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POTENTIAL EFFECTS OF THE EU'S CARBON BORDER ADJUSTMENT MECHANISM ON THE TURKISH ECONOMY

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SUSTAINABLE DEVELOPMENT GOALS AND EXTERNAL SHOCKS IN THE MENA REGION:

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Potential Effects of the EU's Carbon Border Adjustment Mechanism on the Turkish Economy [i]

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Potential Effects of the EU's Carbon Border Adjustment Mechanism on the Turkish Economy

ABSTRACT

In December 2019, the EU announced the European Green Deal (EGD) whose ultimate target is to create a climate-neutral continent by 2050. With the EGD, greenhouse gases (GHGs) reduction targets become more ambitious and the EU industry will be reorganized around the circular economy principles. Accordingly, the EU Emission Trading System (ETS) will be revised to keep economic growth and employment strong against possible losses in competitiveness due to potential increases in the price of carbon under ETS, leading to the problem of "carbon leakage". Carbon Border Adjustment (CBA) is one of the alternative mechanisms proposed to tackle the carbon leakage problem. CBA is an import fee levied by the carbon-taxing region (in this case, the EU) on goods manufactured in non-carbon-taxing countries (in this case, Turkey).

The purpose of this paper is to provide a first-order estimate of the potential sectoral impacts of a CBA on the Turkish economy by employing the Input-Output methodology. Our results suggest that the CBA may bring a carbon bill of 1.1-1.8 billion euros to the Turkish exporters in the EU market.

The revision of the INDC target and the ratification of the Paris Climate Agreement at the parliament are two steps that can be taken immediately. Speeding up the ongoing preparatory process of instituting an emission trading system in Turkey (preferably linked to EU ETS), will help minimize economic losses.

Keywords: *European Green Deal; Carbon Border Adjustment; Turkey; input-output methodology*

JEL Classification: C67; C68; Q56

I. Introduction

In December 2019, the EU announced the European Green Deal (EGD), whose ultimate target is to create a climate-neutral continent by 2050. With the EGD, reduction targets of greenhouse gases (GHGs) were declared with more ambition, and the EU industry was announced to be reorganized around the circular economy principles.

Broadly set within the auspices of the Communication by the European Commission, the EGD is presented "*as a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use*" (emphasis original) (European Commission, 2019).

Combining ambitious climate mitigation targets of *zero net greenhouse gas emissions by 2050*, a viable industry working under the principles of energy efficiency and circularity, and aiming for a fair, healthy and environmentally food system under *farm to fork* management, the EGD purports "*to put sustainability and the well-being of citizens at the center of economic policy, and the sustainable development goals at the heart of the EU's policymaking and action*" (European Commission, 2019). Thereby, The EGD is regarded, in the words of Gaventa (2019), "as a *climate project, aimed at making Europe a climate-neutral continent; as a social project, to support a just transition; as an economic project, seeking to rejuvenate EU investment and competitiveness; as a European project, to give new purpose and unity to the EU; and as an international project which will take a more geopolitical approach to global climate security".*

Accordingly, the EU's Emission Trading System (ETS) will be revised to keep economic growth and employment strong against possible losses of competitiveness due to an increase in carbon price under ETS, a problem called "carbon leakage". Carbon Border Adjustment (CBA) is one of the alternative mechanisms proposed to tackle the carbon leakage problem. CBA, in essence, is expected to serve as an import fee levied by the carbon-taxing region (in this case, the EU) on goods manufactured in non-carbon-taxing countries (in this case, Turkey). CBA is expected to have a considerable effect on the emission-intensive Turkish exports (Yeldan et al. 2020) as the EU continues to be the top destination of the Turkish exports (accounting for 47% of the total in 2018).

The purpose of this paper is to provide a first-order estimate of the potential sectoral impacts of a possible CBA on the Turkish economy by employing the Input-Output methodology.

The plan of the paper is as follows: After summarizing the main elements of the EGD in section 2, we undertake a comprehensive literature review on the implementation experiences of carbon border adjustment mechanisms in section 3. We calculate the carbon bill that Turkish exporters are expected to pay for the embedded carbon in Turkish exportable products to the EU market by employing an Input-Output analysis in section 4. Section 5 concludes with due policy proposals.

II. The European Green Deal

According to the "European Green Deal", the EU aims to become a climate-neutral block by 2050, reducing, in other words, its net greenhouse gas emissions to zero while maintaining its manufacturing and employment levels. The declaration published with the communiqué dated 11.12.2019 stated that EGD was effectively a response to the current issues regarding climate change, delineating a new strategy for growth to make the EU a fairer and a more prosperous society, in which the mode of growth thus aimed for would bring about an economy that is more modern, competitive, and efficient in terms of resource utilization (European Commission, 2019). European Commission notes preserving and improving the state of nature in the EU, protecting the health and welfare of EU citizens from environmental risks and effects, and achieving a free as well as inclusive transition process among the targets of EGD. At the same time, EGD is set to be implemented in integration with the "Sustainable Development Goals" of the United Nations. There is also a particular emphasis on how the transformation required for realizing these goals is to be achieved and financed.

EGD focuses on three basic priorities regarding industrial strategy: a world-leading and globally competitive industry; an industry oriented towards the goal of becoming climate-neutral; and preparing for and transition to the digital future. Additionally, it intends to achieve this transition within the framework of the circular economy. The policy tools to enable such a transition include regulation, standardization, investment, innovation, reform, dialogue with stakeholders, and international cooperation. The European Climate Regulation is expected to serve as a guiding and overseeing role with respect to energy and climate regulations in the context of EGD. For this purpose, existing regulations surrounding the ETS are stated to be revised by 30 June 2021 at the latest. Existing regulations are expected to be updated in light of these revisions.

According to the European Commission, effective pricing of carbon throughout the economy is an essential precondition for achieving climate-related goals. For this purpose, the EU established the ETS, and has been issuing, each year, ever falling emission quotas to specific industries. Implemented through the market-determined "carbon pricing" mechanism, this system requires producers operating in the relevant industries to obtain such quotas in the trading markets, in case their emission levels exceed the limits they were assigned. Over the period 1990-2018, the EU was able to cut its greenhouse gas emissions by 23%, even though its economy grew by 61%. The EU plans to curb greenhouse gas emissions by the year 2030, by approximately 50% to 55% compared to 1990 levels, and to reach that target through a review of all its climate-related policies.

The ETS, as a carbon pricing mechanism, certainly affects the costs incurred by the manufacturers in the EU, and thus, their competitiveness in the EU and international markets. It can be foreseen that the EU manufacturers would react to such an arrangement in various ways, based on the characteristics of the product (in terms of carbon-intensiveness and trade volumes). While certain industries (e.g. road transportation) that are unable to avoid regulation will have to incur extra costs for their greenhouse gas emissions, others (such as iron and steel, or cement production), which are characterized by significant levels of foreign trade, will likely be inclined to move their operations to countries where carbon regulations are laxer. For the EU, this poses two distinct problems. First of all, a not-so-insignificant volume of production and employment would be lost to overseas, as a direct consequence of the carbon emission regulation. Secondly, any manufacturer that would have to incur the obligation to cut back its emissions would be free to move outside the EU and continue its operations elsewhere maintaining its original emission levels. Thus, the impact of any system designed to lower greenhouse gas emissions within the EU would have only limited success on a global scale. The literature refers to this problem as "*carbon leakage*".

Clearly, the threat of *carbon leakage* is an issue that rises out of the contrast between regions/countries that *do* or *do not* implement effective carbon regulations. Hence, one of the most strategic decisions of the EGD, in the context of reducing carbon leakage, is the mechanism for *carbon adjustment at the border*. The purpose of this mechanism is to eliminate any discrepancies of carbon costs across the traded goods, through an adjustment procedure to be applied at the border (Neuhoff, 2011). Even though the specifics of the mechanism, as well as the industries it will be targeting, have yet to be clarified, the carbon contents of the goods awaiting entry through the borders of the EU shall be subjected to a surcharge, if they were not taxed or priced earlier at their country of origin, or to a discount, if the tax or pricing applied at the country of origin was higher than the figure required by the EU.

III. Literature Findings regarding the Carbon Border Adjustment (CBA) Mechanisms

The relocation of polluting sectors from high-income regions to low-income regions has an international counterpart. As countries get richer, they shift their polluting industrial production such as cement, iron-steel, and textiles to poorer countries, thereby exporting pollution. For example, high-income countries often relocate their fossil fuel-intensive pollutant sectors towards low-income regions of the world through an increased volume of foreign direct investments (Poelhekke and van der Ploeg, 2015). High-income countries, which change their production composition and focus on cleaner industries, experience better environmental quality as they export their polluted industries abroad; however there is no reduction in total pollution on a global scale. Instead, increased production in such countries where environmental standards are lower puts more pressure on the environment. In the economics literature, this phenomenon is discussed within the framework of the "Pollution Haven" and "Race to the Bottom" hypotheses (Daly, 1993; Ayres, 1996; Eskeland and Harrison, 2002; Frankel and Rose, 2005). According to the "Pollution Haven" hypothesis, low-income countries may have to liberalize trade and finance to accelerate economic growth and lower their labor and environmental standards to attract more foreign investment. Such concessions, made in an effort to gain competitive power in underdeveloped or developing countries, trigger a “race to the bottom” in environmental (and labor) standards. As a result, low-income countries are turned into shelters for dirty industries. On the other hand, high-income countries can reduce their domestic greenhouse gas emissions and improve environmental quality indicators relatively by importing -instead of producing- goods with high GHG content, without the need to change their consumption patterns. Consequently, this causes an increase in global emissions. For example, the UK is cited as a successful example of lowering greenhouse gas emissions. However, this is only valid for area-based emissions from production. In fact, considering the import and consumption of the UK, it appears that it causes more greenhouse gas emissions than it mitigated in recent years (Baiocchi and Minx, 2010). As the EU ETS system does not cover all sectors in particular, and in the sectors it covers, there may be a loss of competitiveness due to trade, the possibility of carbon leakage shows itself even more. With the announcement of the EGD, foreign trade policies need to be revised to prevent this leakage. It has turned into a problem that contributes greatly to the increase in global emissions as a result of the increase in consumption along with the increased global trade volume. In order to cope with this problem, solutions such as the international emission trading system, international carbon tax, and carbon border adjustment mechanism have been proposed. The legal basis for international emissions trading systems under the WTO rules has been partially discussed by Jegou and Rubini (2011) and it has been concluded that emission permits can be distributed under Article XX exceptions of the GATT 1994 provisions (mainly on health impacts of trade, including climate change-related impacts when adapted to the environment).

CBA is a tool that has been discussed for many years and has been implemented in some countries and states. It is used for eliminating the competitiveness disadvantages faced by producers in countries/regions implementing a unilateral climate policy. For the first time in the 1980s and 90s, the mechanism was used to balance the taxes on domestic goods related to the import of certain chemicals and to tax the entry of ozone-depleting substances. The first and only CBA still in force started to be implemented in California with the inclusion of electricity imports in the cap-and-trade program of California in 2013 (Pauer, 2018). The system requires electricity importers to purchase carbon permits for the carbon content of imported electricity if the state (or Mexico) from which the electricity was purchased does not have a carbon pricing system linked to California's ETS. According to the data of the California Air Resources Board (2020), the GHG content of electricity imports decreased from 0.5 tons of CO_2e/MWh in 2011 to 0.25 tons of CO_2e/MWh in 2018. Besides, the emission intensity of electricity generated within the state has also fallen below 0.2 tons of CO_2e/MWh.

Böhringer et al. (2012) find that CBA can effectively cope with carbon leakage and smooth out the negative impacts on energy-intensive and trade-exposed sectors in countries that have unilateral carbon pricing mechanisms. The channel behind this consequence, according to the study, is the changes in international prices and the transfer of the climate mitigation cost to the non-abating countries. As such, the cost of climate change can be internalized into domestic prices.

Bao et al. (2013) investigate the impact of a possible CBA that can be applied by the EU and the US on the carbon emissions of Chinese sectors via a dynamic multi-sector general equilibrium model. Accordingly, the CBA will reduce the export prices of China, and hence, will affect the output of the sectors, whose effects will spread to the whole economy. On the supply side, sectors may tend to sell goods in the domestic market instead of exporting. On the demand side, the decrease in revenues due to the cheaper export prices may manifest itself in the form of a decrease in the demand for goods in the respective sectors. Such a shrinkage in demand may also reduce energy prices and call for new energy substitution possibilities, and if the trend shifts towards fossil fuels, this may even have an increasing effect on the country's emissions. At the sectoral level, a CBA applied at a level of 50 USD/ton in 2020 is found to reduce the total emissions from the use of primary and secondary energy resources, especially from non-metallic mineral products, glass manufacturing, casting, and pressing of ferrous metals. On the other hand, a CBA at the same level is expected to increase emissions from sectors such as electrical and electronic equipment manufacturing, non-ferrous metal mining and processing, and textile manufacturing in China. The different energy demands of the sectors lie behind these results that differ from each other in terms of emissions. Following the implementation of the CBA, energy demand is found to decline in the sectors whose emissions decrease. The greatest decrease in export prices will be observed in export-oriented, energy- and carbon-intensive sectors. Sectors with the highest export price decline will have more total output decline than sectors with lower export prices. For example, in sectors such as non-metallic mineral products and glass manufacturing, the output reduction will be greater than in sectors such as electrical and electronic equipment manufacturing, cultural activity, and office machinery. As a result, a CBA to be applied to China by the EU and the US may lead to a further increase in carbon leakage, apart from not achieving its original purpose. According to the analysis of Bao et al. (2013), such a CBA would serve to negligibly reducing the total emissions in China. On the other hand, according to the authors, measures such as cooperation agreements, technology sharing, energy-saving, and transition to low carbon technologies can contribute more to the global emissions reduction.

Several studies propose that mechanisms like the CBA should only be activated when it is not possible to reduce global emissions and prevent carbon leakage by other means (e.g., see Winchester et al., 2011). Van Asselt and Brewer (2010), in their analysis of possible border adjustment measures in the US and the EU, argue that there should be a thorough risk analysis for the sectors that might be prone to carbon leakage before adopting any CBA. Second, they propose that alternative measures to address leakage and competitiveness loss issues should be investigated. Third, it is recommended that the timing of border adjustment measures - if used - allows sufficient time for policymakers in the EU and the US to conclude international climate change negotiations that could reinstate their use (Van Asselt and Brewer, 2010: 50).

Another concern regarding the success of CBAs relates to the use of state carbon tax and CBA revenues from imports. How these income strands are utilized determines the effects of a CBA mechanism on social welfare (McKibbin et al., 2018).[5]

IV. Assessing the Potential Effects of the EU's Carbon Border Adjustment Mechanism on Turkish Exports to the EU Market

Turkey made a total of 192.5 billion Euros worth exports of goods and services in 2018. The EU continues to be the top destination of the Turkish exports, having the highest share in aggregate Turkish exports with 91 billion Euros in 2018, reaching 47% of her export revenues (see Table A3 in the appendix). Automotive (AU), Textiles (TE), Machinery (MW), Iron & Steel (IS), and Chemicals (CH) sectors have emerged as the most exporting sectors to the world. The share of the EU28 market in the total exports of these sectors is 78% for Automotive, 60% for Textiles, 57% for Machinery, 44% for Iron & Steel, and 43% for Chemicals in 2018, respectively.

The Customs Union agreement that was initiated in 1996 had been particularly conducive in expanding bilateral trade relations with the EU. Over the years, the two economic bodies have dwelled in wide-reaching partnerships in trade and joint ventures. Following the European Commission's declaration of the EGD at the end of 2019, it is predicted that the attitudes of the countries on climate issues will affect their bargaining power in the negotiations to be held with the EU on issues such as the ongoing Custom Union Modernization negotiations (PMR, 2018, p.50). Besides, the effects of the contraction experienced during the COVID-19 pandemic in the global economy are expected to be extremely severe for developing countries like Turkey, whose economies are highly reliant on external markets. Turkey's steps to be taken both in the private

[5] For an evaluation of the studies investigating the effects of CBA on international trade, see Condon and Ignaciuk (2013). For an assessment of CBA and alternative mechanisms within the EU, see Ismer et al. (2020).

sector, as well as public awareness on the climate facade, will support a sustained trade market share in the international arena as well as a greater share of the globally expanding green finance.

Given this historical background, it is clear that the EU's call for the EGD will generate very strong repercussions on the Turkish industry, as well as its trade relations at large. Now we turn to a quantitative analysis of these likely impacts on the Turkish economy.

IV.I The Economic Model and Data Sources

Our "base-year" is 2018, given the most recent available greenhouse emissions inventory and the heart of our data set is the 2012 input-output (I-O) data released by TurkStat. We first aggregated the 65 sectors of the original 2012 I-O table to 24 model sectors. Making use of the final demand components of national income accounting we have updated the 2012 intermediate flows to 2018 using the RAS technique. This consistent data set is then utilized to 'calibrate' the micro/sectoral and macroeconomic balances of the analytical model to the existing data. The 2018 I/O Table is disclosed in the Appendix below.

In 2018, Turkey emitted a total of 520.9 Mt CO_2e of GHG emissions to the atmosphere. This sum is grouped by the GHG Inventory under energy combustion (321.2 Mt), industrial and agricultural processes (130.0 Mt), and household waste (69.6 Mt). After leaving aside the household waste, we allocate the remaining 451.3 Mt of GHGs emissions to the 24 sectors by making use of the TurkStat data as reported to the UNFCCC inventory system. The original data on greenhouse gas source and sink categories are used whenever it was possible to make a direct connection between the sectors recognized in the official data and our aggregation distinguished in the model.[6] Following Acar and Yeldan (2016), we allocated the remaining unaccounted CO_2e emissions using the share of sectoral intermediate input demand to the aggregate volume of sectoral output as weights. Sectoral GHGs allocation is shown in Table A1 in the appendix.

IV.2 Emissions Embodied in Turkey's Exports to the EU28 Market

[6] Direct sectoral emissions data were available for Agriculture, mining, food processing, paper products, refined petroleum, chemicals, cement, iron and steel, transportation, and electricity.

In the second step, we conduct an Input-Output analysis to calculate the sectoral emissions embodied in the exports to the EU28 market to analyze the potential effects of the CBA on Turkish sectors exporting to the EU market (see Table A3 for sectoral exports to the EU market in 2018). The GHGs emissions embodied in the EU28 exports are calculated by using Equation 1 given below:

$$GHG = K_{GHG}(I - A)^{-1}EX_{EU28} \quad (1)$$

where EX_{EU28} is the diagonalized vector of exports to the EU28 market, $(I - A)^{-1}$is the Leontief inverse, K_{GHG} is the diagonalized GHG-intensity vector and GHG is the 24*24 matrix of GHGs embodied in EU28 exports. The row sums of the GHG matrix give the total GHGs embodied in the exports of the corresponding column sector.

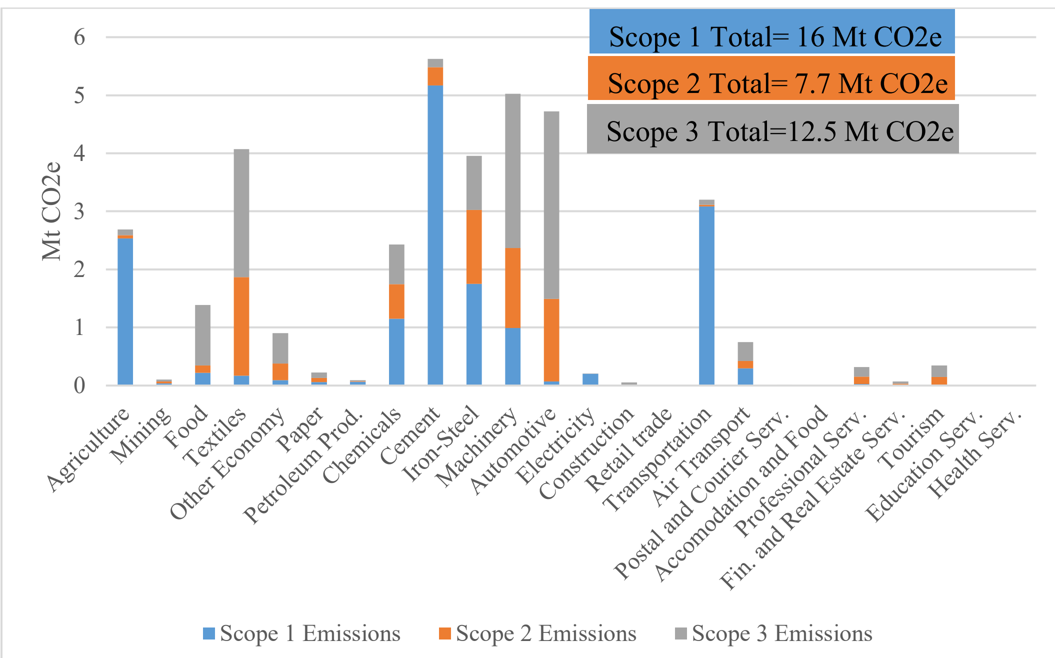
Note that, it is still not clear how the CBA will be implemented regarding the scope of emissions[7] and sectoral coverage. Currently, under the ETS mechanism, the EU prices the Scope 1 emissions of intra-EU plants/power stations under the seven energy and carbon-intensive sectors listed in Table A1 in the appendix. However, covering only the Scope 1 emissions of a limited number of sectors does not necessarily mean leaving the majority of emissions outside the ETS. Note that pricing Scope 1 emissions in the ETS-covered sectors not only increases the production costs directly but also the costs of other sectors using them as inputs in their production processes. For example, the *Textiles* sector (*C13-C15*) does not pay for its emissions since it is not currently covered under the EU ETS. Yet it faces higher costs for its inputs such as electricity and chemical inputs as these are covered under the ETS. Once electricity or chemical input providers reflect the carbon price on their prices, the unit costs of a textile plant will also increase. This is similar to the case when a textile plant is required to pay for its Scope 2 and (part of) Scope 3 emissions. Taking into account the fact that one of the main aims of the CBA mechanism is to level the cost disadvantages of intra-EU producers caused by carbon taxation vis a vis producers outside the EU (with no or weaker carbon regulation), this will necessarily require the CBA to consider not only Scope 1 emissions but also Scope 2 and Scope 3 emissions. See Marcu et al. (2020) for a detailed discussion.

[7] The emissions of the plants are grouped under 3 sections. Scope 1 is direct emissions generated by owned or controlled sources; Scope 2 emissions are indirect emissions from the generation of purchased energy; and Scope 3 emissions are indirect emissions from the production of other purchased inputs (WRI and WBCSD, 2004).

Thereby we proceed with two further working hypotheses: Firstly, unlike the implementation under EU ETS, we assume that the CBA will cover all three scopes of emissions embodied in the goods exported to the EU market; and secondly, we assume that exports from all sectors to the EU market (not only ETS-covered sectors' exports) will be subject to the CBA.

The I-O analysis makes it possible to decompose GHGs over different emission scopes. The diagonal elements of GHG represent the sectors' Scope 1 emissions embodied in exports, and the elements of the Electricity (EL) row represents the sectors' Scope 2 emissions related to the use of electricity input. The rest of the elements show the Scope 3 emissions of the column sector related to the use of corresponding inputs purchased from the row sector. The decomposition of the sectoral emissions is given in Figure 1.

Figure 1. GHGs emissions embodied in Turkish exports to EU28 (2018, Mt CO2e)



Turkish exports to the EU28 market in 2018 contained 36.2 Mt of CO_2e emissions (Scope 1-2-3), and the majority of them were concentrated in Cement (CE), Machinery (MW), Automotive (AU), Iron-Steel (IS), and Textiles (TE) sectors.

The high carbon-intensity of the electricity production in Turkey is one of the vulnerabilities of the Turkish exporting sectors. Figure 1 shows that the Scope 2 emissions (7.7 Mt) embedded in

EU28 exports accounts for %21.3 of the total emissions (36.2 Mt CO_2e). Irrespective of their Scope 1 emissions, heavy reliance on electricity inputs in Textiles (TE), Chemicals (CE), Iron-Steel (IS), Machinery (MW), and Automative (AU) sectors would pose serious competitiveness risks in the EU export market.

IV.3 Calculating the CBA-induced Carbon Cost

The CBA-induced Carbon cost is calculated simply by multiplying the carbon embodied in exports with a unit carbon price of 30 and 50 Euros/ton CO_2e.

Figure 2. Carbon Costs (Million Euros)

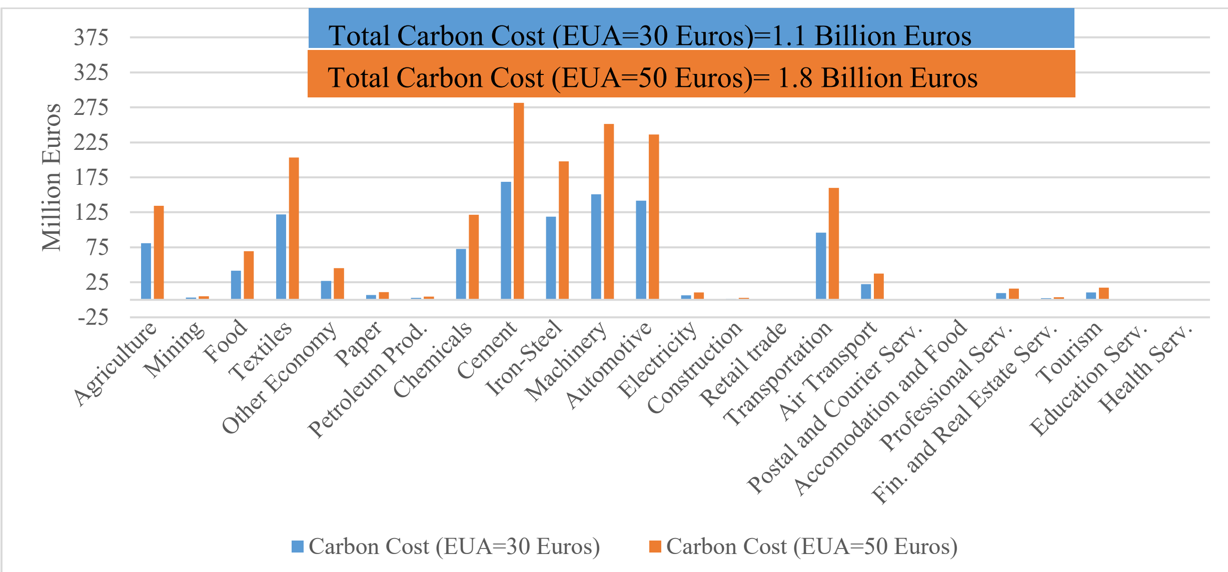
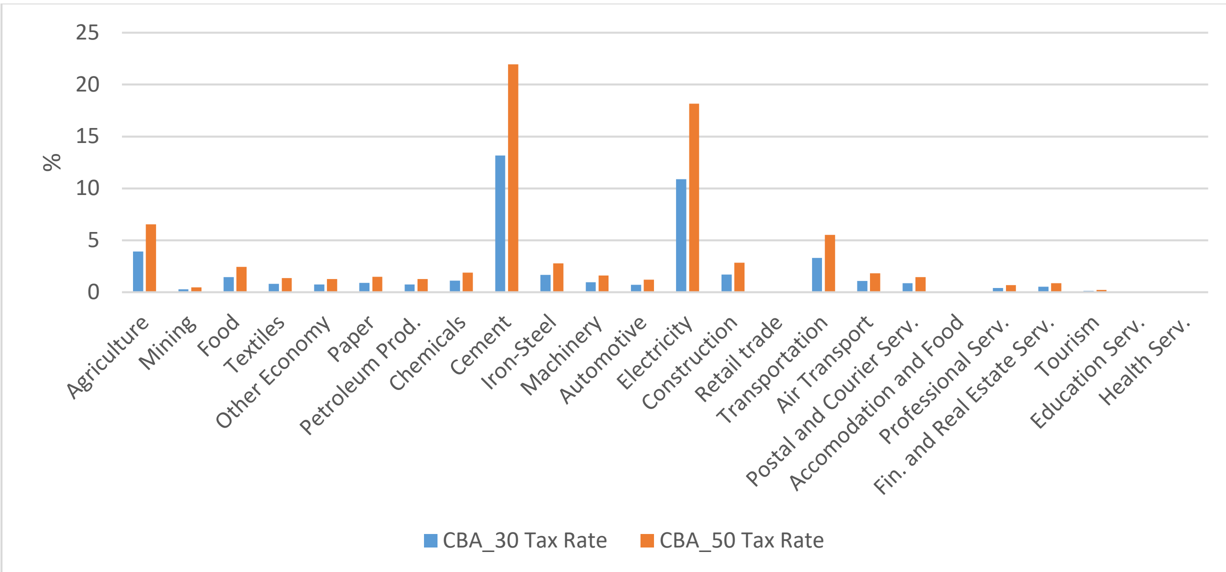


Figure 2 shows that if the Turkish exporters were required to pay 30 Euros per ton of GHGs (all scopes), they would have faced a carbon cost of 1.1 billion Euros (1.8 billion Euros if the price of EUA were to be 50 Euros). Yet, carbon costs may not fully quantify the level of vulnerability (which can be defined as the export revenue fall risk) to the CBA. Dividing sectoral carbon costs to exports revenues earned from the EU28 market would give a much clearer picture. In terms of the sectoral "shadow" tax rates (CBA_30/CBA_50 when the EUA price is 30/50 Euros), one can see that the CBA would have the worst impact on the "Cement" and "Electricity" sectors in Turkey. Figure 3 shows that GHG-intensive cement and electricity exporters to the EU28 market should pay back, respectively, 22 and 18 Euros per 100 euros of the earned revenues to the EU ETS (see Table A3 in the appendix).

Figure 3. CBA Tax Rates



V. Conclusion and Policy Implications

In this paper, we have sought to investigate the expected economic impacts of the European Green Deal policies on the Turkish economy, and the potential benefits to be reaped by pursuing a more active climate policy. The EGD announced in December 2019 will affect the Turkish economy through two channels: planned initiation of the CBA mechanism and the Circular Economy regulations. The current paper focuses exclusively on the effects of the CBA mechanism on Turkish exports to the EU market.

Our results suggest that the CBA may bring a carbon bill of 1.1-1.8 billion euros annually to the Turkish exporters in the EU market depending on the price of 30 and 50 Euros per ton of GHGs. The *Cement* and the *Electricity* sectors are expected to be the worst affected. For every 100 euros of export revenues, the *Cement* and the *Electricity* sector should return 13-22 and 11-18 euros respectively. Note that this figure reflects only the effects of the CBA mechanism and not the costs associated with the Circular Economy regulations which will require Turkish exporters to redesign their product specifications.

Yet, our results also suggest that the risks can be turned into an opportunity by pursuing a more active climate policy and transforming the economic structure towards a more climate-friendly one. Speeding up the ongoing preparatory process of instituting an emission trading system in Turkey (preferably linked to EU ETS), will help minimize economic losses. Rather than transferring to the EU ETS, under such a system Turkey would keep the carbon bill that ranges from 1.1 to 1.8 billion Euros in Turkey that can be used to decarbonize the sectors. Overall, a shift to an active climate-policy will help Turkey to access climate finance opportunities which will ease the climate-friendly transformation of Turkish sectors. The revision of the INDC target and the ratification of the Paris Climate Agreement at the parliament are two steps that can be taken immediately.

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Appendix

Table A1. Model Sectors and Sectoral GHG Allocations

2018	**Million tons**	**Share**
Total CO2e Emissions (Energy, Industrial Processes and Agriculture)	**451.3**	**86.63**
AG: Agriculture (NACE Rev 2 Code: A01-A03)	74.6	14.33
MI: Mining (NACE Rev 2 Code: B05, B06 - B09)	2.4	0.46
FO: Food Processing (NACE Rev 2 Code: C10 - C12)	5.2	1.01
TE: Textiles, Clothing (NACE Rev 2 Code: C13 - C15)	0.6	0.11
OE: Other Economy (NACE Rev 2 Code: C16, C30 -C33, E36 - E39, G45, G46, N80 - N82, O84)	4.4	0.84
PA: Paper Products (NACE Rev 2 Code: C17, C18)	1.0	0.20
PE: Petroleum Products (NACE Rev 2 Code: C19)	6.7	1.28
CH: Chemicals (NACE Rev 2 Code: C20-C22)	10.1	1.95
CE: Cement (NACE Rev 2 Code: C23)	75.1	14.42
IS: Iron and Steel (NACE Rev 2 Code: C24)	17.6	3.38
MW: Machinery, White Goods (NACE Rev 2 Code: C25-C28)	5.8	1.12
AU: Automotive (NACE Rev 2 Code: C29)	0.2	0.03
EL: Electricity (NACE Rev 2 Code: D35)	154.9	29.75
CN: Construction (NACE Rev 2 Code: F41-F43)	3.0	0.58
RT: Retail trade (NACE Rev 2 Code: G47)	1.0	0.20
TR: Transportation (NACE Rev 2 Code: H49, H50)	81.7	15.68
AT: Air Transport (NACE Rev 2 Code: H51, H52)	3.8	0.72
PS: Postal and Courier Services (NACE Rev 2 Code: H53)	0.2	0.03
AF: Accomodation and Food (NACE Rev 2 Code: I55, I56)	0.3	0.05
PR: Professional Services (NACE Rev 2 Code: J58 - J63, M71 - M75, N77 - N78, S94 - S96)	0.7	0.14
FS: Financial and Real Estate Services (NACE Rev 2 Code: K64 - K66, L68, M69-M70)	1.2	0.23
TS: Tourism (NACE Rev 2 Code: N79, R90 - R93)	0.2	0.03
ES: Education Services (NACE Rev 2 Code: P85)	0.3	0.05
HE: Health Services (NACE Rev 2 Code: Q86 - Q88)	0.3	0.06
Total CO_{2e} Emissions from Households & Waste	**69.6**	**13.37**
Total (CO_2e)	**520.9**	**100**

Table A2. Input-Output Table, 2018 (at basic prices, Millions TL)

	AG	MI	FO	TE	OE	PA	PE
AG: Agriculture	54,347.1	414.3	92,012.7	13,883.7	8,572.9	876.9	1.2
MI: Mining	834.6	6,049.1	1,362.9	2,534.7	3,271.5	713.6	109,944.9
FO: Food Processing	11,755.5	115.5	38,700.8	1,240.5	7,327.1	321.4	29.0
TE: Textiles, Clothing	201.3	329.3	503.7	127,766.3	11,917.5	1,171.6	12.8
OE: Other Economy	9,592.1	5,423.1	18,560.2	20,102.0	116,420.8	5,520.7	2,675.5
PA: Paper Products	207.7	27.8	4,049.0	2,650.9	11,860.5	20,388.0	114.5
PE: Petroleum Products	8,240.8	5,894.2	1,064.8	917.0	23,325.5	274.2	3,086.0
CH: Chemicals	16,511.5	2,075.5	9,180.6	27,868.0	25,259.2	8,000.6	118.1
CE: Cement	242.2	642.6	895.6	81.1	4,834.5	11.6	3.3
IS: Iron and Steel	11.4	1,138.2	178.8	82.9	16,873.7	340.9	53.5
MW: Machinery, White Goods	486.2	1,456.6	1,345.0	1,538.4	24,170.0	261.8	124.6
AU: Automotive	492.2	32.6	0.9	0.1	10,534.5	3.9	0.1
EL: Electricity	1,666.2	3,045.2	2,979.7	7,225.6	15,581.5	1,405.2	92.6
CN: Construction	672.1	289.8	568.9	446.4	23,781.2	119.0	7.1
RT: Retail trade	2,057.3	750.5	4,747.5	4,659.7	7,594.8	732.2	782.0
TR: Transportation	4,719.5	5,343.7	11,245.8	6,702.8	43,147.1	2,738.2	2,969.1
AT: Air Transport	179.9	747.9	1,229.3	709.2	15,254.9	372.4	320.4
PS: Postal and Courier Services	7.2	45.0	101.4	388.2	4,637.3	106.9	0.0
AF: Accomodation and Food	43.0	205.6	322.6	530.9	8,841.2	185.8	42.0
PR: Professional Services	1,503.6	2,404.0	3,277.5	2,260.7	40,907.2	1,598.4	300.8
FS: Financial and Real Estate Services	504.2	2,349.4	4,437.5	10,162.8	53,825.9	3,072.5	1,649.7
TS: Tourism	0.6	48.0	156.4	2.3	1,115.2	36.6	21.2
ES: Education Services	1.1	31.9	61.4	29.0	4,360.1	28.2	21.2
HE: Health Services	0.0	0.0	1.6	5.4	24.0	0.0	0.0
TOTALS (Column Sum)							
Compensation of Employees	19,836.2	103,930.0	56,498.0	51,120.3	280,667.2	7,786.6	1,686.8
Gross Payments to Capital	224,708.1	247,468.4	140,193.5	83,261.1	199,798.6	16,196.0	11,317.5
Net Taxes on Production	-954.5	3,206.3	3,411.0	5,972.9	42,188.3	2,314.1	2,321.0
Total Value Added (at MP)	243,589.8	354,604.6	200,102.4	140,354.3	522,654.1	26,296.7	15,325.3
Total Production Exp	357,867.3	393,464.3	397,087.1	372,143.2	1,006,092.2	74,577.3	137,694.9

	CH	CE	IS	MW	AU	EL	CN
AG: Agriculture	2,159.9	74.9	6.4	49.2	0.2	1.4	212.7
MI: Mining	8,517.2	20,902.0	38,420.7	1,135.5	597.9	174,812.2	9,136.9
FO: Food Processing	563.4	89.8	61.0	256.1	63.6	128.8	209.8
TE: Textiles, Clothing	2,275.1	488.5	237.8	1,023.5	1,511.1	28.5	281.2
OE: Other Economy	18,815.9	8,751.3	112,681.0	30,372.0	22,886.1	6,395.1	34,680.8
PA: Paper Products	3,448.5	1,356.6	929.3	2,691.8	426.1	471.9	295.5
PE: Petroleum Products	3,034.8	4,597.8	1,588.8	2,813.5	459.8	2,499.1	9,291.5
CH: Chemicals	137,504.6	5,444.3	8,654.6	20,491.5	10,791.5	465.6	16,794.9
CE: Cement	2,198.0	17,566.6	1,587.8	3,001.2	2,041.2	809.6	49,118.6
IS: Iron and Steel	2,164.5	1,024.6	86,702.2	110,280.4	31,650.1	446.4	46,831.0
MW: Machinery, White Goods	3,034.2	863.0	2,964.3	72,249.5	28,590.9	3,338.2	38,093.0
AU: Automotive	3.5	44.7	0.1	3,293.1	58,429.5	0.9	50.6
EL: Electricity	7,006.4	6,503.9	17,231.2	5,276.2	2,059.9	375,367.6	798.2
CN: Construction	779.4	216.5	1,000.0	1,100.8	347.0	2,542.7	88,047.8
RT: Retail trade	3,581.2	1,553.0	3,213.6	6,826.6	2,400.6	1,054.9	6,060.0
TR: Transportation	10,738.6	4,703.6	17,652.0	16,583.6	8,342.8	3,097.1	10,531.4
AT: Air Transport	3,258.7	305.3	697.9	1,391.8	644.5	156.8	685.9
PS: Postal and Courier Services	297.3	73.6	99.4	397.7	39.8	108.4	130.5
AF: Accomodation and Food	745.9	213.0	465.3	1,418.5	364.0	228.4	705.4
PR: Professional Services	5,925.0	1,581.7	2,081.7	7,082.0	2,505.2	4,170.7	15,155.3
FS: Financial and Real Estate Services	8,544.6	3,048.9	5,190.9	12,278.5	3,784.2	17,475.3	9,322.2
TS: Tourism	204.2	25.9	30.8	140.0	34.3	59.4	40.0
ES: Education Services	156.3	31.9	35.4	194.6	229.0	55.3	16.4
HE: Health Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS (Column Sum)							
Compensation of Employees	10,077.7	10,921.6	7,553.6	36,599.7	26,612.0	8,761.5	76,438.0
Gross Payments to Capital	30,273.2	20,609.7	21,672.8	33,703.3	32,807.7	22,180.7	203,469.8
Net Taxes on Production	9,778.7	4,523.0	10,585.9	10,839.4	6,029.5	2,908.0	16,833.3
Total Value Added (at MP)	50,129.6	36,054.4	39,812.3	81,142.5	65,449.2	33,850.2	296,741.1
Total Production Exp	275,085.8	115,515.8	341,344.5	381,490.2	243,648.3	627,564.6	633,220.7

	RT	TR	AT	PS	AF	PR
AG: Agriculture	403.9	14.1	4.4	0.0	8,158.7	341.6
MI: Mining	517.5	400.3	6.7	1.2	288.5	565.4
FO: Food Processing	2,609.9	151.0	119.3	103.9	40,293.7	1,075.0
TE: Textiles, Clothing	619.0	155.0	170.7	147.7	735.9	3,447.6
OE: Other Economy	12,670.0	10,881.1	14,373.3	1,401.1	10,146.5	15,932.8
PA: Paper Products	3,813.9	365.9	1,118.0	331.0	1,337.4	8,194.1
PE: Petroleum Products	5,831.3	21,207.0	29,141.0	1,009.0	1,333.3	3,717.7
CH: Chemicals	2,856.8	2,364.1	460.1	119.7	1,354.6	3,741.8
CE: Cement	229.9	837.1	0.0	0.3	361.2	893.6
IS: Iron and Steel	387.3	206.1	210.9	0.3	236.3	839.2
MW: Machinery, White Goods	4,395.6	1,198.8	628.1	64.5	879.3	7,061.2
AU: Automotive	4.5	1,163.1	90.1	0.4	1.0	628.3
EL: Electricity	7,318.4	369.9	1,546.9	137.1	4,706.2	3,744.0
CN: Construction	4,497.8	372.5	129.4	91.3	1,105.3	3,257.0
RT: Retail trade	1,024.7	1,745.9	2,359.3	110.0	2,178.4	1,451.1
TR: Transportation	6,623.0	35,337.7	9,883.0	1,949.2	2,806.1	6,397.2
AT: Air Transport	1,173.9	10,093.3	32,725.1	1,295.2	63.1	1,019.9
PS: Postal and Courier Services	2,941.8	233.5	569.5	877.9	64.3	1,682.6
AF: Accomodation and Food	1,666.9	324.3	974.3	114.2	1,592.4	2,417.1
PR: Professional Services	13,186.8	2,149.6	5,232.1	1,137.2	2,735.2	66,837.4
FS: Financial and Real Estate Services	38,308.5	4,747.0	12,163.3	1,941.6	12,478.5	19,709.7
TS: Tourism	619.6	43.6	1,506.9	12.6	689.9	2,083.9
ES: Education Services	138.5	29.3	472.5	8.8	35.9	579.9
HE: Health Services	0.0	0.0	0.0	0.0	0.0	79.0
TOTALS (Column Sum)						
Compensation of Employees	38,340.9	84,232.2	22,266.9	6,087.9	51,869.1	70,165.2
Gross Payments to Capital	98,110.5	238,877.9	19,042.0	2,436.7	82,034.2	147,984.7
Net Taxes on Production	6,227.3	31,272.5	8,999.6	523.7	6,340.4	9,737.5
Total Value Added (at MP)	142,678.7	354,382.7	50,308.5	9,048.3	140,243.6	227,887.4
Total Production Exp	254,518.3	448,771.9	164,193.3	19,902.5	233,825.3	383,584.6

	PCE: Private Consumption Exp	GCE: Government Consumption Exp.	GFCF: Gross Fixed Capital Formation	EXP: Exports	IMP: Imports (-)
AG: Agriculture	154,302.6	0.0	38,500.6	28,337.8	46,036.0
MI: Mining	13,406.2	0.0	7,603.8	16,449.0	29,406.6
FO: Food Processing	254,147.6	0.0	1,657.2	66,454.2	33,758.2
TE: Textiles, Clothing	113,631.6	0.0	902.4	141,790.9	38,726.1
OE: Other Economy	155,583.1	232,161.0	99,782.0	71,701.0	97,266.7
PA: Paper Products	9,573.2	0.0	0.0	11,916.2	18,815.2
PE: Petroleum Products	53,661.5	0.0	299.9	26,353.7	78,327.0
CH: Chemicals	34,237.3	22,767.7	670.0	86,906.2	191,757.3
CE: Cement	6,203.9	0.0	1,940.6	20,352.1	8,851.9
IS: Iron and Steel	0.0	0.0	106,098.0	93,482.9	158,112.1
MW: Machinery, White Goods	47,211.8	0.0	196,452.8	158,434.5	224,447.1
AU: Automotive	39,210.6	0.0	76,285.7	144,610.5	91,316.1
EL: Electricity	144,298.5	0.0	0.0	483.1	276.4
CN: Construction	4,478.4	13.5	484,118.9	2,740.7	959.1
RT: Retail trade	171,003.4	7,616.3	17,430.2	0.0	0.0
TR: Transportation	184,509.6	1,419.2	16,029.9	49,153.9	26,930.2
AT: Air Transport	32,810.2	0.1	203.5	69,384.8	16,804.2
PS: Postal and Courier Services	4,655.8	0.0	0.0	1,004.5	162.8
AF: Accomodation and Food	160,921.2	0.0	0.0	44,751.3	10,922.2
PR: Professional Services	119,022.7	17,855.3	53,666.2	22,889.1	45,580.5
FS: Financial and Real Estate Services	295,571.6	0.0	0.0	9,287.1	14,290.8
TS: Tourism	44,356.0	6,056.6	0.0	33,332.1	7,931.5
ES: Education Services	38,086.5	130,197.8	0.0	0.0	0.0
HE: Health Services	30,368.1	134,270.0	0.0	0.0	0.0
TOTALS (Column Sum)	2,111,251.4	552,357.5	1,101,641.6	1,099,815.6	1,140,678.2

Table A3. Exports, Emissions, Carbon Costs, and Tax Rates (2018)

	Emissions (Mt CO2e)				Carbon Costs (million euros)		Revenues (million euros)	Tax Rates (Carbon Cost as a % of Revenues)	
	Scope 1	Scope 2	Scope 3	Total	EUA=30 Euros	EUA=50 Euros	Exports to EU28	CBA_30	CBA_50
AG: Agriculture	2.53	0.06	0.10	2.69	81	135	2057	4	7
MI: Mining	0.04	0.03	0.04	0.11	3	5	1093	0	0
FO: Food	0.22	0.13	1.04	1.39	42	69	2842	1	2
TE: Textiles	0.17	1.70	2.20	4.07	122	203	14853	1	1
OE: Other Economy	0.09	0.29	0.52	0.90	27	45	3585	1	1
PA: Paper	0.06	0.07	0.09	0.22	7	11	754	1	1
PE: Petroleum Prod.	0.07	0.01	0.02	0.09	3	5	369	1	1
CH: Chemicals	1.15	0.59	0.68	2.43	73	121	6468	1	2
CE: Cement	5.17	0.31	0.14	5.62	169	281	1280	13	22
IS: Iron-Steel	1.75	1.27	0.93	3.96	119	198	7121	2	3
MW: Machinery	0.99	1.38	2.65	5.02	151	251	15752	1	2
AU: Automotive	0.07	1.42	3.23	4.72	142	236	19669	1	1
EL: Electricity	0.20	0.00	0.01	0.21	6	10	58	11	18
CN: Construction	0.00	0.01	0.04	0.05	2	3	91	2	3
RT: Retail trade	0.00	0.00	0.00	0.00	0	0	0	.	.
TR: Transportation	3.08	0.03	0.09	3.20	96	160	2894	3	6
AT: Air Transport	0.30	0.13	0.32	0.75	22	37	2040	1	2
PS: Postal and Courier Serv.	0.00	0.00	0.00	0.01	0	0	24	1	1
AF: Accommodation and Food	0.00	0.00	0.00	0.00	0	0	0	.	.
PR: Professional Serv.	0.03	0.12	0.17	0.32	10	16	2321	0	1
FS: Financial and Real Estate Serv.	0.01	0.03	0.04	0.07	2	4	405	1	1
TS: Tourism	0.02	0.13	0.20	0.35	10	17	7339	0	0
ES: Education Serv.	0.00	0.00	0.00	0.00	0	0	0	.	.
HE: Health Serv.	0.00	0.00	0.00	0.00	0	0	0	.	.
Total	**16**	**7.7**	**12.5**	**36.2**	**1085**	**1809**	**91016**		

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