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The Changing Dynamics of Turkish Sectors within the Context of Trade in Emissions

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ABSTRACT

Although countries have been aware of the climate change risks, no one predicts that such hazardous outcomes will come much earlier. Thus, there have been enormous efforts to mitigate the climate change risks and significant targets to access for dealing with climate change. Not only focusing on the domestic sources of emissions but also focusing on avoiding emissions embodied in trade, developed countries such as the EU and USA impose policies. However, there are some difficulties in terms of holistic point of view and providing a fair framework for a win-win situation for each country. This is especially due to the role of increasing production fragmentation since 1990s within the context of global value chains. That is, trade in value added, which is at the basis of global value chains, manifests itself as trade in emissions when it comes to emissions. We first discuss the emissions issue in a more holistic way in terms of trade in emissions by comparing selected countries with Türkiye and propose policy recommendations for further discussion of climate issues to access more effective and fair solutions. Moreover, our dynamic panel data estimates imply that while inward FDI stocks increase both production and gross exports related emissions. Outward FDI stocks seem to reduce domestic emissions embodied in gross exports, which promotes the argument that developed countries outsource the emissions into developing nations through foreign trade and foreign direct investment.

Keywords: Emissions, trade in emissions, carbon taxing, climate change, FDI

Emisyon Ticareti Bağlamında Türkiye'deki Sektörlerin Değişen Dinamikleri

Bilgi

Süreç
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ÖZ

Ülkeler her ne kadar iklim değişikliği risklerinin farkında olsalar da öngörülen tehlikeli sonuçların bu kadar da erken gerçekleşeceğini düşünmemişlerdi. İklim değişikliğiyle mücadele hedeflerine ulaşılması için büyük çabalar gösterilmektedir. AB ve ABD gibi gelişmiş ülkeler, yalnızca ulusal emisyon kaynaklarına odaklanmakla kalmayıp aynı zamanda ticarette ortaya çıkan emisyonların önlenmesine de odaklanarak politikalar uygulamaktadırlar. Ancak bu süreçte bütüncül bir bakış açısı yakalanması noktasında ve her ülke için kazan-kazan temelinde adil bir çerçeve sağlanması açısından bazı zorluklar mevcuttur. Bu durumun önemli sebeplerinden biri de özellikle küresel değer zincirleri bağlamında 1990'lı yıllardan bu yana artan üretim parçalanması veya paylaşımıdır. Yani küresel değer zincirlerinin temelinde yer alan katma değer ticareti, konu emisyon olduğunda emisyon ticareti olarak kendini göstermektedir. Bu çalışmada Türkiye'yi seçilmiş ülkeler ile karşılaştırarak emisyon konusunu emisyon ticareti açısından daha bütüncül bir şekilde hem teorik hem de ampirik olarak ele alıyoruz. Daha etkili ve adil çözümlere ulaşmak için nasıl bir politika çerçevesine ve yönteme ihtiyaç duyulacağını tartışıyoruz. Ayrıca, dinamik panel veri tahminlerimiz, ülkeye gelen doğrudan yabancı yatırım stoklarının hem üretim hem de ihracat kaynaklı emisyonları artırdığını göstermektedir. Dışarıya doğru doğrudan yabancı yatırım stokları, ihracatta yer alan yurt içi emisyonları azaltmaktadır. Bu sonuçlar gelişmekte olan ülkelere dış ticaret ve doğrudan yabancı yatırım yoluyla emisyonların kaydırılması sonrasında gelişmiş ülkelerin emisyonlarını azalttığı argümanını desteklemektedir.

Anahtar Kelimeler: Emisyon, emisyon ticareti, karbon vergisi, iklim değişikliği, DYY

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1. Introduction

Although the fight against climate change is a crucial issue that cannot tolerate any delays, it has not yet been placed on an inclusive and fair ground on a global scale. While the efforts of developed nations seem to be much more progressive compared to the efforts of developing and underdeveloped countries, discussing the climate change issue from different dimensions enables us to grasp some missed points. For instance, the lower level of emissions in many industrial countries are not solely due to advancing climate change targets but also more importantly due to outsourcing emissions to developing countries. This outsourcing is primarily as a result of production fragmentation which is mainly discussed within the framework of global value chains. Trade in value added concept is developed for understanding the outsourcing in international trade beyond gross statistics (Yanikkaya and Altun, 2021). Similarly, trade in emissions is developed for understanding emissions in international trade beyond the gross emissions statistics (Yamano and Guilhoto, 2020). Not only concerns in understanding the responsibilities in abovementioned concerns but also the concerns for economic development to mitigate poverty on the one hand and concerns about reducing emissions on the other hand put many developing and underdeveloped countries into another challenge. This challenge is at the very center of unfair policy selections.

As to Türkiye, the higher investments in transportation, energy production and manufacturing associated with booming consumption cause surges in emissions for the last decades. Transportation services and electricity production are the two main contributors of the emissions in Türkiye (Isik et al., 2020 and Calikoglu and Koksal, 2023). The emissions in Türkiye increased 157% in 2021 from 1990 and reached to total 564.4 million tonnes in 2021 (TurkStat, 2023). Türkiye thus seems to be in need of urgent provisions in terms of green technological developments. Note that the integration of Türkiye in global and regional value chains results in unignorable shares of emissions both in final demand and exports of Türkiye. For example, the foreign CO2 emissions embodied in final demand for manufacturing in Türkiye is more than 40% and the foreign CO2 emissions share of Turkish manufacturing exports is around 30% (OECD, 2023). That is, developing effective and efficient emissions policies towards the repercussions of the climate change, Türkiye should be aware of the 'trade in emissions" concepts for avoiding possible unfair and costlier outcomes of carbon taxing and carbon border adjustment mechanism (CBAM).

In this paper we discuss the various relevant dimensions of emissions issue for Türkiye comparatively with the selected country groups and countries. The next section discusses the emissions from the gross statistics point of view. Then the section three discusses comparatively the trade in emissions issue for Türkiye and selected country and country groups. The fourth section presents the data and estimation methodology and shows the panel data estimates for various measures emissions. Finally, we conclude our paper by implying significant policy recommendations and attracting interest for the possible unfair and costly results of the ignorance of the "trade in emissions" concept.

2. Emissions Based on Production: Conventional Way of Understanding Emissions

First, we shall focus on the gross emissions based on the production of the selected country groups and countries. Actually, such type of emissions are the emissions released within the domestic borders as a result of production activities within the national borders. However, in these emissions, there is no distinction who releases and how much emissions until the final production within the final destination.

2.1 Selected Country Groups

Figure 1 below reports CO2 emissions for the different country groups based on their production. G20 countries account for the largest portion of these emissions. 28 European Union Countries (EU28) has a much lower share compared to other country groups such as Asia-Pacific Economic Cooperation (APEC), Organization for Economic Co-Operation and Development (OECD) and non-OECD (see Table A1 for the

member countries of each country group). Another important point is the significantly increasing share of the APEC in generating emissions.

Figure 1 also shows the industry level details of the emissions reported. Electricity, gas, water supply, sewerage, waste and remediation services are responsible for the largest portion of the emissions in the world. The increasing trend of emissions for manufacturing and services is also seen very clearly (see, Table A3 for the details of industries).

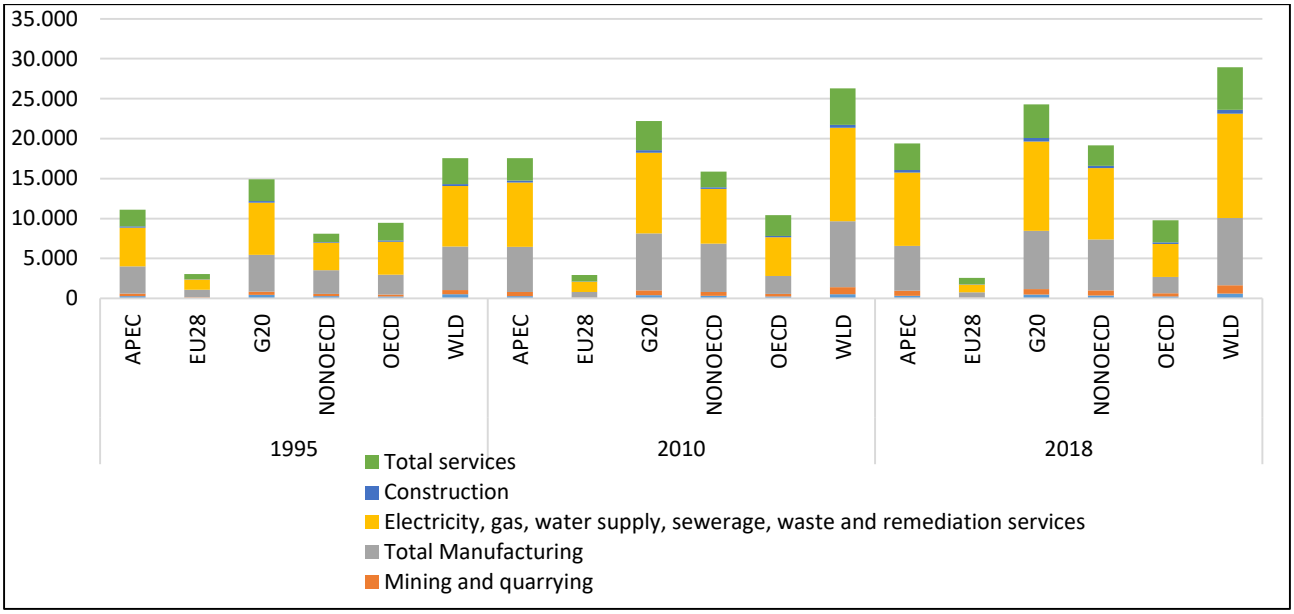

Figure 1. CO_2 Emissions of the Selected Countries by Industry based on Production (Millions Tonnes)
Notes: See Table A1 for country groups and countries. Source: OECD (2023a)

2.2 Production based Emissions of Türkiye and Selected Countries

Figure 2 reports the per capita emissions for main country groupings. ZNAM (North America), the EU and the OECD witness decreases in per capita emissions. However, the ZNAM region has by far the largest levels of per capita emissions in the world.

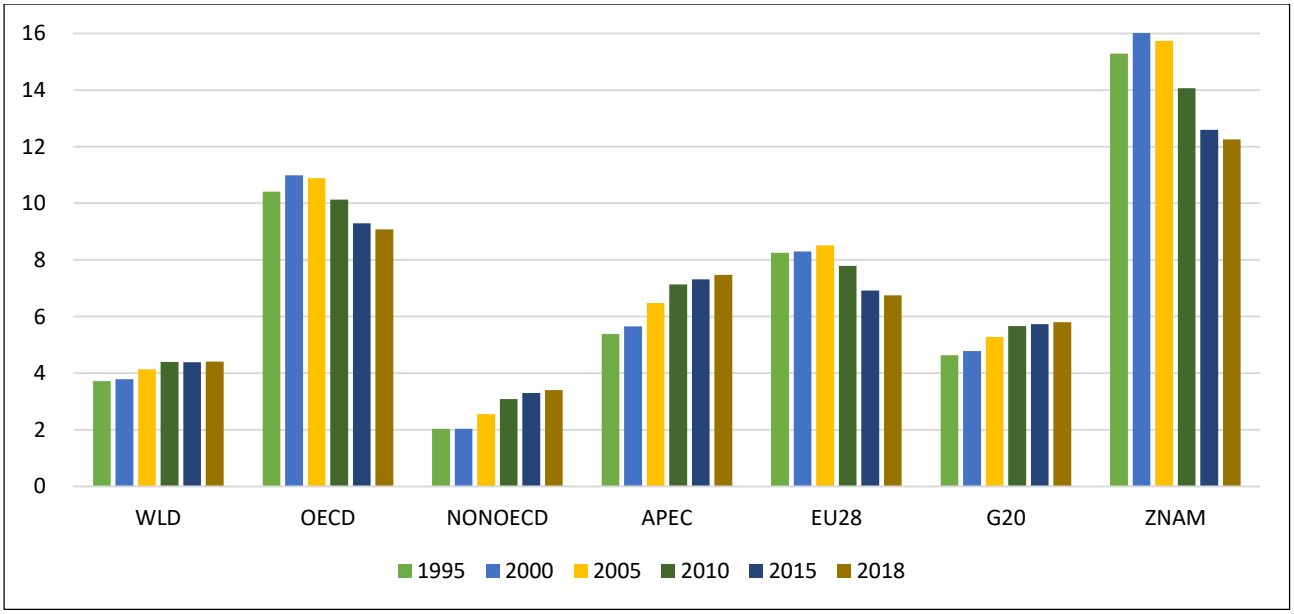

Figure 2. CO2 Emissions per Capita of the Different Country Groups based on Production (Total) (Kilograms per Capita, Thousands), Notes: See Table A1 for country groups and countries. Source: OECD (2023a)

Figure 3 displays the disaggregated measures of emissions for selected countries. Countries listed here are responsible for about 70% of global production-based CO2 emissions, according to our calculations. The most significant rise in emissions is recorded in China from 1995 to 2018 according to Figure 3. Regarding the main destination of foreign direct investments (FDIs) since 1990s China has the biggest production hub of the world with the swelling emissions. India also has a significant increase in emissions probably due to increasing energy consumption to assist its development process and support growing population but its emission levels are not comparable with those for China. Türkiye has also an increasing trend of releasing emissions. A slightly decreasing trend in releasing emissions is observed especially in the USA and EU countries during the period.

Figure 3 also presents the industry level details of the emissions. One can see that increases in emissions considerably in almost every industry of China. Although there is a decrease in the emissions of the USA for many industries, there is a slight increase in services, which has the lower levels of trade openness with the limited opportunities for outsourcing.

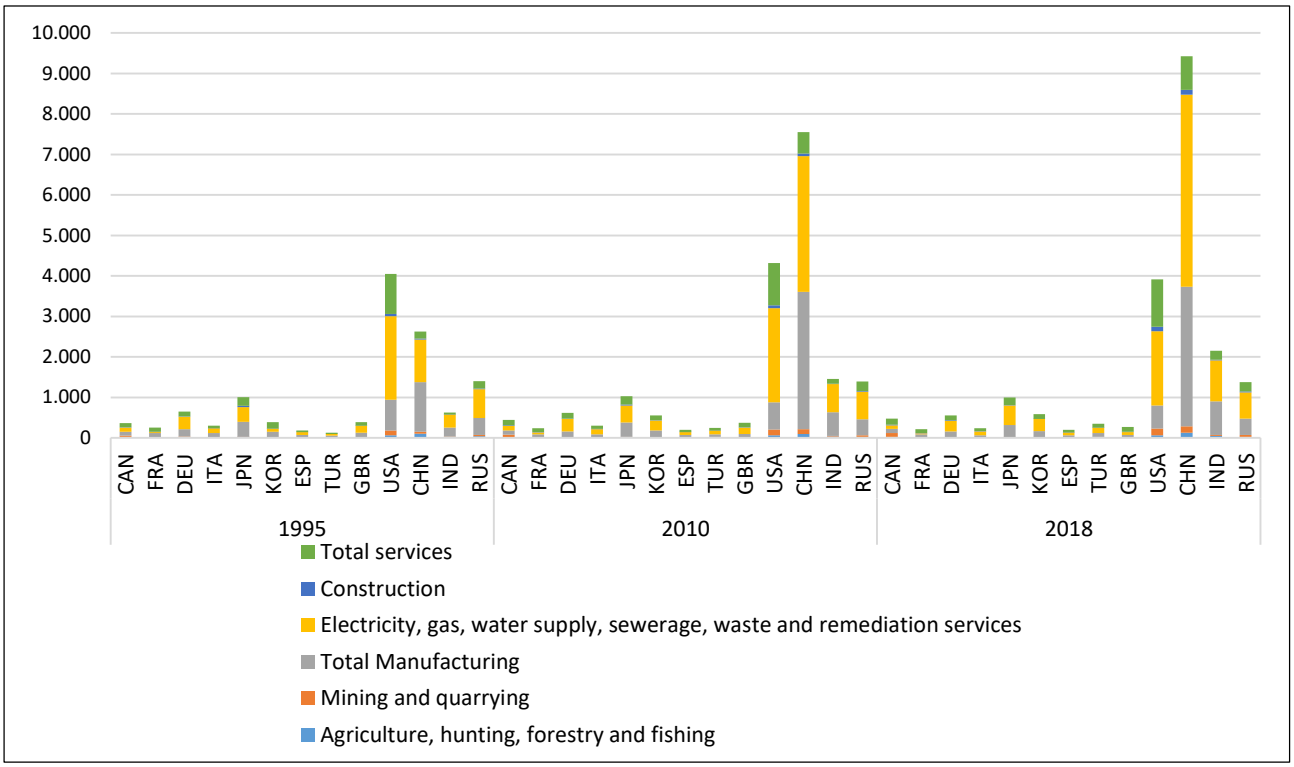

Figure 3. CO2 Emissions of the Selected Countries by Industry based on Production (Millions Tonnes), Notes: See Table A1 for country groups and countries. Source: OECD (2023a)

According to Figure 4, while the per capita emissions of the selected EU countries and the USA on the decreasing trend, the per capita emissions of countries such as Japan, Russia and Canada seem relatively to be stable and the per capita emissions of China, India, South Korea and Türkiye are on the rising trend.

Note also that just focusing on the gross emissions based on production aggregates may hide some very significant facts. For example, although China has the largest levels of emissions in total, it has much lower levels of per capita emissions compared to industrial countries. More importantly, discussing the issue from different points of views, especially in terms of trade in emissions, can further enrich our understandings.

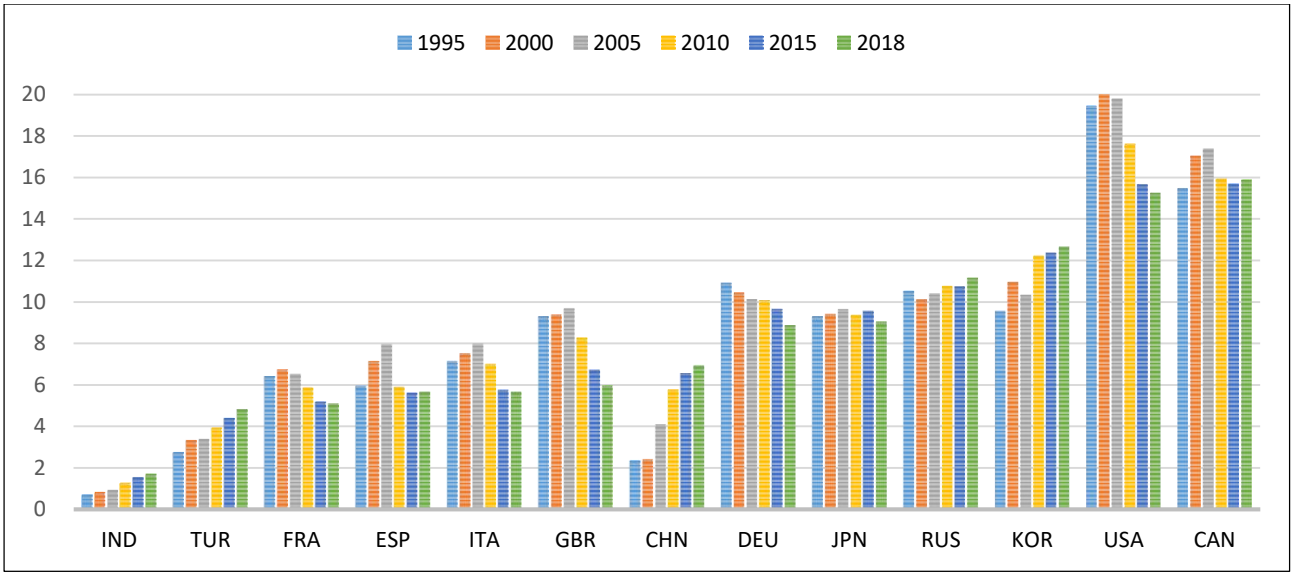

Figure 4. CO2 Emissions per Capita of the Selected Countries based on Production (Total) (Kilograms per Capita, Thousands), Notes: See Table A1 for country groups and countries. Source: OECD (2023a)

3. Trade in Emissions

The calculations methodology of the trade in emissions are similar to the calculations methodology of the trade in value added. Using the same matrices by just changing value added vector with environmental accounts gives us the trade in emissions values (OECD, 2022; Yamano and Guilhoto, 2020). Another important point is that life-cycle assessments based on input-output tables can be made by using the similar methodology (Hendrickson et al., 2006). Although it is possible to separate forward and backward relations from each other for trade in emissions as trade in value added, we here mainly focus on the backward relations. It is necessary to state here that backward GVCs participation is the share of the foreign value added in the gross exports of the home country and forward GVCs is the domestic value added embodied in the exports of foreign countries (Kowalski et al., 2015), from trade in value added point of view. Similarly, we can mention the backward and forward relations in terms of trade in emissions.

As to the higher shares of foreign CO2 emissions in final demands and exports may mean the outsourcing of emissions for the developed countries, whereas higher import dependency for the developing countries. The previous one implies an eager outsourcing; however, the second one implies an unwilling situation. Regarding the increasing self-sufficiency concerns of the contemporary after pandemics world economy, developed nations focus much on withdrawing foreign direct investments (FDIs) from abroad toward domestic economy. Whether trade wars and the European Union Carbon Border Adjustment Mechanism are attempts for this purpose is an important research question from this point of view. The EU declare that they want to reduce emissions leakages by imposing sanctions to provide withdrawing FDIs from higher emissions regions to EU's more regulated lower emissions regions. These attempts at first seem to be very reasonable in reducing total emissions by giving up higher emissions for producing the same amount of goods and services with lower emissions. However, these may also mean letting other countries with more difficult challenges in terms of development and employment. The possible disorders even may be much worse in total compared to previous levels.

As to developing countries and their foreign share of emissions, the increasing self-sufficiency concerns of course affect them, as well. Whether their efforts to increase domestic value added in their production bring relatively more emissions in total.

3.1 Trade in Emission in Selected Country Groups and Industries

Figure 5 and Figure 6 provide various statistics, which has specific significance for understanding the missing points in assessing the emissions of the countries. These figures provide the foreign CO2 emissions embodied in domestic final demand and exports as percentages, respectively. Researchers must take trade in emissions into account for relevant policy making. Since without considering beyond the ordinary understandings of emissions, it is not possible to implement fair and sustainable fighting strategies against climate change. These two figures mainly reflect the outsourcing of emissions to other countries (see, Yanikkaya et al., 2022). Thus, one can argue that the decreasing trends of emissions in developed countries are not solely caused by their domestic success in reduction but also outsourcing production stages abroad.

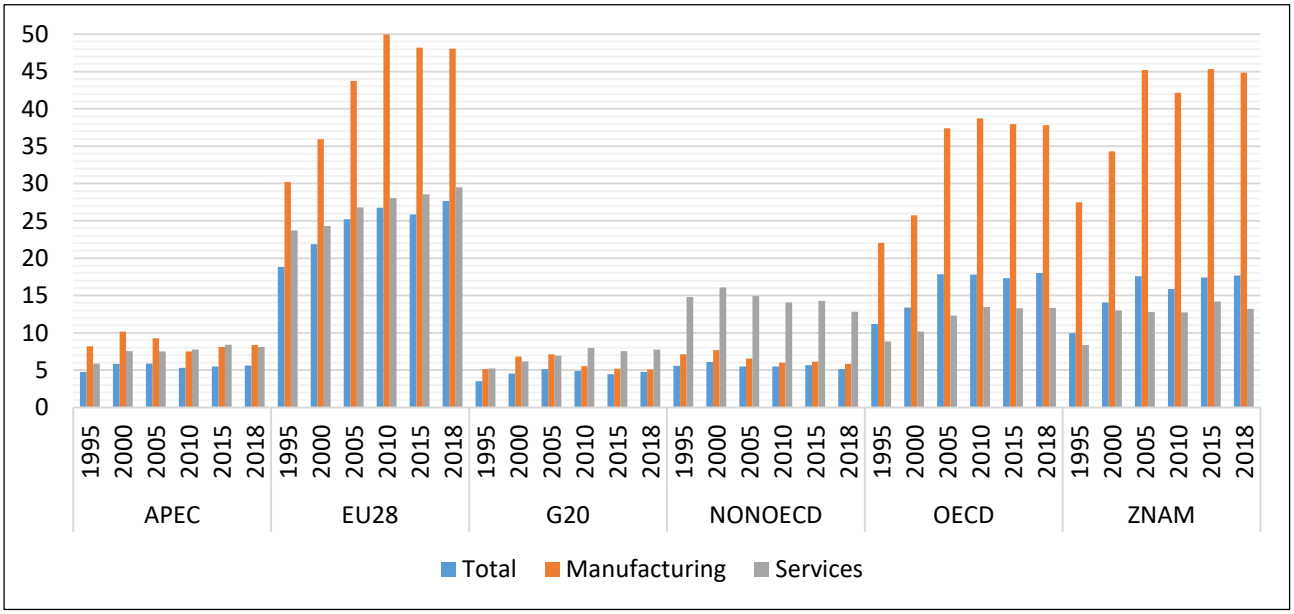

Figure 5. The Share of Foreign CO2 Emissions Embodied in Domestic Final Demand for Selected Country Groups (%), Notes: See Table A1 for country groups and countries. Source: OECD (2023a).

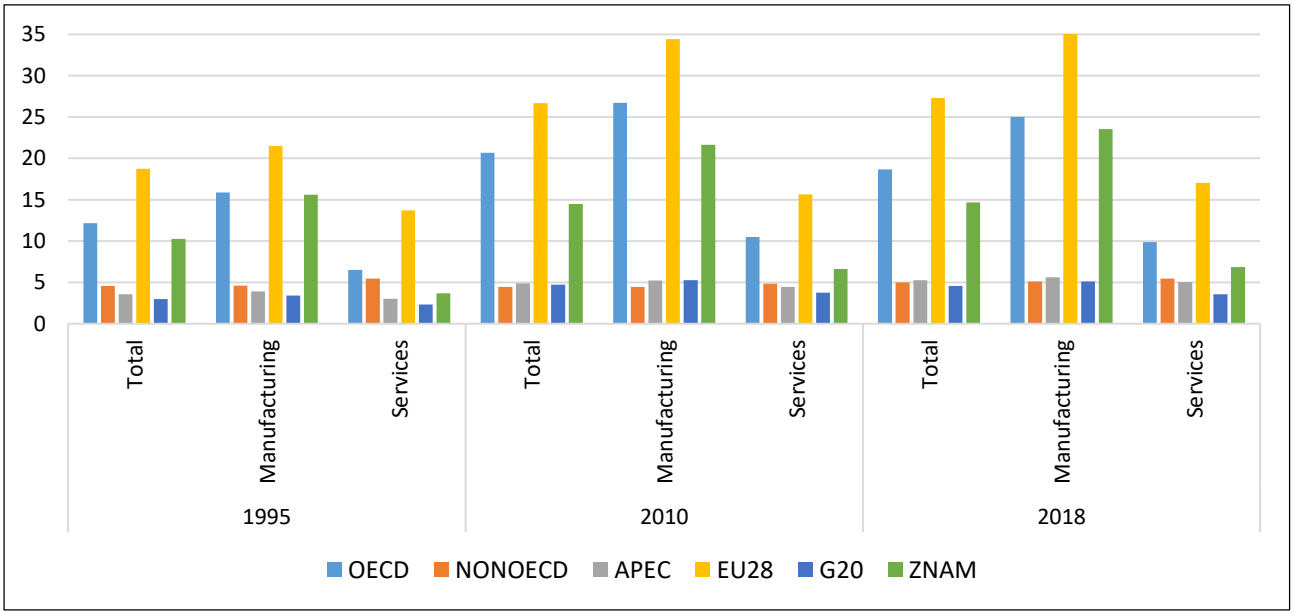

Figure 6. Foreign Share of CO2 Emissions in Exports of Selected Country Groups (%), Notes: See Table A1 for country groups and countries. Source: OECD (2023a).

The foreign share of emissions embodied in the final demand of North America, EU and OECD has increased considerably since 1990s especially in manufacturing (see, Figure 5). A significant amount of production thus takes place abroad for the domestic final demand of these countries. In other words, not only domestic successes in reducing emissions solely belong to developed nations, but also all emissions produced in developing nations are not only their responsibility.

As to exports of countries, in one sense the exports of many countries consist of emissions generated from the production of goods and services ultimately consumed in other countries. A significant share of emissions is generated for importer developed countries, not consumed in the producer countries (see, Figure 6). Considering Figure 5 and Figure 6 together, an important question arises related to potential strategies against emissions: Who will bear how much of the responsibility? This question is both valid for the financing of emissions reducing investments in countries and for the taxing of trade flows. Otherwise, the global income inequality in fighting with climate change is more likely to worsen instead of achieving a fair global framework.

3.2 Trade in Emission for Türkiye

What we observe in Figures 5 and 6 for selected country groups are shown in Figures 7 and 8 for Türkiye. Especially in manufacturing, a high share of foreign emissions is embodied in domestic final demand of Türkiye. The same trend is also valid for the manufacturing exports of Türkiye. These shares have vital implications for Türkiye during the process of forming own strategies for protecting its interests contrary to unfair carbon taxing and other related impositions. Both becoming domestically vulnerable to emissions embodied in final demand of other countries and paying tax for exporting or delivering these products are two contradictory cases. Since especially in manufacturing foreign CO2 emissions have certain shares embodied in final demand and exports.

Moreover, in Table A2 we focus on disaggregated trade in emissions value of Turkish industries. Table A2 shows the foreign share CO2 emissions embodied in final demand of Turkish industries, the foreign share CO2 emissions embodied in exports of Turkish industries and the foreign share CO2 emissions embodied in intermediate exports of Turkish industries. In general, an increase in foreign emissions for manufacturing and a decrease for services are observed.

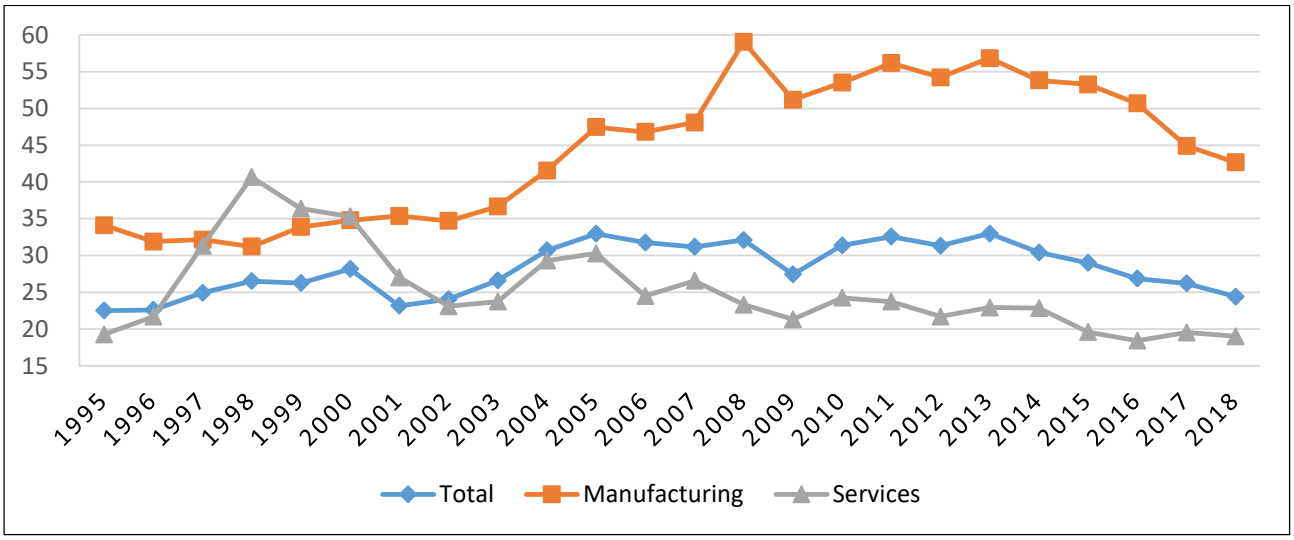

Figure 7. The Share of Foreign CO2 Emissions Embodied in Domestic Final Demand for Türkiye (%)
Source: OECD (2023a)

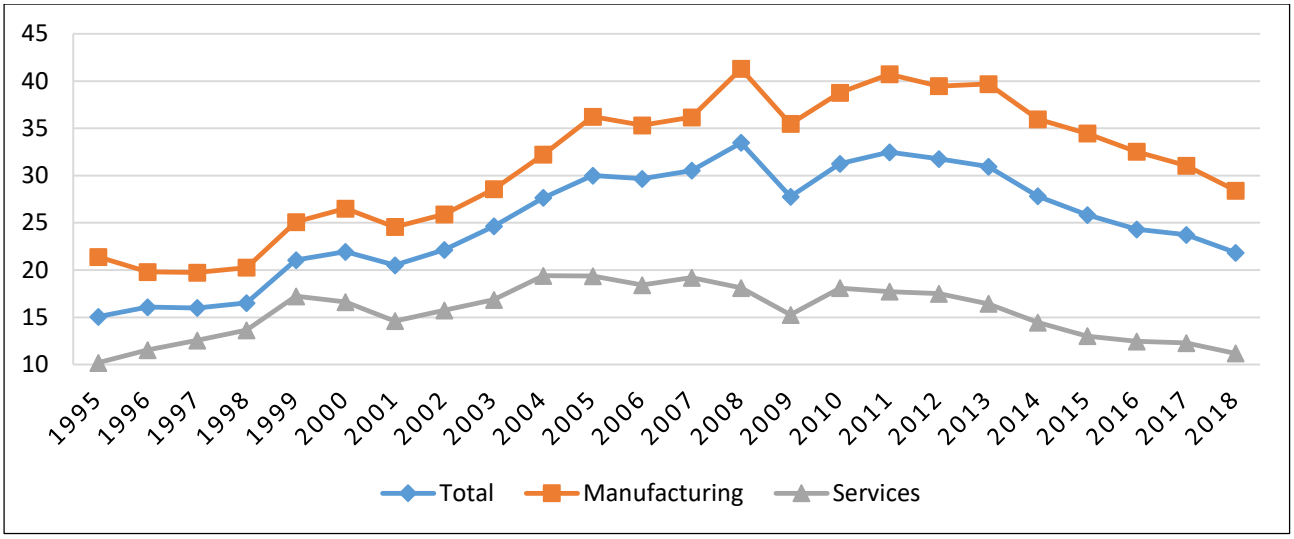

Figure 8. Foreign Share of CO2 Emissions in Exports of Türkiye (%), Source: OECD (2023a)

4. Empirical Strategy

4.1 Data and Methodology

In addition to our graphical analysis above, we estimate the impact of inward and outward FDI stock on the trade in emissions of the 29 Turkish sectors* for the years 1995-2018 by employing the following dynamic panel data model:

$$ltradeinemissions_{s,t} = \alpha_0 + \alpha_1 ltradeinemissions_{s,t-1} + \alpha_2 lvalueadded_{s,t} + \alpha_3 lemployment_{s,t} + \alpha_4 lFDIin_{s,t} + \alpha_5 lFDIout_{s,t} + \varepsilon_{s,t}$$

where $ltradeinemissions_{s,t}$ is the dependent variable (s: sector and t: year) and represents the log values of the various sectoral trade in CO2 emissions such as emissions based on production, emissions based on final demand, domestic emissions based on gross exports, foreign emissions based on gross exports, domestic emissions based on intermediate exports and foreign emissions based on intermediate exports. $ltradeinemissions_{s,t-1}$ represents the one-period lagged values of our dependent variable alternatives. $lvalueadded_{s,t}$represents the log values of sectoral value added, $lemployment_{s,t}$ represents the log values of sectoral employment, $lFDIin_{s,t}$ represents the log values of sectoral inward foreign direct investment stock and $lFDIout_{s,t}$ stands for the log values of sectoral outward foreign direct investment stock.

Data on emissions come from OECD Trade in Emissions Database (OECD, 2023a), data on value added are from the OECD Trade in Value Added Database (OECD, 2023b), data on employment come from the OECD Trade in Employment Data (OECD, 2023c) and data on FDI stocks are from the Electronic Data Delivery System of the Central Bank of the Republic of Türkiye (CBRT, 2023). Table 1 presents the summary statistics for all variables used in the estimations.

In our empirical estimations, by using five-year non-overlapping averages of all variables we employ the system generalized method of moments (GMM) methodology, which is developed by Arellano and Bover (1995) and Blundell and Bond (1998) for mainly dealing with the problems such as endogeneity, heteroscedasticity, overidentification, and validity. There is no correlation between instruments and errors in our estimations regarding the high p values in our Hansen test statistics. AR(2) tests also imply that there is not autocorrelation in first difference levels of AR(2). Thus, based on Hansen test statistics and AR(2) tests, our system GMM results are valid, and our models are correctly specified.

* See Table A3 for empirically included sectors.

Table 1: Summary Statistics

Variables	Observations	Mean	Std. Dev.	Min	Max
lproco2	112	0.71	1.73	-2.92	4.78
lfdco2	112	0.92	1.63	-3.01	4.88
lexgrdco2	112	-0.37	1.65	-4.03	3.35
lexgrfco2	112	-1.50	1.79	-5.10	1.96
lexgrintdco2	112	-1.54	2.40	-6.91	2.95
lexgrintfco2	108	-2.45	2.30	-8.52	1.84
lvalueadded	112	9.39	1.09	6.15	11.55
lemployment	112	5.83	1.32	1.73	8.62
lfdiin	112	6.86	1.83	2.06	10.57
lfdiout	78	4.89	2.04	0.42	10.05

4.2 Empirical Results

Tables 2-4 reports the results of our system GMM estimations. The first three columns of Table 2 show the impact of inward and outward FDI stock on emissions based on production for 29 Turkish industries. The significantly and positively estimated coefficients on the lagged dependent variables imply that emissions are persistent over the period. While our results also show that emissions increase with value added, it decreases with the level of employment. The significantly and positively estimated coefficients indicate that inward FDI stock substantially raises the level of production emissions. The estimates for outward FDI stock are not significant though.

The last three columns of Table 2 show their impacts on emissions based on final demand. Although inward FDI stocks seem to increase the level of emissions based on final demand, if inward and outward FDI stocks included together, none has significant effects.

Table 2. Estimations for the Production and Final Demand Based Emissions

	(1) lproco2	(2) lproco2	(3) lproco2	(4) lfdco2	(5) lfdco2	(6) lfdco2
Lagged DV	0.757***	0.827***	0.816***	0.774***	0.865***	0.867***
	(23.52)	(44.67)	(59.98)	(54.91)	(74.51)	(81.78)
lvalueadded	0.136**	0.101**	0.0480	0.102***	0.143***	0.0796**
	(2.259)	(2.056)	(0.800)	(3.778)	(4.017)	(2.072)
lemployment	-0.0160	-0.0299*	0.00618	-0.0418*	-0.0475**	-0.0207
	(-0.500)	(-1.687)	(0.396)	(-1.693)	(-2.382)	(-1.046)
lfdiin	0.0819***		0.0414***	0.0809***		0.0109
	(6.339)		(5.196)	(7.133)		(0.913)
lfdiout		0.00219	-0.0234		0.00135	-0.00789
		(0.359)	(-1.343)		(0.193)	(-0.771)
Observations	112	79	78	112	79	78
# of industries	29	29	29	29	29	29
# of IVs	30	30	36	30	30	36
AR(2) test p value	0.0378	0.123	0.239	0.136	0.240	0.284
Hansen test p value	0.197	0.411	0.526	0.314	0.470	0.596
z-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1						

Table 3 reports the estimations for gross exports based on domestic and foreign emissions. It is interesting that value added and employment measures change their signs for export emissions compared to production emissions. One explanation would be that industries might employ emissions-saving technologies for exports.

Estimations for inward FDI stocks are almost similar to what we have found in Table 2. The inward FDI stock increases the foreign CO2 emissions in exports as expected. Similar results are observed for the domestic and foreign CO2 emissions in intermediate exports in Table 4 below, as well.

However, the effects of outward FDI stocks on foreign and domestic CO2 emissions embodied in gross exports are substantially different for both Tables 3 and 4. When included individually, outward FDI seems to raise the domestic CO2 emissions embodied in gross exports (of intermediate products). However, if included with inward FDI, it decreases domestic CO2 emissions embodied in gross exports (of intermediate products). One can argue that holding the level of inward FDI stock constant, outward FDI stocks as expectedly reduce domestic CO2 emissions embodied in gross exports which is consistent with the concept of the outsourcing of emissions.

Table 3. Estimations for the Export Based Domestic and Foreign Emissions

	(1)	(2)	(3)	(4)	(5)	(6)
	lexgrdco2	lexgrdco2	lexgrdco2	lexgrfco2	lexgrfco2	lexgrfco2
Lagged DV	1.048***	1.063***	1.069***	1.057***	1.087***	1.055***
	(142.8)	(80.74)	(81.92)	(120.0)	(38.65)	(72.56)
lvalueadded	-0.177***	-0.097***	-0.0122	-0.229***	-0.0706*	-0.108*
	(-10.79)	(-4.117)	(-0.421)	(-5.981)	(-1.767)	(-1.897)
lemployment	0.0957***	0.102***	0.135***	0.136***	0.162***	0.224***
	(5.306)	(4.822)	(4.308)	(16.33)	(4.499)	(14.54)
lfdiin	0.0489***		0.0350***	0.0783***		0.0475***
	(7.348)		(4.332)	(8.399)		(2.879)
lfdiout		0.0340***	-0.0369**		0.0250	-0.0166
		(3.945)	(-2.240)		(1.509)	(-0.695)
Observations	112	79	78	112	79	78
# of industries	29	29	29	29	29	29
# of IVs	30	30	36	30	30	36
AR(2) test p value	0.0992	0.845	0.748	0.325	0.500	0.370
Hansen test p value	0.380	0.473	0.607	0.197	0.416	0.674

z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Estimations for the Intermediate Export Based Domestic and Foreign Emissions

	(1)	(2)	(3)	(4)	(5)	(6)
	lexgrintdco2	lexgrintdco2	lexgrintdco2	lexgrintfco2	lexgrintfco2	lexgrintfco2
Lagged DV	1.053***	1.065***	1.087***	1.069***	1.065***	1.058***
	(168.1)	(220.1)	(155.4)	(108.9)	(145.9)	(119.1)
lvalueadded	-0.242***	-0.156***	-0.0907*	-0.265***	-0.103*	-0.103***
	(-5.631)	(-6.587)	(-1.910)	(-8.409)	(-1.682)	(-2.832)
lemployment	0.122***	0.134***	0.267***	0.224***	0.211***	0.208***
	(5.162)	(4.033)	(4.452)	(5.547)	(11.53)	(7.219)
lfdiin	0.0398***		0.0509*	0.0662***		0.0135
	(3.023)		(1.717)	(4.932)		(0.613)
lfdiout		0.0325**	-0.0530**		-0.0147	-0.0277
		(2.506)	(-2.308)		(-0.485)	(-1.580)
Observations	112	79	78	106	73	73
# of industries	29	29	29	29	29	29
# of IVs	30	30	36	30	30	36
AR(2) test p value	0.101	0.460	0.447	0.261	0.257	0.276
Hansen test p value	0.231	0.335	0.627	0.251	0.170	0.180

z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

Many countries such as the EU and the US countries are aggressively targeting the reduction of emissions through stopping financing fossil fuels, imposing taxes by the emissions level of the products and the latest EU's carbon border adjustment mechanism (CBAM). However, just focusing on the abovementioned strategies are not sufficient for Türkiye and other developing nations where trade in emissions matters and countries are vulnerable to unfair impacts of carbon taxing and CBAM.

Trade in emissions is at the core of relevant policy making. It is not possible to implement fair and sustainable policy implementation by just focusing on gross emissions based on production. Determining the responsibilities of different actors along value chains will shed light who will undertake the burden and responsibilities in a fairer way.

Our dynamic panel data estimates show that while inward FDI stocks raise both production and gross exports related emissions. More importantly, outward FDI stocks are more likely reduce to domestic CO2 emissions embodied in gross exports. This result provides substantial evidence for the hypothesis that developed countries seem to outsource the emissions into developing nations through foreign trade and FDIs. Specifically, at least some part of the successes of developed nations in reducing emissions can well be explained by this argument. All of the emissions produced in developing nations are thus not only their responsibility, which is the most crucial point to take into account in formulating trade policies for reducing emissions in developing nations.

The EU's CBAM is a different but closely related topic of interest. This mechanism will also have a significant impact on the Turkish economy and economies of other developing nations. By aiming at the reduction of carbon leakages, this mechanism focuses on withdrawing FDIs from third countries (EU, 2023). Basically, while transferring FDIs from abroad to the domestic EU or USA economies has potential to reduce total emissions in the host countries, the possible value added and employment losses might be much higher than the gains from emissions reduction.

Moreover, how long does it take for an alternative energy source to be fully depreciated and become trash? The emissions for producing alternative energy generators or equipment? The security of supply chains for renewable energy sustainability is another matter of interest.

Deteriorating the capacity or preventing the capacity development of currently developing nations in terms of exploiting other energy source towards fully renewable energy sources, how they will cope with a crisis situation similar to the Russia and Ukraine War. The EU easily revive its previous energy sources and energy generating facilities after a certain level of resistance. But this is not a valid for developing nations.

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Appendix

Table A1. Country Group Codes and Names

Country Group Code	Country Group Name	Countries
APEC	Asia-Pacific Economic Cooperation	Australia, Canada, Chile, Japan, Korea, Mexico, New Zealand, United States, Brunei Darussalam, China (People's Republic of), Hong Kong (China), Indonesia, Malaysia, Peru, Philippines, Russian Federation, Singapore, Thailand, Chinese Taipei, Viet Nam
EU28	European Union (28 Countries)	Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, Bulgaria, Cyprus*, Croatia, Malta, Romania
OECD	Organization for Economic Co-Operation and Development	Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, United Kingdom, United States
NONOECD	Non-OECD	Argentina, Brazil, Brunei Darussalam, Bulgaria, Cambodia, China (People's Republic of), Colombia, Costa Rica, Croatia, Cyprus*, India, Indonesia, Hong Kong (China), Kazakhstan, Malaysia, Malta, Morocco, Peru, Philippines, Romania, Russian Federation, Saudi Arabia, Singapore, South Africa, Chinese Taipei, Thailand, Tunisia, Viet Nam and Rest of the World
WLD	World	OECD Countries + NONOECD Countries
ZNAM	North America	Canada, Mexico, United States

Source: Yamano and Guilhoto (2020); OECD (2023a)

*Note by Türkiye: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognizes the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue". Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognized by all members of the United Nations

with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

Table A2. Foreign Share of CO2 Emissions embodied in Final Demand (%) (DFD_FCO2), in Exports (%) (EXGR_FCO2) and in Intermediate Exports (%) (EXGR_INT_FCO2)

		DFD_FCO2		EXGR_FCO2		EXGR_INT_FCO2	
Industry	**Industries**	**1995**	**2018**	**1995**	**2018**	**1995**	**2018**
D01T03	Agriculture, hunting, forestry and fishing	7.73	11.42	5.92	21.74	5.77	21.67
D05T09	Mining and quarrying	78.62	62.46	16.80	10.75	16.60	10.72
D10T12	Food products, beverages and tobacco	9.05	5.49	15.00	19.52	15.21	19.51
D13T15	Textiles, textile products, leather and footwear	33.43	11.63	24.10	26.44	24.06	26.43
D16	Wood and products of wood and cork	88.38	12.08	27.27	18.58	27.27	18.70
D17T18	Paper products and printing	30.07	32.11	21.30	26.54	21.74	26.49
D19	Coke and refined petroleum products	34.13	73.34	16.09	46.16	16.03	46.14
D20	Chemical and chemical products	43.30	66.95	17.34	28.29	17.39	28.26
D21	Pharmaceuticals, medicinal chemical and botanical products	17.85	34.57	5.00	19.27	6.67	19.23
D22	Rubber and plastics products	26.14	58.89	11.64	32.98	11.65	32.99
D23	Other non-metallic mineral products	9.72	7.79	8.59	6.33	8.64	6.32
D24	Basic metals	49.68	65.45	18.73	18.83	18.75	18.83
D25	Fabricated metal products	59.68	44.79	40.95	43.39	40.98	43.39
D26	Computer, electronic and optical equipment	98.27	91.41	44.78	54.95	46.15	54.86
D27	Electrical equipment	63.65	44.50	46.62	49.59	46.69	49.59
D28	Machinery and equipment, nec	82.81	70.07	37.14	42.23	37.30	42.26
D29	Motor vehicles, trailers and semi-trailers	64.69	57.70	35.71	45.02	35.61	45.03
D30	Other transport equipment	92.75	65.66	37.69	41.92	37.78	41.51
D31T33	Manufacturing nec; repair and installation of machinery and equipment	8.95	47.31	21.88	31.20	21.82	31.17
D35T39	Electricity, gas, water supply, sewerage, waste and remediation services	25.58	20.28	9.68	3.99	8.96	3.93
D41T43	Construction	1.70	1.98	27.17	28.42	27.12	28.37
D45T47	Wholesale and retail trade; repair of motor vehicles	45.33	14.91	17.92	17.73	18.02	17.74
D49	Land transport and transport via pipelines	10.86	15.86	9.44	18.55	9.45	18.55
D50	Water transport	59.52	50.55	5.48	8.86	5.44	8.88
D51	Air transport	27.55	62.54	5.66	5.40	5.67	5.39
D52	Warehousing and support activities for transportation	54.06	38.61	18.18	21.03	18.38	21.10
D53	Postal and courier activities	20.82	21.39	13.33	18.27	14.00	18.31
D55T56	Accommodation and food service activities	27.39	3.82	16.05	16.62	20.00	14.29
D58T60	Publishing, audiovisual and broadcasting activities	47.26	13.24	29.21	20.22	29.21	20.00
D61	Telecommunications	49.44	8.82	17.50	15.33	17.65	14.29
D62T63	IT and other information services	54.76	17.66	25.88	15.38	25.81	14.29
D64T66	Financial and insurance activities	49.01	17.11	19.28	14.21	19.27	14.41
D68	Real estate activities	6.33	1.67	20.32	17.46	20.21	17.41
D69T75	Professional, scientific and technical activities	44.28	17.66	23.08	19.20	22.22	19.23
D77T82	Administrative and support services	40.93	16.42	22.65	21.12	22.85	21.32
D84	Public administration and defence; compulsory social security	3.61	0.89	-	16.46	-	16.07
D85	Education	2.29	1.04	17.07	10.14	0.00	0.00
D86T88	Human health and social work activities	1.59	0.62	20.51	19.10	0.00	0.00
D90T98	Other social and personal services	15.18	2.52	20.12	18.65	20.31	16.88
DTOTAL	Total	22.51	24.39	15.07	21.85	14.60	20.92

Source: OECD (2023a)

Table A3. The Industry Names for Empirical Strategy

Industry Code	Industry Name
D01T03	Agriculture, hunting, forestry and fishing
D05T09	Mining and quarrying
D10T12	Food products, beverages and tobacco
D13T15	Textiles, textile products, leather and footwear
D16	Wood and products of wood and cork
D17T18	Paper products and printing
D19	Coke and refined petroleum products
D20T21	Chemicals and pharmaceutical products
D22	Rubber and plastics products
D23	Other non-metallic mineral products
D24T25	Basic metals and fabricated metal products
D26T27	Computer, electronic and electrical equipment
D28	Machinery and equipment, nec
D29T30	Transport equipment
D35	Electricity, gas, steam and air conditioning supply
D36T39	Water supply; sewerage, waste management and remediation activities
D41T43	Construction
D45T47	Wholesale and retail trade; repair of motor vehicles
D49T53	Transportation and storage
D55T56	Accommodation and food service activities
D58T63	Information and communication
D64T66	Financial and insurance activities
D68	Real estate activities
D69T75	Professional, scientific and technical activities
D77T82	Administrative and support services
D84	Public administration and defence; compulsory social security
D85	Education
D86T88	Human health and social work activities
D90T93	Arts, entertainment and recreation
D94T96	Other service activities

Sources: OECD (2023a), CBRT (2023)