Kong and China. On the other hand, Türkiye is ranked relatively lower with 19% of its production due to foreign production processes.

Figure 11. **AVERAGE DOMESTIC AND INTERNATIONAL LENGTH OF TÜRKİYE**



Source: OECD TiVA, BBVA Research

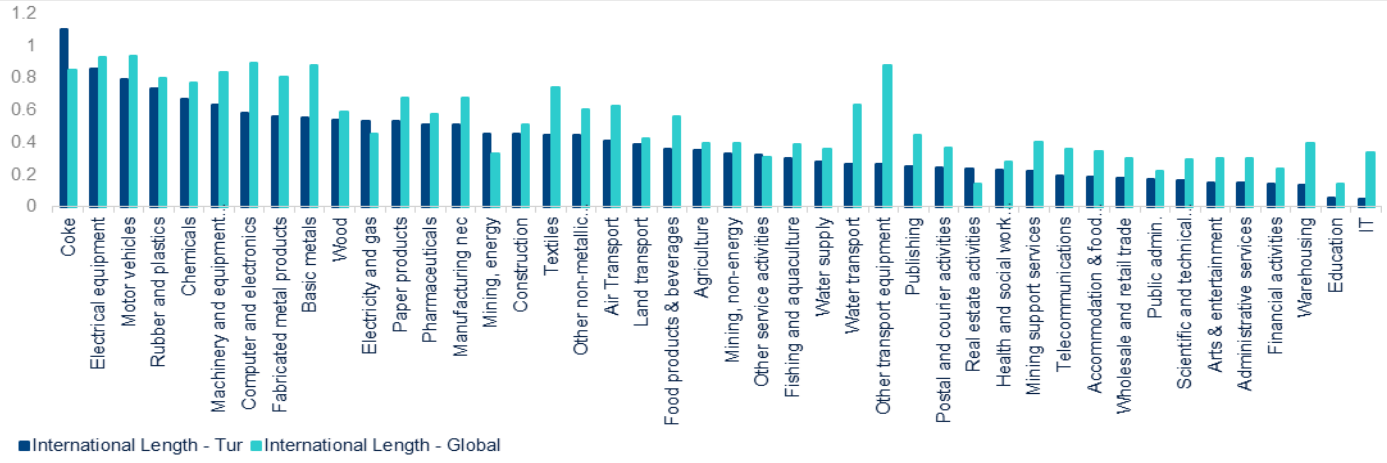
Figure 12. **AVERAGE LENGTH BY SELECTED COUNTRIES** (2018)



Source: OECD TiVA, BBVA Research. *Activities excluding export processing / **Activities excluding Global Manufacturing / ***Export processing activities / ****Global Manufacturing activities

Sectorally in Türkiye, electricity, gas, steam and air conditioning supply sector has the highest total length, which is followed by electrical equipment and food products. Average international length, on the other hand, is the highest for coke and refined petroleum, electrical equipment and motor vehicles. These results are in line with the fact that these sectors are highly fragmented across borders and that Türkiye relies on imported intermediate goods for their production. Similarly, services sectors which are relatively less prone to the usage of imported intermediate inputs, also report lower international length. Another interesting thing to point out here is that except for coke and refined petroleum products, Türkiye's international length is shorter than average global length. This finding indicates that Türkiye has the room for improving its global integration in its production.

Figure 13. **AVERAGE INTERNATIONAL LENGTH BY SECTORS** (2018)



Source: Turkstat, BBVA Research

4. GVC Approach on Revealed Comparative Advantage

Data on global value chains allows us to revisit the benchmark indicators of trade with a perspective on domestic and foreign value added. One of these indicators is revealed comparative advantage (RCA) quantifying the overall competitiveness of a country in the export of a sector or a product. Known also as Balassa Index, RCA compares the share of exports of a country of a particular product to the share of global exports. Accordingly, we can write the formula for RCA as follows,

$$RCA_{c,p} = \frac{\frac{X_{c,p}}{\sum_p X_{c,p}}}{\frac{\sum_c X_{c,p}}{\sum_{c,p} X_{c,p}}}$$

where $X_{c,p}$ stands for the exports of a country c of a product p. If RCA is bigger than 1 for a particular country, this means that the country is exporting the product with a share of more than the share of world trade. Hence, the country is competitive in exporting that product.

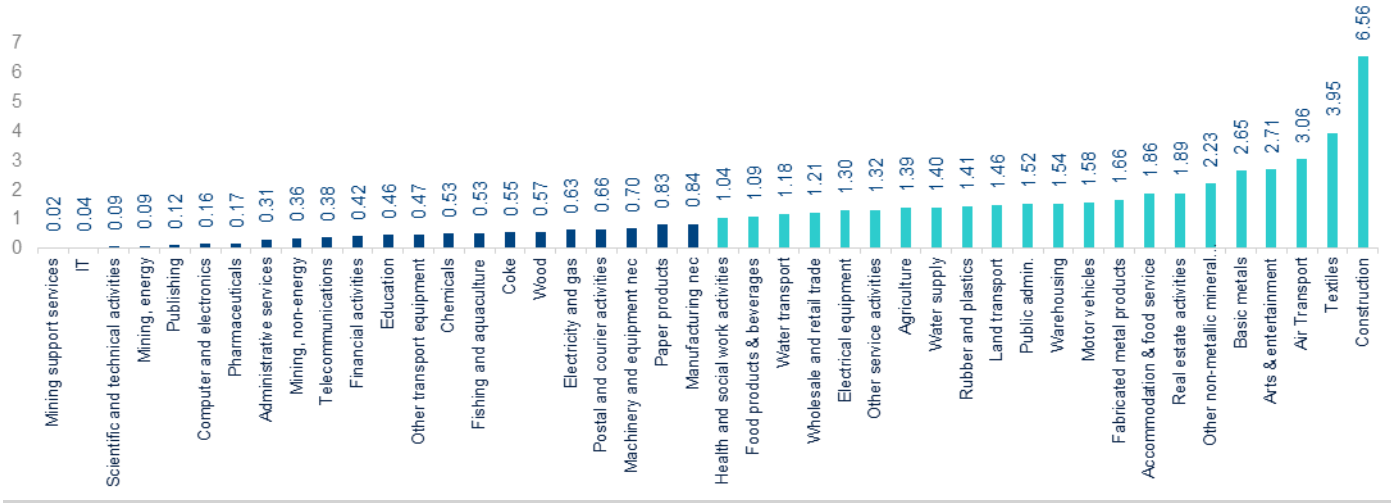
One thing to consider here is that mainstream RCA is calculated with the gross exports data. However, what we do know from global value chains is that the gross exports of a country is comprised of both domestic value added which is due to the domestic production and also foreign value added which is due to imported inputs from abroad. By using this information, we can subtract the foreign value added component from gross exports we come up with an "adjusted RCA" which assesses the competitiveness of a country's domestic value added in exports:

$$RCA\_Adjusted_{c,p} = \frac{\frac{X_{c,p} - FVA_{c,p}}{\sum_p (X_{c,p} - FVA_{c,p)}}}{\frac{\sum_c (X_{c,p} - FVA_{c,p})}{\sum_{c,p} (X_{c,p} - FVA_{c,p})}}$$

where $FVA_{c,p}$ denotes the foreign value added in the gross exports of country c of product p.

The adjusted RCA calculation reveals that Türkiye's top 3 competitive exports are in construction, textile and air transport sectors. There are currently 22 sectors in which Türkiye has higher export share compared to global, 7 of which are manufacturing sectors. On the other hand, Türkiye still does not hold competitiveness in high technology related sectors like computer and electronics, information technologies, pharmaceuticals, machinery and equipment with adjusted RCA values less than 1, meaning that Türkiye does not export as much as the share of global exports in high value added products. Therefore, Türkiye needs to do more in order to increase the sophistication of its exports and thereby help its development.

Figure 14. **ADJUSTED RCA SCORES**



Source: Turkstat, BBVA Research

5. The Sophistication of Turkish Exports

While the competitiveness of a country in its exports is important, the income level, i.e. the productivity or sophistication, associated with the exports of a product and a country give substantial information on the quality of exports. Following UNCTAD (2012), we define the PRODY index as the weighted average of the per capita income of all countries exporting a particular product, while we define EXPY index as the weighted average of the PRODY for each country:

$$PRODY_p = \sum_c RCA_{c,p} * y_c$$

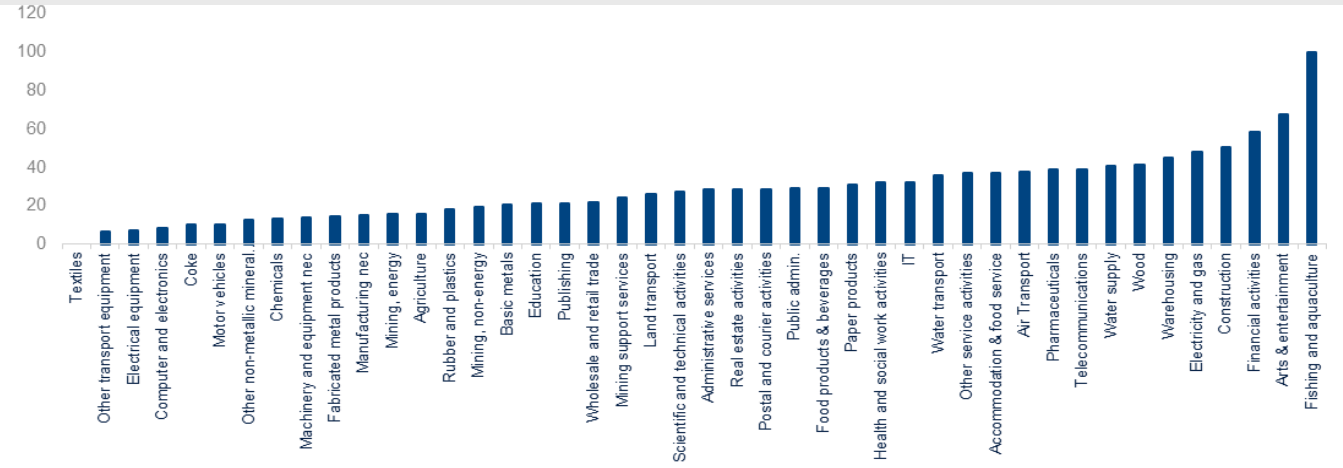
$$EXPY_c = \sum_p \frac{X_{c,p}}{X_c} * PRODY_p$$

where y_c is the per capita GDP. In Section 4, we had calculated "adjusted RCA" to assess the competitiveness of a country's domestic value added in exports. We can use adjusted RCA measures to come up with adjusted PRODY and EXPY scores to understand the sophistication of Türkiye's exports when the impact of the foreign value added component is eliminated. When comparing the sophistication indices for products, we scale the results in a way that 0 corresponds the minimum and 100 corresponds to the maximum.

Comparing the PRODY scores of sectors, we observe that fishing and agriculture reports that highest PRODY index which could be due to the fact that high income countries such as Israel, Norway or New Zealand report high RCA in the production of the sector (Figure 15). Fishing and agriculture is followed by services sectors such as arts and entertainment and financial services. The fact that construction exports are placed in 4th rank in terms of export sophistication is promising considering that Türkiye reports the highest adjusted RCA in the sector. On the other

hand, textiles sector, a sector which Türkiye is highly specialized with the second highest RCA comparing with other sectors, reports the lowest level of sophistication.

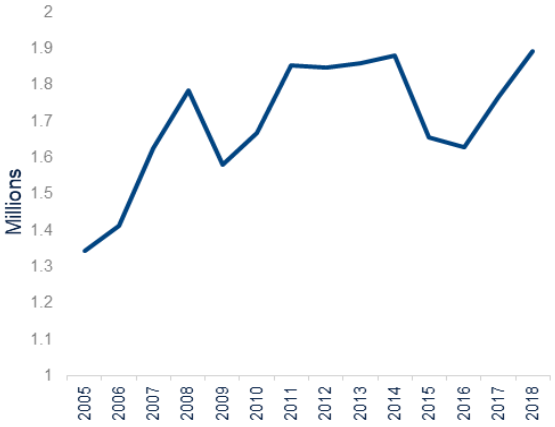
Figure 15. **ADJUSTED PRODY SCORES ACROSS SECTORS** (0-100)



Source: OECD TiVA, World Bank, BBVA Research calculations

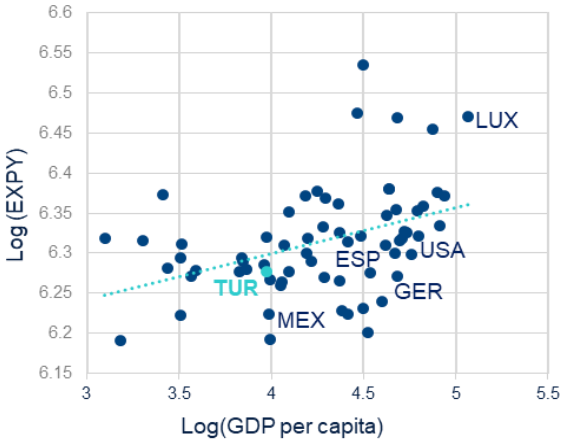
Adjusted EXPY scores of Türkiye shows that Türkiye improved its export sophistication between 2005-2008 and 2009-2011 periods. The decline in the sophistication in the 2008-2009 period could be attributed to the global financial crisis. Similarly, export sophistication recovered in 2016-2018 after stagnating during 2011-2014 (Figure 16), when particularly European economies had suffered from the slow recovery following the global financial crisis. The relationship between GDP per capita and EXPY is straightforward, as the export sophistication index shows the degree to which the country's exports resemble the export basket of a rich country. Türkiye lags behind many high-income countries in terms of export sophistication, despite having a more sophisticated export composition compared to the countries with the same level of income.

Figure 16. **HISTORICAL EXPY SCORE OF TÜRKIYE**



Source: OECD TiVA, World Bank, BBVA Research

Figure 17. **EXPY VS. GDP PER CAPITA** (2018)



Source: OECD TiVA, World Bank, BBVA Research

Despite the fact that a significant positive relationship was documented between human capital or R&D and EXPY scores, the suggestions from export sophistication analysis should be considered with caution. Because the sophistication depends on each country's share in world exports, the scores may be biased towards countries that are relatively bigger in size (Kumakura, 2007). In addition, the EXPY and PRODY indicators do not take quality differences across products into account (Minondo, 2010). In order to account for the quality of the product when assessing export performance, we need to understand the technology skills and knowledge required to produce and export that products. The methodology of complexity covers this gap in the literature and provides an analytical framework to assess the capabilities of a country and opportunities for a country to improve its export composition.

6. Complexity

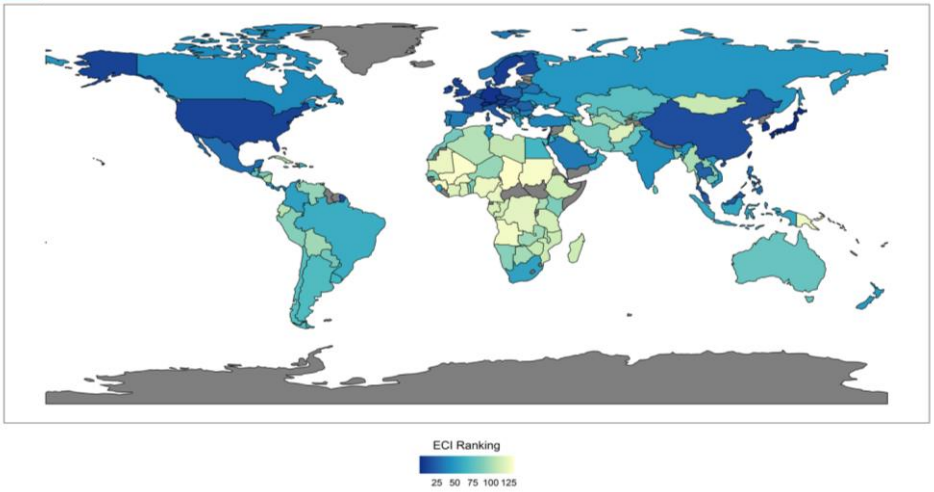
The identification of Türkiye's position along value chains brings the question on which products' exports to focus on. Framing the same question within the development policy perspective, which products or sectors can policy makers promote when shaping their industrial policies so that the per capita income increases and the country develops. One particular approach is economic complexity where the main assumption is that becoming more specialized in the exports of products or sectors with higher complexity (eg. with higher level of "productive knowledge") would bring economic prosperity. From this perspective, income differences among rich and poor countries are simply due to differences in productive knowledge. In the case of a search for Türkiye's export diversification strategy to find products or sectors which could ignite higher per capita income, it is imperative to identify which products are more complex and relatively easier to be attained given Turkish economy's current knowledge set. Our calculations of complexity of Türkiye's exports gives answer to these questions.

The complexity calculation follows the methodology (see Technical Appendix) introduced by Hausmann et. al. (2013) which utilizes annual bilateral trade data which is compiled from UNComtrade. The data is available online for the period of 1995-2020 under HS 4 digit classification (The Growth Lab at Harvard University, 2019). We included 132 countries (Table 1) in our analysis which had been selected by the Observatory of Economic Complexity and employed "ecomplexity" library in Python which had been offered by the Harvard Kennedy School Center for International Development.

6.1. The Economic Intuition of Complexity Methodology

As discussed in the Technical Appendix, productive knowledge in an economy could be determined with the information on the diversity of countries and ubiquity of products. The result of the iterations on average diversity and ubiquity yields us Economic Complexity Index (ECI) which ranks countries according to their complexity. Figure 18 shows that Japan is the "winner of the competition in complexity", while Türkiye ranks 40 among 132 countries included in our analysis. The majority of the countries scoring higher than Türkiye have higher GDP per capita and are classified as advanced economies.

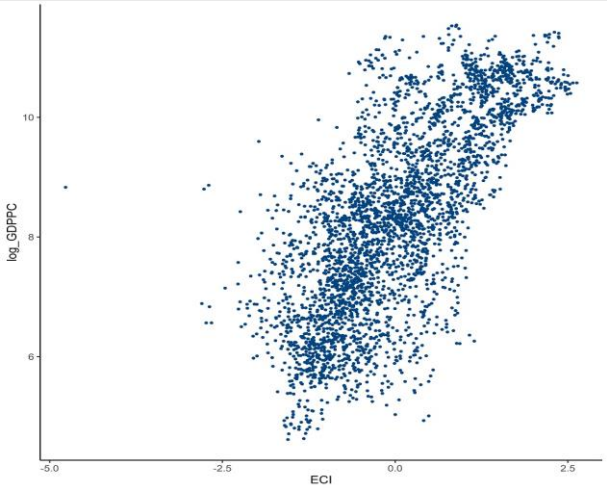
Figure 18. **ECI RANK OF COUNTRIES** (2020)



Source: The Growth Lab at Harvard University International Trade Data (2019), BBVA Research calculations

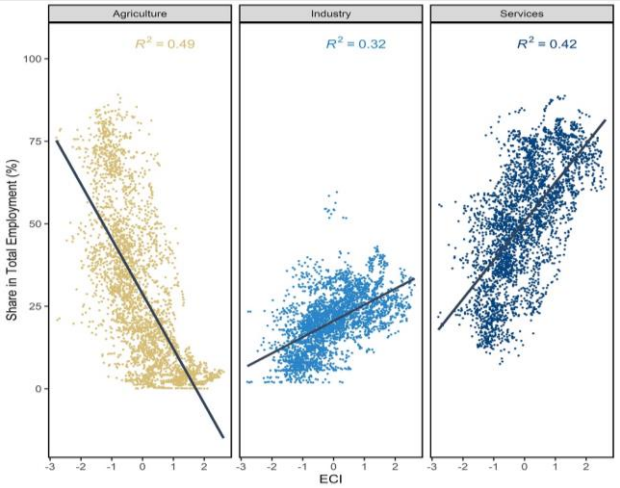
A direct implication of the ECI rankings is that there exists a positive relationship between economic complexity and GDP per capita as seen by Figure 19. In addition, a strong relationship between GDP growth and ECI is also documented in Hausmann's (2013) study. The implication for the employment is that there exists a positive relationship between ECI and the share of employment in industry and services sectors, while the share of employment in agriculture has negative correlation with ECI (Figure 20). This phenomenon could be explained as follows: As the economy becomes more complex, the income increases and the resources in the economy is redistributed in such a way that they are directed towards sectors with higher value added, such as services and high technology manufacturing.

Figure 19. **ECI VS. GDP PER CAPITA** (1995-2020)



Source: The Growth Lab at Harvard University International Trade Data (2019), World Bank, BBVA Research calculations

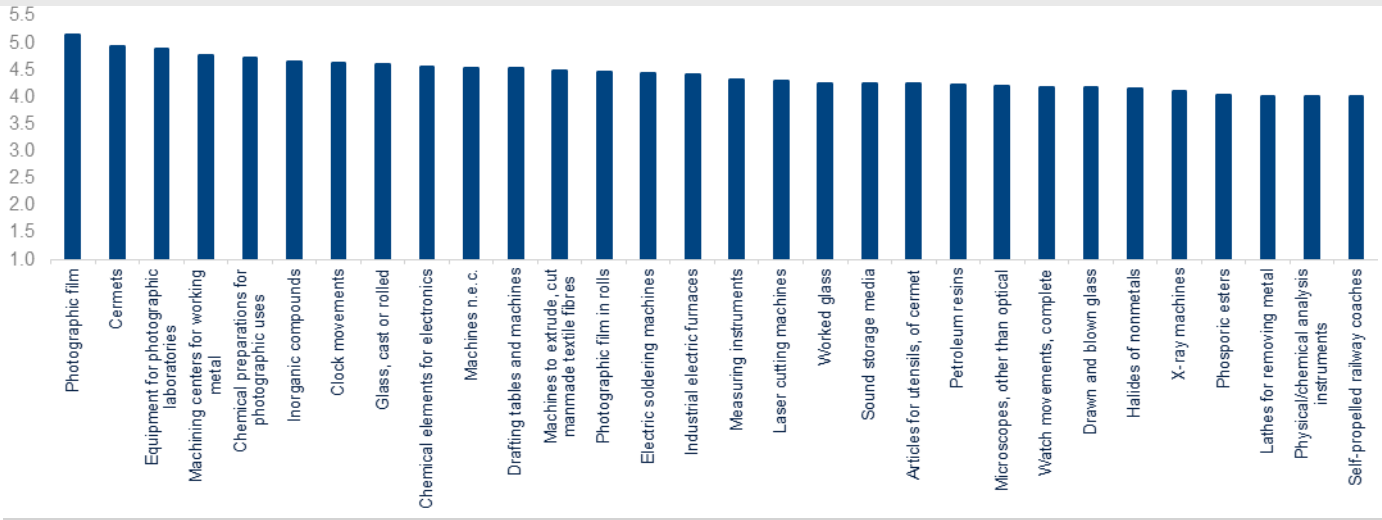
Figure 20. **EMPLOYMENT VS. ECI** (1995-2020)



Source: The Growth Lab at Harvard University International Trade Data (2019), World Bank, BBVA Research calculations

Just as we can compare the complexity of the economies, we can also compare products in terms of the amount and quality of the productive knowledge required for producing them. This idea is characterized by the Product Complexity Index (PCI) where the products with higher complexity scores can only be produced by very few countries with high economic complexity scores. These products require not only high technology but also a wide range of know-how and high-skilled workers. Indeed, according to Figure 21, top 30 products (among 1222 different products classified under HS92 4 digit level) are mainly related to high-tech manufacturing machinery such as laser cutting machines, microscopes or X-ray machines.

Figure 21. **HIGHEST RANKING PRODUCTS BY PCI** (2020)

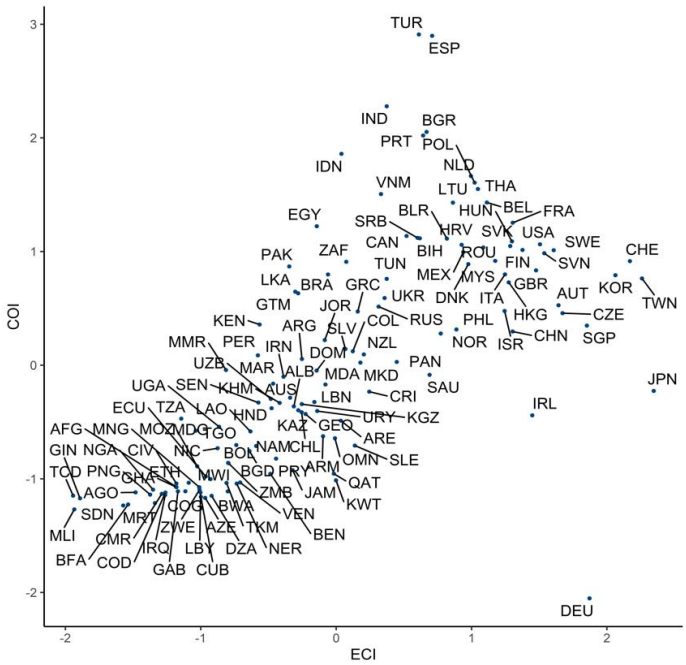


Source: The Growth Lab at Harvard University International Trade Data (2019), BBVA Research calculations

Given the complexities of economies and products, it is possible to point out which products a country can jump to increase its complexity. However, another dimension showing the "distance" of a country to a particular product is needed for the analysis. The products that are "far away" from a country's current capabilities (ie. productive knowledge set) are harder to obtain simply because the country needs to invest more to acquire the knowledge required for producing them. Complexity methodology assumes that countries prefer to switch to products which require knowledge that is relatively less costly to attain, hence they look for other products that are "closer" to the products that they currently produce.

Once the distance of a country to products is defined, an immediate question arises regarding the differing distances of different countries to products. It might be the case that a country might be close to many complex products, hence have more opportunities to improve its complexity, while another may be situated near basic products with less complexity. In order to distinguish the countries in terms of the complexity improvement opportunities, we calculate complexity outlook index (COI) which basically computes the total closeness of a country to all the products that it does not yet produce and weight it by these products' complexity indices. A corollary of this definition is that countries with higher ECI also have higher COI as they are "closer" to products with higher complexity (Figure 22). Interestingly, among its counterparts with the same ECI, Türkiye reports higher COI which suggests the higher potential that Türkiye has to increase its complexity, being near to many complex products in terms of its capabilities. Using the complexity outlook index, we can generate the gain in complexity of a country when it starts to produce a product, known as the complexity outlook gain (COG).

Figure 22. **ECONOMIC COMPLEXITY INDEX VS. COMPLEXITY OUTLOOK INDEX** (2020)



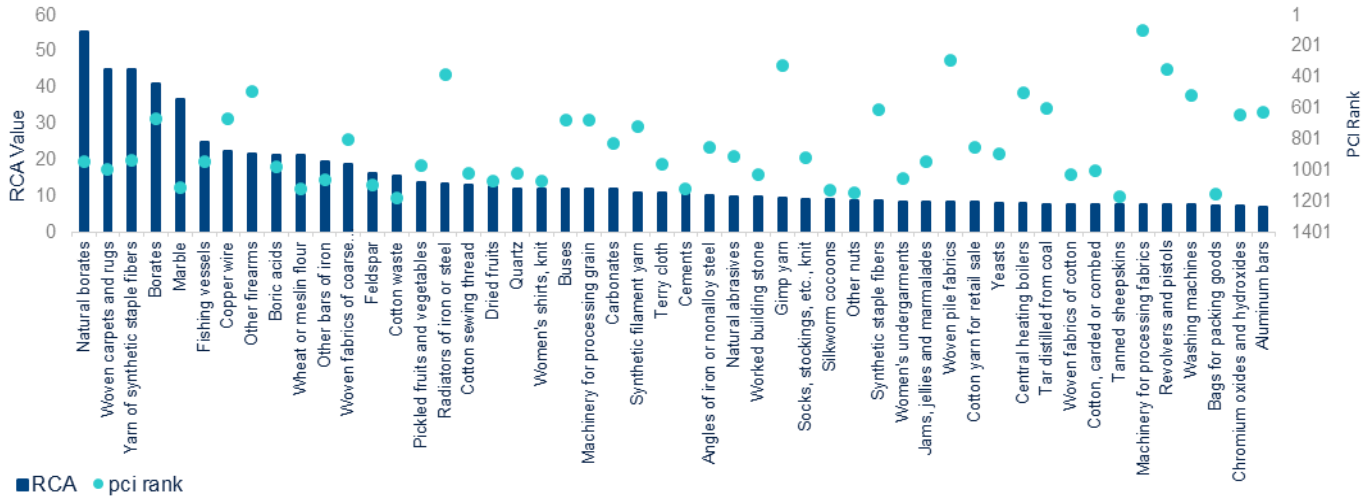
Source: The Growth Lab at Harvard University International Trade Data (2019), BBVA Research calculations

6.2. Export Diversification Strategy

Comparing Türkiye's position in terms the current capabilities, it could be deduced that the products where Türkiye has the highest RCA in exports also has relatively lower PCI ranking (Figure 23). This picture tells us that Türkiye has a wide room to improve its exports composition by switching to more complex products.

In the previous section we have discussed various concepts giving information about the complexity score of products, the complexity gain that they would bring to a country and distance of a country to them. We can combine these indices in a linear combination to create a score which would rank products according to different strategies. This kind of approach has been employed in the literature by using the linear combination of 3 indices including PCI, COG and distance (Hausmann et. al. 2014; Estmann et. al. 2021). We extend this analysis with a fourth variable considering the share of imports of each product in total exports of high income countries. By adding the share in high income countries' imports we aim to account for the demand of high income regions in the product selection process. Hence, the selected products will not only allow improvement in complexity but also specialization in exports to high income countries. The high income countries in our analysis (Table 2) are determined according to World Bank classification. We further filter out the countries with population less than 1.5 million from the high income countries list.

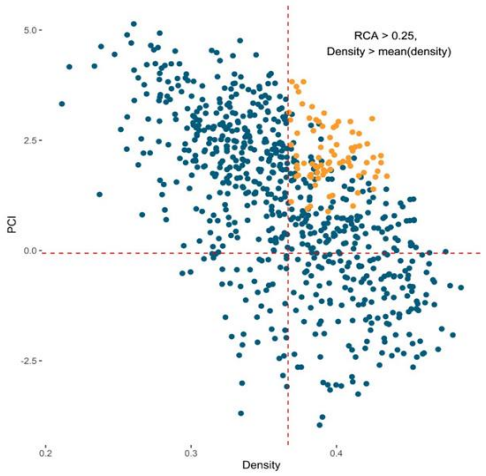
Figure 23. **TOP 50 PRODUCTS WITH THE HIGHEST RCA AND THEIR PCI RANKINGS** (2020)



Source: The Growth Lab at Harvard University International Trade Data (2019), BBVA Research calculations

Before selecting products according to the index scores, we restrict product sample to feasible products in line with certain assumptions regarding Türkiye's closeness and abilities. Firstly, we pick the products with RCA between 0.25 and 1, because we aim to focus only on products that Türkiye is currently not specialized and could increase its export share relatively more easily. In order to distinguish between the products according Türkiye's competitiveness in their exports, we denote products with RCA between 0.25 and 0.5 "low RCA", while products with RCA between 0.5 and 1 are named as "middle RCA". Secondly, we exclude the products with negative normalized COG values in order to focus only on the products which would bring positive complexity gain. Thirdly, products at the bottom 25% quantile in terms of complexity and finally products that are closer than mean density are included in the feasible product list (shown with the red dashed lines in Figure 24). The resulting set of products are highlighted in Figure 26. Our analysis sorts these highlighted feasible products according to weighted indices provided below.

Figure 24. **FEASIBLE PRODUCTS**



Source: The Growth Lab at Harvard University International Trade Data (2019), BBVA Research calculations

While constructing our index, we take the normalized versions of variables PCI, COG, density and the products' share in high income country imports. The normalization is achieved by standardizing each variable by year and country category around mean of zero and standard deviation of 1. In our construction, the density is calculated as 1-distance, which basically gives the information on how close the country is to the product.

The first index gives more importance to the "closeness" of the product to the current capabilities of the country, hence it shows the products that are relatively easier to attain. The second index focuses on interim advantage prioritizing the products with higher share in high-income country imports which would bring higher revenues. Finally, third index details a long term strategy, giving higher importance on the complexity score and the complexity gain that the product would bring to the country.

$$Easier\ to\ Go = 0.1 * PCI + 0.1 * COG + 0.6 * Density + 0.2 * Import\ Share$$

$$Interim\ Advantage = 0.1 * PCI + 0.1 * COG + 0.2 * Density + 0.6 * Import\ Share$$

$$Long\ Term\ Gains = 0.4 * PCI + 0.4 * COG + 0.15 * Density + 0.05 * Import\ Share$$

The results of the export diversification strategy indices summarized in Table 3, 4 and 5 clearly point out to the Türkiye's specialization in machinery and electrical categorized under 84 and 85 codes in harmonized system. Another prominent group of products chosen are classified among metals which is the main category for 72-83 codes in HS 2 digit classification. One particular product, namely packaged medicaments is ranked highly even though Türkiye is not specialized, because it has a high share in imports of high income countries.

7. Conclusion

Türkiye's improving integration in global trade is confirmed by its increasing backward and forward participation in global value chains. Despite increasing the share of intermediate goods in both imports and exports over the years, Türkiye still has a wide room for enhancing its vertical fragmentation by lengthening production chains. It is evident that Türkiye's competitiveness originating from the domestic value added in its exports are highly varied across sectors from construction to textiles, food, motor vehicles and electrical equipment. However, some of these sectors have relatively lower productivity or income level associated with them necessitating a strategy showing which products Türkiye could focus on in order to increase the sophistication of its exports thereby achieve higher income per capita. The aim of our analysis is to provide an answer to this exact question.

It is also true that there is not an only one exact path to achieve the desired final goal: enriching complexity of exports, earning a higher market share on exports of that product in the globe and thereby helping the development of the country. Countries might follow different paths, depending on the priorities they assign in different time horizons. In our analysis, we try to differentiate those paths in the following way: 1) "easier to go" targeting products nearer to our current capabilities to achieve short term results, 2) "interim advantage" guaranteeing rapid revenue gains from high income countries so that Türkiye can be able to allocate resources more efficiently to start required long-term investment, and consequently 3) "long term gains" enhancing complexity with needed costly investment which can be achieved in a longer horizon. The three paths can also be targeted at the same time, which we do not find feasible, given the current dynamics in Türkiye's trade composition. Therefore, this is why we propose a differentiated path to take steps gradually, build a technology infrastructure with needed know-how and capital and in the meantime develop the future for next generations.

One would realize the "interim advantage" path has almost the same prioritized products with the "easier to go" goods in the top lists we propose since those closer to our skill-set are also the ones high income countries mostly import from the rest of the world. This is a good coincidence where Türkiye can both benefit from its relative advantageous position and also generate more revenues from those countries in order to satisfy their import needs. This can be facilitated by the rest of the sectors easier to attain and in the meantime more sectors can be added from higher global demand group to widen the revenue gains and raise more capital to help more costly long term investment. As a result, our suggestions of "easier to go" and "interim advantage" can be run simultaneously after the early steps and know-how of "easier to go".

All in all, our results show the high potential of Türkiye being near to many opportunities to increase its economic complexity particularly due to its current know-how in machinery and electrical equipment. Intermediate products related to electrical apparatus could facilitate Türkiye's transition to much complex products with higher value added requiring higher technology. While the export diversification indices give a rough preliminary idea on where to look shaping a transition path in global value chains, they would produce more targeted results when complemented with a sound plan addressing not only economic but also social and political conditions ranging from financing conditions and incentives to investment to labor productivity, skills, access to education and training in high technology, distributional and gender inequalities.

8. Tables

Table 1. **LIST OF COUNTRIES INCLUDED IN COMPLEXITY CALCULATION**

Country Name	Country Code	Country Name	Country Code	Country Name	Country Code	Country Name	Country Code
Afghanistan	AFG	Denmark	DNK	Lebanon	LBN	Russian Federation	RUS
Albania	ALB	Dominican Republic	DOM	Libya	LBY	Saudi Arabia	SAU
Algeria	DZA	Ecuador	ECU	Lithuania	LTU	Senegal	SEN
Angola	AGO	Egypt	EGY	Madagascar	MDG	Serbia	SRB
Argentina	ARG	El Salvador	SLV	Malawi	MWI	Sierra Leone	SLE
Armenia	ARM	Ethiopia	ETH	Malaysia	MYS	Singapore	SGP
Australia	AUS	Finland	FIN	Mali	MLI	Slovakia	SVK
Austria	AUT	France	FRA	Mauritania	MRT	Slovenia	SVN
Azerbaijan	AZE	Gabon	GAB	Mexico	MEX	South Africa	ZAF
Bangladesh	BGD	Georgia	GEO	Moldova	MDA	South Korea	KOR
Belarus	BLR	Germany	DEU	Mongolia	MNG	Spain	ESP
Belgium	BEL	Ghana	GHA	Morocco	MAR	Sri Lanka	LKA
Benin	BEN	Greece	GRC	Mozambique	MOZ	Sudan	SDN
Bolivia	BOL	Guatemala	GTM	Myanmar	MMR	Sweden	SWE
Bosnia	BIH	Guinea	GIN	Namibia	NAM	Switzerland	CHE
Botswana	BWA	Honduras	HND	Netherlands	NLD	Taiwan	TWN
Brazil	BRA	Hong Kong	HKG	New Zealand	NZL	Tanzania	TZA
Bulgaria	BGR	Hungary	HUN	Nicaragua	NIC	Thailand	THA
Burkina Faso	BFA	India	IND	Niger	NER	Togo	TGO
Cambodia	KHM	Indonesia	IDN	Nigeria	NGA	Tunisia	TUN
Cameroon	CMR	Iran	IRN	North Macedonia	MKD	Turkmenistan	TKM
Canada	CAN	Iraq	IRQ	Norway	NOR	Türkiye	TUR
Chad	TCD	Ireland	IRL	Oman	OMN	Uganda	UGA
Chile	CHL	Israel	ISR	Pakistan	PAK	Ukraine	UKR
China	CHN	Italy	ITA	Panama	PAN	United Arab Emirates	ARE
Colombia	COL	Jamaica	JAM	Papua New Guinea	PNG	United Kingdom	GBR
Congo	COG	Japan	JPN	Paraguay	PRY	Uruguay	URY
Congo (DR)	COD	Jordan	JOR	Peru	PER	USA	USA
Costa Rica	CRI	Kazakhstan	KAZ	Philippines	PHL	Uzbekistan	UZB
Côte d'Ivoire	CIV	Kenya	KEN	Poland	POL	Venezuela	VEN
Croatia	HRV	Kuwait	KWT	Portugal	PRT	Vietnam	VNM
Cuba	CUB	Kyrgyzstan	KGZ	Qatar	QAT	Zambia	ZMB
Czech Republic	CZE	Laos	LAO	Romania	ROU	Zimbabwe	ZWE

Source: The Growth Lab at Harvard University International Trade Data (2019), BBVA Research calculations

Table 2. **HIGH INCOME COUNTRIES**

Country Name	Country Code	Country Name	Country Code
United Arab Emirates	ARE	Japan	JPN
Australia	AUS	Korea, Rep.	KOR
Austria	AUT	Kuwait	KWT
Belgium	BEL	Lithuania	LTU
Bahrain	BHR	Latvia	LVA
Canada	CAN	Netherlands	NLD
Switzerland	CHE	Norway	NOR
Chile	CHL	New Zealand	NZL
Czech Republic	CZE	Oman	OMN
Germany	DEU	Panama	PAN
Denmark	DNK	Poland	POL
Spain	ESP	Puerto Rico	PRI
Finland	FIN	Portugal	PRT
France	FRA	Qatar	QAT
United Kingdom	GBR	Romania	ROU
Greece	GRC	Saudi Arabia	SAU
Hong Kong SAR, China	HKG	Singapore	SGP
Croatia	HRV	Slovak Republic	SVK
Hungary	HUN	Slovenia	SVN
Ireland	IRL	Sweden	SWE
Israel	ISR	Uruguay	URY
Italy	ITA	United States	USA

Source: The Growth Lab at Harvard University International Trade Data (2019), BBVA Research calculations

Table 3. **TOP 25 PRODUCTS WITH THE HIGHEST "EASIER TO GO SCORE**

Product Code	Product Name	PCI	Density	COG	RCA	Share	Index Score	RCACategory
3004	Medicaments, packaged	2.40	0.40	0.66	0.29	2.82%	2.30	low RCA
3926	Other articles of plastic	1.80	0.43	0.63	0.59	0.56%	1.12	middle RCA
8536	Electrical apparatus for < 1k volts	2.35	0.41	0.78	0.65	0.52%	0.98	middle RCA
8419	Equipment for temperature change of materials	2.99	0.42	0.83	0.74	0.22%	0.97	middle RCA
8421	Centrifuges	2.93	0.41	0.89	0.78	0.46%	0.97	middle RCA
8501	Electric motors and generators	2.42	0.42	0.75	0.46	0.33%	0.95	low RCA
8537	Electrical boards	1.99	0.42	0.68	0.82	0.39%	0.95	middle RCA
8512	Electrical lighting equipment used for motor vehicles	2.15	0.43	0.69	0.89	0.19%	0.94	middle RCA
6810	Articles of cement, of concrete or of artificial stone	1.69	0.43	0.51	0.97	0.07%	0.84	middle RCA
8607	Parts of railway locomotives	1.99	0.43	0.60	0.65	0.08%	0.84	middle RCA
8481	Appliances for thermostatically controlled valves	3.12	0.39	0.97	0.78	0.51%	0.81	middle RCA
8538	Parts for electrical apparatus	2.69	0.41	0.84	0.48	0.17%	0.76	low RCA
8546	Electrical insulators of any material	2.11	0.43	0.69	0.83	0.01%	0.76	middle RCA
4911	Other printed matter	1.67	0.43	0.46	0.64	0.07%	0.73	middle RCA
7019	Glass fibers	2.37	0.42	0.66	0.87	0.07%	0.69	middle RCA
8530	Electric signal and traffic controls	2.65	0.42	0.72	0.34	0.01%	0.68	low RCA
8414	Pumps, compressors, fans, etc.	3.26	0.38	0.99	0.69	0.41%	0.67	middle RCA
5111	Woven fabrics of carded wool	1.39	0.43	0.48	0.50	0.00%	0.66	low RCA
8426	Ships' derricks; cranes	1.70	0.42	0.68	0.83	0.07%	0.66	middle RCA
7907	Other articles of zinc	1.77	0.42	0.61	0.74	0.01%	0.64	middle RCA
7307	Tube or pipe fittings of iron or steel	2.93	0.40	0.90	0.86	0.10%	0.64	middle RCA
8303	Safes	2.26	0.41	0.70	0.26	0.01%	0.60	low RCA
5906	Rubberized textile fabrics	2.32	0.41	0.72	0.39	0.01%	0.60	low RCA
8712	Bicycles	1.31	0.41	0.56	0.60	0.07%	0.59	middle RCA
8433	Harvesting or agricultural machinery	2.02	0.40	0.59	0.45	0.14%	0.57	low RCA

Source: The Growth Lab at Harvard University International Trade Data (2019), BBVA Research calculations

Table 4. **TOP 25 PRODUCTS WITH THE HIGHEST "INTERIM ADVANTAGE" SCORE**

Product Code	Product Name	PCI	Density	COG	RCA	Share	Index Score	RCACategory
3004	Medicaments, packaged	2.40	0.40	0.66	0.29	2.82%	5.58	low RCA
3926	Other articles of plastic	1.80	0.43	0.63	0.59	0.56%	1.26	middle RCA
8536	Electrical apparatus for < 1k volts	2.35	0.41	0.78	0.65	0.52%	1.18	middle RCA
8481	Appliances for thermostatically controlled valves	3.12	0.39	0.97	0.78	0.51%	1.16	middle RCA
8421	Centrifuges	2.93	0.41	0.89	0.78	0.46%	1.12	middle RCA
8414	Pumps, compressors, fans, etc.	3.26	0.38	0.99	0.69	0.41%	0.95	middle RCA
8537	Electrical boards	1.99	0.42	0.68	0.82	0.39%	0.92	middle RCA
8501	Electric motors and generators	2.42	0.42	0.75	0.46	0.33%	0.83	low RCA
8419	Equipment for temperature change of materials	2.99	0.42	0.83	0.74	0.22%	0.69	middle RCA
9405	Lamps	1.96	0.38	0.56	0.47	0.35%	0.64	low RCA
8901	Cargo ships and similar vessels	1.00	0.38	0.55	0.85	0.34%	0.58	middle RCA
3304	Make-up preparations	1.72	0.38	0.61	0.42	0.31%	0.57	low RCA
8512	Electrical lighting equipment used for motor vehicles	2.15	0.43	0.69	0.89	0.19%	0.57	middle RCA
8538	Parts for electrical apparatus	2.69	0.41	0.84	0.48	0.17%	0.52	low RCA
8407	Spark-ignition reciprocating internal combustion piston engines	2.40	0.37	0.74	0.67	0.27%	0.51	middle RCA
8207	Interchangeable tools for hand tools	3.83	0.38	1.17	0.55	0.12%	0.45	middle RCA
8482	Ball or roller bearings	3.00	0.38	1.01	0.43	0.15%	0.44	low RCA
8408	Compression-ignition internal combustion piston engines	2.66	0.37	0.88	0.62	0.20%	0.43	middle RCA
9032	Automatic regulating instruments	2.72	0.38	0.76	0.41	0.18%	0.41	low RCA
7307	Tube or pipe fittings of iron or steel	2.93	0.40	0.90	0.86	0.10%	0.38	middle RCA
8433	Harvesting or agricultural machinery	2.02	0.40	0.59	0.45	0.14%	0.34	low RCA
8466	Parts and accessories for metal working machines	3.83	0.37	1.05	0.43	0.10%	0.34	low RCA
8607	Parts of railway locomotives	1.99	0.43	0.60	0.65	0.08%	0.32	middle RCA
7019	Glass fibers	2.37	0.42	0.66	0.87	0.07%	0.29	middle RCA
6810	Articles of cement, of concrete or of artificial stone	1.69	0.43	0.51	0.97	0.07%	0.29	middle RCA

Source: The Growth Lab at Harvard University International Trade Data (2019), BBVA Research calculations

Table 5. **FEASIBLE PRODUCTS**

Product Code	Product Name	PCI	Density	COG	RCA	Share	Index Score	RCA category
8207	Interchangeable tools for hand tools	3.83	0.38	1.17	0.55	0.12%	1.39	middle RCA
8466	Parts and accessories for metal working machines	3.83	0.37	1.05	0.43	0.10%	1.24	low RCA
8420	Calendering or other rolling machines, other than for metals or glass	3.72	0.37	1.02	0.55	0.01%	1.18	middle RCA
7315	Chain of iron or steel	3.33	0.38	1.08	0.50	0.03%	1.16	middle RCA
8414	Pumps, compressors, fans, etc.	3.26	0.38	0.99	0.69	0.41%	1.14	middle RCA
8481	Appliances for thermostatically controlled valves	3.12	0.39	0.97	0.78	0.51%	1.12	middle RCA
8208	Knives and blades for machines	3.60	0.37	0.99	0.42	0.02%	1.12	low RCA
8482	Ball or roller bearings	3.00	0.38	1.01	0.43	0.15%	1.05	low RCA
6804	Grindstones	2.97	0.39	1.02	0.64	0.02%	1.04	middle RCA
8421	Centrifuges	2.93	0.41	0.89	0.78	0.46%	1.04	middle RCA
3004	Medicaments, packaged	2.40	0.40	0.66	0.29	2.82%	1.03	low RCA
8464	Machine tools for working stone	2.96	0.37	1.05	0.85	0.01%	1.02	middle RCA
8419	Equipment for temperature change of materials	2.99	0.42	0.83	0.74	0.22%	0.99	middle RCA
7307	Tube or pipe fittings of iron or steel	2.93	0.40	0.90	0.86	0.10%	0.97	middle RCA
8459	Machine tools for drilling by removing metal	2.82	0.39	0.95	0.68	0.01%	0.95	middle RCA
8441	Other machinery for making paper	3.13	0.37	0.92	0.64	0.04%	0.93	middle RCA
8468	Machinery for soldering	2.56	0.40	0.96	0.70	0.00%	0.92	middle RCA
8547	Insulating fittings for electrical machines	2.93	0.39	0.90	0.40	0.03%	0.92	low RCA
8538	Parts for electrical apparatus	2.69	0.41	0.84	0.48	0.17%	0.89	low RCA
5911	Textile articles for technical use	2.79	0.40	0.81	0.66	0.03%	0.82	middle RCA
8408	Compression-ignition internal combustion piston engines	2.66	0.37	0.88	0.62	0.20%	0.82	middle RCA
8536	Electrical apparatus for < 1k volts	2.35	0.41	0.78	0.65	0.52%	0.82	middle RCA
8501	Electric motors and generators	2.42	0.42	0.75	0.46	0.33%	0.79	low RCA
8530	Electric signal and traffic controls	2.65	0.42	0.72	0.34	0.01%	0.74	low RCA
8416	Furnace burners	2.83	0.40	0.71	0.91	0.01%	0.73	middle RCA

Source: The Growth Lab at Harvard University International Trade Data (2019), BBVA Research calculations

9. Technical Appendix

The term "complexity" is based on the idea that different products require different levels of knowledge or know-how and the prosperous countries are the ones that hold a diversity of knowledge, enabling them produce products which could be produced by very few countries. From this it follows that we need to know which countries make which products. Assuming that bilateral trade data gives information on the types of products each country produces, we first come up with a matrix $M_{c,p}$ in which each row stands for countries while each column stands for products. If a country produces a certain product with an RCA above 1, the entry for that country for that particular product is 1 and 0 otherwise:

$$M_{c,p} = \begin{cases} 1 \; if \; RCA_{c,p} \geq 1 \\ 0 \; otherwise \end{cases} \quad (1)$$

Once $M_{c,p}$ matrix is calculated two building blocks of complexity index "diversity" of a country and "ubiquity" of a product is defined as follows,

$$Diversity = k_{c,0} = \sum_p M_{cp} \quad (2)$$

$$Ubiquity = k_{p,0} = \sum_c M_{cp} \quad (3)$$

where c stands for countries and p for products. As the diversity is the row-sum of the matrix, it reflects the number of products that a particular country exports. Conversely, ubiquity is the column-sum of the matrix standing for the number of countries that export a particular product.

Following these two equations, the average diversity of the countries that make a product and the average ubiquity of the other products that this country makes, could be computed to better understand the current capabilities of a country and the capabilities that is required by a product:

$$k_{c,N} = \frac{1}{k_{c,0}} \sum_p M_{cp} * k_{p,N-1} \quad (4)$$

$$k_{p,N} = \frac{1}{k_{p,0}} \sum_c M_{cp} * k_{c,N-1} \quad (5)$$

Going further, we can insert (5) into (4) to obtain the recursive equations:

$$k_{c,N} = \frac{1}{k_{c,0}} \sum_p M_{cp} * \frac{1}{k_{p,0}} \sum_{c'} M_{c'p} \, k_{c',N-2} \quad (6)$$

$$k_{c,N} = \sum_{c'} k_{c',N-2} * \sum \frac{M_{cp} M_{cp}}{k_{c,0} k_{p,0}} \quad (7)$$

Equation 7 could be rewrited as follows:

$$k_{c,N} = \sum_{c'} \widetilde{M}_{c,c'} k_{c',N-2}$$

where $\widetilde{M}_{c,c'} = \sum_p \frac{M_{cp}M_{cp}}{k_{c,0}k_{p,0}}$. The eigenvector of the largest eigenvalue for $\widetilde{M}_{c,c'}$ is when $k_{c,N} = k_{c,N-2} = 1$ which is the eigenvector with all elements equal to 1. Since this eigenvector is trivial, the eigenvector corresponding to the second largest eigenvalue is chosen to stand for the largest amount of variance which is the measure of the economic complexity. The economic complexity index is defined as:

$$ECI = \frac{\vec{K} - \langle\vec{K}\rangle}{stdev(\vec{K})}$$

where $\vec{K}$ stands for the eigenvector of $\widetilde{M}_{c,c'}$ associated with second largest eigenvalue and the signs "<>" represent the average of the eigenvector. Similarly, the Product Complexity Index (PCI) could be computed by converting $\widetilde{M}_{cc'}$ into $\widetilde{M}_{pp'}$ which could be done just by changing the subscripts. The resulting equation is as follows:

$$PCI = \frac{\vec{Q} - \langle\vec{Q}\rangle}{stdev(\vec{Q})}$$

where $\vec{Q}$ stands for the eigenvector of $\widetilde{M}_{pp'}$ associated with second largest eigenvalue and the signs "< >" represent the average of the eigenvector.

The construction of product space depends on quantifying to what extent two distinct goods require similar capabilities. Directly measuring this similarity of capabilities required for producing products is not possible, however by calculating the conditional probability that a country that exports product p given that it already exports product p' could help us understand which products are "closer" to each other in terms of know-how that they require. From this logic, the term proximity is defined as follows:

$$Proximity = \varphi_{p,p'} = \frac{\sum_c M_{cp}M_{cp'}}{\max(k_{p,0}k_{p',0})}$$

Using the information on the similar capabilities the products require provided by the proximity, we can locate countries in product space by distance metric. Summing up the proximities between a product and all the other products that the country currently does not have knowledge, distance basically gives an idea about how far away a product is to the exports of a country. Distance variable takes values between 0 and 1: The distance of a country to a product becomes smaller, closer to 0 if the country produces many products that require similar capabilities as that product of interest. Conversely, if distance is closer to 1, it could be deduced that the country is further away from that product. While distance quantifies how far the country is to a product, density variable shows how "close" the country is to the product in question.

$$distance_{c,p} = \frac{\sum_c (1 - M_{cp'})\varphi_{p,p'}}{\sum_{p'} \varphi_{p,p'}}$$

$$density_{c,p} = (1 - distance_{c,p})$$

Having computed the distance (therefore density) of countries to products, complexity outlook index (COI) is defined in order to quantify the opportunities for each country to increase their complexity score. Complexity outlook for a country is the summation of density of the country to the products that it doesn't have specialty yet weighted by the

level of complexity of these products. Finally, the gain in complexity due to moving to a new product on product space is calculated by the complexity outlook gain (COG):

$$COI_c = \sum_{p'}(1 - d_{c,p})(1 - M_{cp'})PCI_{p'}$$

$$COG_{c,p} = \left[\sum_{p'} \frac{\varphi_{p,p'}}{\sum_{p''}\varphi_{p'',p'}}(1 - M_{cp'})PCI_{p'}\right] - \left(1 - d_{c,p}\right)PCI_p$$

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