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THE EU'S CARBON BORDER ADJUSTMENT MECHANISM AND THE TURKISH ECONOMY

Ahmet Atıl Aşıcı

IPC

ISTANBUL POLICY CENTER

SABANCI UNIVERSITY

STIFTUNG MERCATOR INITIATIVE

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Introduction

European Union (EU) Commission President Ursula von der Leyen announced the European Green Deal (EGD) program in December 2019.

The main aims of the EGD are to create the first climate-neutral continent by 2050, to protect production and employment in the EU, and for the EU to become an effective player in global emissions reduction. Despite the high visibility of the EU's climate neutrality target, it would be incorrect to view the EGD's main ambitions as purely ecological. The EGD covers economic, labor, health, food, and social justice dimensions, as well. The EGD emphasizes innovation and competitiveness as well as creating climate-friendly technologies, developing a healthy and just food system under the "farm-to-fork" strategy, and the Just Transition Mechanism to ensure no one is left behind. In the communique from December 11, 2019, the EGD is presented as a response to climate change based on a modern, resource-efficient, and competitive new economic growth strategy to create an egalitarian and prosperous EU. The EU Commission highlights the protection and improvement of the EU's natural capital, the protection of EU citizens' health and welfare from environmental risks, and securing the transition in a just and inclusive manner. The EGD will be implemented in accordance with the United Nation's Sustainable Development Goals.[1]

The effects of the EGD will not be limited to the EU. It would be fair to think of the EGD as the driving force behind the maturing "New Climate Regime," which would ultimately transform other countries with trade, financial, and political ties to the EU. Countries' future trade and financial performance and the quality and depth of political relationships with the EU will be dependent on how successfully they can align with the requirements of this new regime. EU Commission President Ursula von der Leyen's emphasis on "making the EU as the main actor in combatting climate change globally" hints that the EU would use its trade/financial/political powers as leverage to change its partners' climate ambitions.

How would the EGD change the climate ambitions of countries outside the EU? The EGD utilizes two tools that are applied through trade channels. These are the Carbon Border Adjustment (CBA) mechanism and the circular economy regulations. CBA aims to tax imports to the EU market according to the carbon content of the imported goods. The circular economy regulations require the redesign of goods according to durability/post-sale liability criteria. This paper examines the implementation of the CBA mechanism and its possible effects on the Turkish economy.

What is the Carbon Border Adjustment Mechanism?

While it is possible to reach climate neutrality by 2050 through reducing intra-EU emissions, this would have negative effects on global emissions, intra-EU production, and employment. The EU Emissions Trading System (ETS) has been regulating the greenhouse gas emissions of the intra-EU facilities and power plants under energy- and carbon-intensive sectors such as electricity, paper, cement, iron-steel, refinery products, chemical products, and air transportation since 2005. Accordingly, these intra-EU producers are required to buy "emission rights" (European Union Allowances, EUA) at the freely determined carbon market price for the emissions they have generated. The number of allowances has been decreasing along with the emission reduction targets, which increases the costs of the carbon- and energy-intensive industries resisting transformation.

CBA can be simply understood as the extension of the intra-EU ETS on the global scale. The EU, which so far focuses on intra-EU emissions, will extend its carbon pricing system to its partners through the CBA mechanism to level off the cost disadvantage (created by the EU carbon regulations) of intra-EU producers and to secure emissions reductions globally. Yet, for the CBA to take effect, the EU needs to re-regulate many areas, including the ETS, and to create new tools and definitions. This is an ongoing process. It is expected that related

stakeholders will deliver a proposal to the EU Commission in June 2021, and the CBA will take effect by the start of 2022.

Even though the CBA aims to reduce global GHG emissions, it would also help to resolve some constraints within the EU ETS. Regulating carbon under the ETS taxes decreases the competitiveness of the intra-EU producers vis-a-vis extra-EU producers (those operating in a country with no or weaker carbon regulations). This forces plants/factories in some sectors, particularly the Energy-Intensive and Trade-Exposed (EITA), to move from the emission-regulated region (the EU) to the parts of the world economy with no (or weaker) regulations (e.g., Turkey). In the literature, this problem is called "carbon leakage." In the absence of offsetting regulations, the risk of losing competitiveness forces companies to relocate their dirty production to extra-EU countries, which decreases EU GDP and employment with no effect on global emissions. This simply nullifies the benefits sought from a carbon pricing system. In order to protect the EU's GDP and employment while reducing intra-EU and global emissions, the carbon leakage problem must be adequately addressed. So far, the EU ETS has been dealing with this problem by allocating free allowances and providing subsidized electricity to the EU-based EITA sectors (See Box 1).

At this point, one can ask whether or not protecting EITA sectors for production/employment/competitiveness concerns would jeopardize the emission targets of the ETS. This challenge is currently being resolved through some fine tuning during implementation. For example, the share of freely allocated allowances has decreased from 100% when ETS was first introduced in 2005 to 46% in

BOX 1. CARBON LEAKAGE AND THE FREE ALLOCATION OF ALLOWANCES

The allocation of free allowances to the EITA sectors is one tool for keeping production and employment strong while reducing emissions under the EU ETS. One hundred percent of allowances were granted for free to EITA firms in the first years of the ETS, but starting from the initiation of the third phase in 2013, EITA firms started to receive only the amount indicated by the equation shown below for free and were required to buy allowances for their emissions exceeding this amount. The benchmark value is the most important determinant in this equation. The benchmark values show the carbon-intensity average of the top 10% of firms in terms of efficiency for 52 goods produced by the EU EITA sectors.[2]

The amount of free allowances for 52 goods is determined by the equation shown below:

$$F_{p,k} = BM_p * HAL_p * CLEF_{p,k} \qquad [Equation\ 1]$$

In this equation,

$F_{p,k}$: Annual preliminary allocation for a product benchmark sub-installation producing good p in year k (expressed in EUAs),

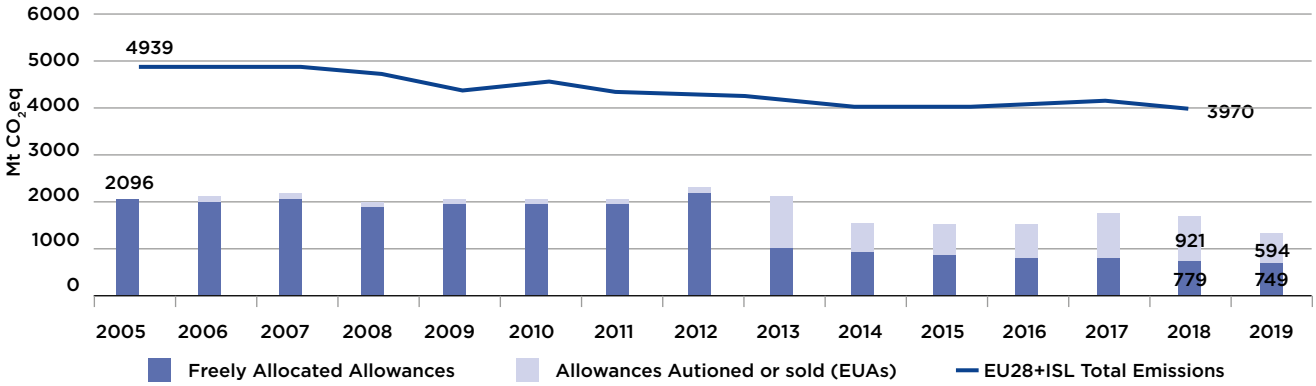
BM_p : Benchmark for good p (expressed in EUAs/unit of product),

HAL_p : Historical activity level, i.e., the arithmetic mean of annual production in the baseline period as determined and verified in the baseline data collection (expressed in units of product),

$CLEF_{p,k}$ *:* Applicable Carbon Leakage Exposure Factor for product p in year k.

For example, the benchmark value for aluminum with a 24.42.11.30 Prodcom 2010 code is determined as 1.514 (EUA per ton of aluminum).[3] This value reflects the average emission levels of the top 10% most carbon-efficient aluminum producers in the EU. According to the equation, any aluminum plant in the EU can get $F_{alu,\ 2020}$ amount of the allowances for free depending on the levels of *CLEF* and *HAL*. Note that the benchmark values are being updated regularly to reflect improvements in technology, which incentivizes firms to be more carbon efficient.

Figure 1. The Evolution of the EU28's GHG Emissions under the ETS



Source: EU Emissions Trading System (ETS) data viewer; Eurostat env_air_ghg database

2018 (see Figure 1).[4] While the free allocation of allowances will continue in the fourth phase of ETS (2021–2030), the benchmark values will be updated regularly to be able to reflect technological innovations and to meet climate targets. The gradual reduction of benchmark values decreases the number of allowances distributed for free.

Figure 1 shows that the total emissions of the EU28 countries and the ETS member Iceland fell from 4.94 billion tons of CO_2eq in 2005 to 3.97 billion tons in 2018. As of 2018, more than 11,000 electricity, manufacturing, and aviation firms operating in EU-ETS member states released 1.7 billion tons of GHG emissions (43% of the total). Out of 1.7 billion total allowances, 779 million of them were allocated for free (46%), and the rest have been auctioned or sold. ETS member states generated 14 billion euro of revenues from allowance sales in 2018. In line with the ETS regulation, these funds were returned back to member states on the condition that they will be spent on a climate-friendly transformation. While it was determined that at least 50% of this return is to be spent on climate-friendly transformations, on average ETS member states spent 70% on climate-friendly transformations in 2018.[5]

What about emissions that are not regulated under the ETS, which stood at 2.27 billion tons CO_2eq as of 2018? GHG generating activities are grouped under energy, industrial process, agriculture, and waste. While emissions from the transportation and heating/cooling of buildings are not covered under the ETS, they are controlled under different regulations. For example, the "A European Strategy for Low-Emission Mobility"[6] directive in 2016 and the Europe Commission's "The energy performance of buildings"[7] directive in 2002 (revised in 2010) aim to reduce emissions from the transport sector (25% of total emissions) and the building sector.

The ETS and the above-mentioned regulations will affect the future form of the CBA. Although the CBA was announced in the EGD document, the details about its implementation will not be clarified until after mid-2021.

At this juncture, the most important question regarding the Turkish economy will be how the emissions of the Turkish EITA firms (cement, iron-steel, aluminum, paper, etc.) will be calculated under the CBA mechanism. Two points need to be clarified. The first one is whether or not the benchmark values will also apply to foreign producers. Granting free allowances up to benchmark values to intra-EU producers while making foreign producers accountable for their total emissions would be against the World Trade Organization's "non-discrimination" principle.[8] Therefore, one can expect that the benchmark values determined for EITA sectors would also be applied to the extra-EU producers under the CBA until 2030, the year till when the free allocation policy will continue.

The second issue is the scope of the emissions.[9] The EU's ETS only taxes the direct emissions (Scope 1) of carbon and energy-intensive industries. However, by looking at the implementation

under the ETS, it would not be realistic to expect that the CBA will only be applied to extra-EU producers' Scope 1 emissions. Note that the cost of inter-sectoral input exchange also increases with other carbon regulations, and this requires taking into account facilities' indirect emissions (Scope 2 and Scope 3). This point will be elaborated on in the preceding section.

Uncertainties Concerning Emission Scopes

One issue that needs to be clarified is the scope of the emissions for which the extra-EU producers will be held responsible. The ETS taxes only the Scope 1 emissions of the plants/stations above a certain size. Firms are not taxed for the emissions generated from the purchased energy (Scope 2) and other purchased inputs (Scope 3).

The important point here is the fact that most of the inputs used in the production process have already been taxed. If an intra-EU cement factory were to be held responsible for the emissions generated by the purchased electricity, chemicals, etc. (Scope 2 and Scope 3), this would be double taxation, since both emissions have been already taxed from the powerplant and chemical factory before reaching the downstream production unit (in this case the cement factory). Hence, the carbon cost of intra-EU energy-intensive industries is based off the taxes paid for their Scope 1 emissions and the increasing price of inputs purchased from other sectors covered under the ETS. Moreover, to some extent, this is also the case for inputs purchased from sectors that are not covered under the ETS.

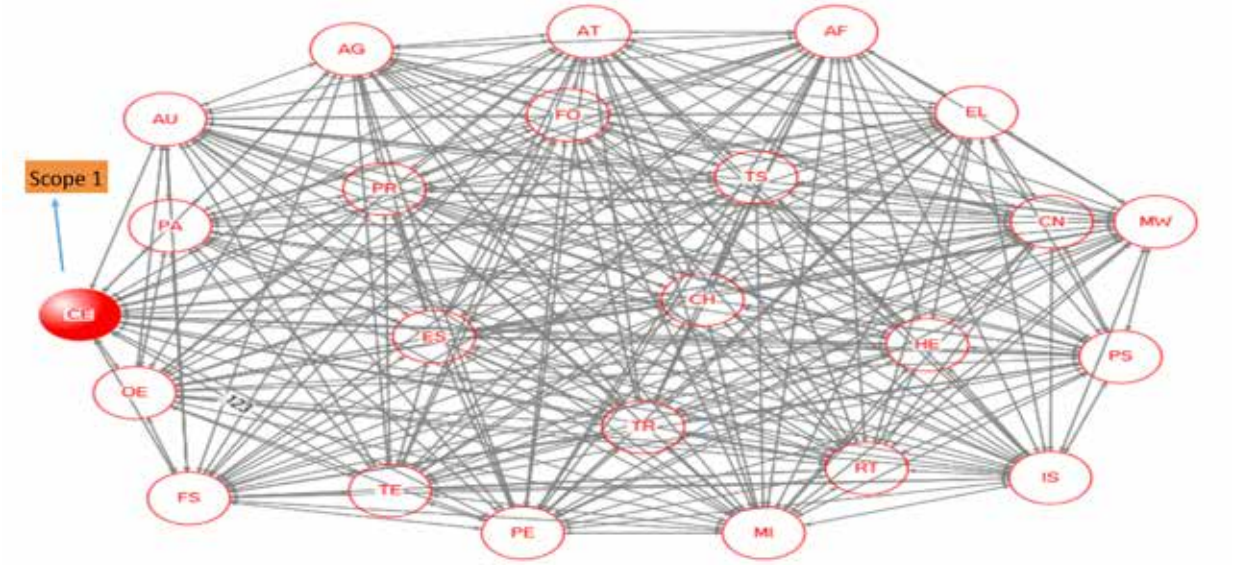
In ETS terminology, it would be unnecessary to refer to Scope 2 and Scope 3 emissions, since Scope 2 and Scope 3 emissions are indirectly taxed through the taxation of Scope 1 emissions. In the ETS implementation, Scope 2 emissions are only mentioned in the case of on-site powerplants owned by a plant that operates in a sector not covered by the ETS (e.g., the on-site powerplants of a textile or an automotive factory). For example, an automotive factory having an on-site powerplant (producing 200 MW or more) would not pay for allowances for its Scope 1 emissions but its Scope 2 emissions. As a result, the ETS can cover the emissions of fossil fuel-fired powerplants in all sectors.

Therefore, in order to better understand how the CBA affects the extra-EU producers operating in an EITA sector, we should ask, "what are the additional carbon costs of a plant if it were to be relocated to the EU?"

In Figures 2–6, an economic system is constructed that consists of 24 model sectors.[10] These 24 sectors interact with each other in terms of input-output exchanges during the production process. Any output produced in a sector is used by other sectors as inputs. These outputs then become inputs for other sectors. Hence, there exist 552 (24*23) different input-output relationships among the 24 sectors (see Figure 2).

Now, imagine a Turkey-based cement factory is relocated to the EU. The cement factory is operating under the cement sector (CE). Since it is now operating in the EU, it will be responsible for its Scope 1 emissions (leave aside for a moment the freely allocated allowances at the level of $F_{p,k}$).

Figure 2. Scope 1 Carbon Cost under the ETS



Yet, the carbon cost of the cement factory (which hampers its competitiveness) is not limited to Scope 1 emissions.

As can be seen from Figure 3, CE is purchasing inputs from the ETS-covered electricity (EL), paper (PA), chemical (CH), refinery products (PE), iron-steel (IS), and air transportation (AT) sectors. The price paid for these inputs includes the Scope 1 emissions costs of these sectors. Therefore, the cement factory faces an extra carbon cost for these "ETS-covered inputs" in addition to its Scope 1 emissions costs.

The extra costs born by the cement factory are still not limited to the costs associated with the "ETS-covered inputs." It is important to keep in mind that the price paid for inputs purchased from the remaining 16 sectors that are not covered by the ETS, e.g., mining (MI), is also higher under the ETS. Although a mining company does not pay for allowances for its Scope 1 emissions, it also faces higher input costs purchased from ETS-covered sectors (e.g., EL, CH, etc.) and reflects these costs in its prices. Figure 4 also shows that the cement factory faces extra carbon costs through the inputs pur-

Figure 3. Indirect Carbon Costs-1 under the ETS

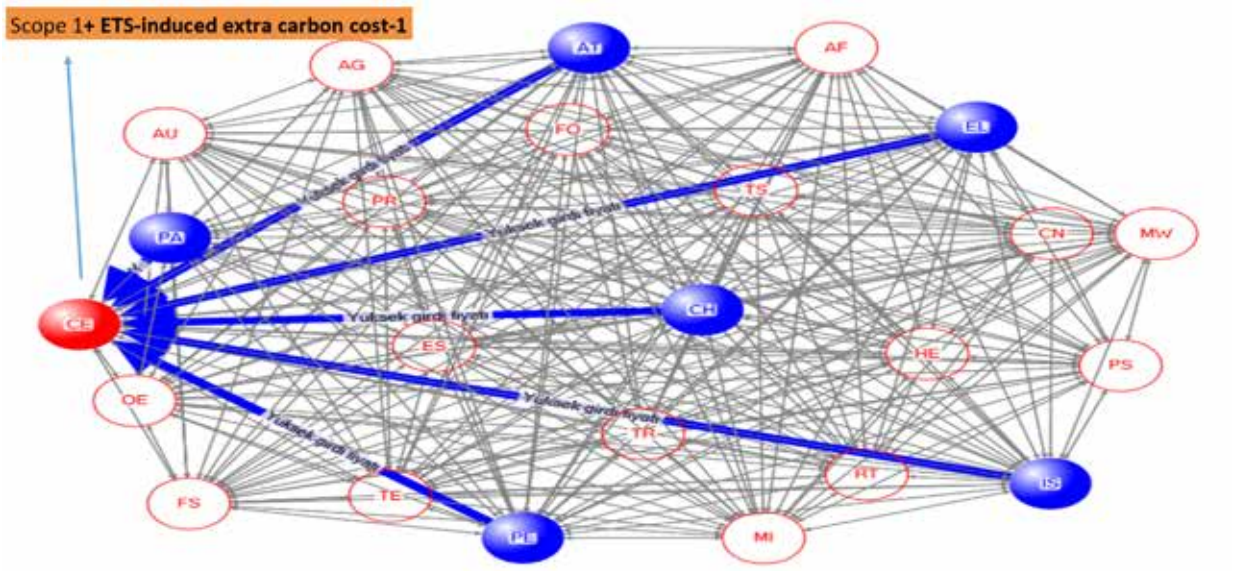
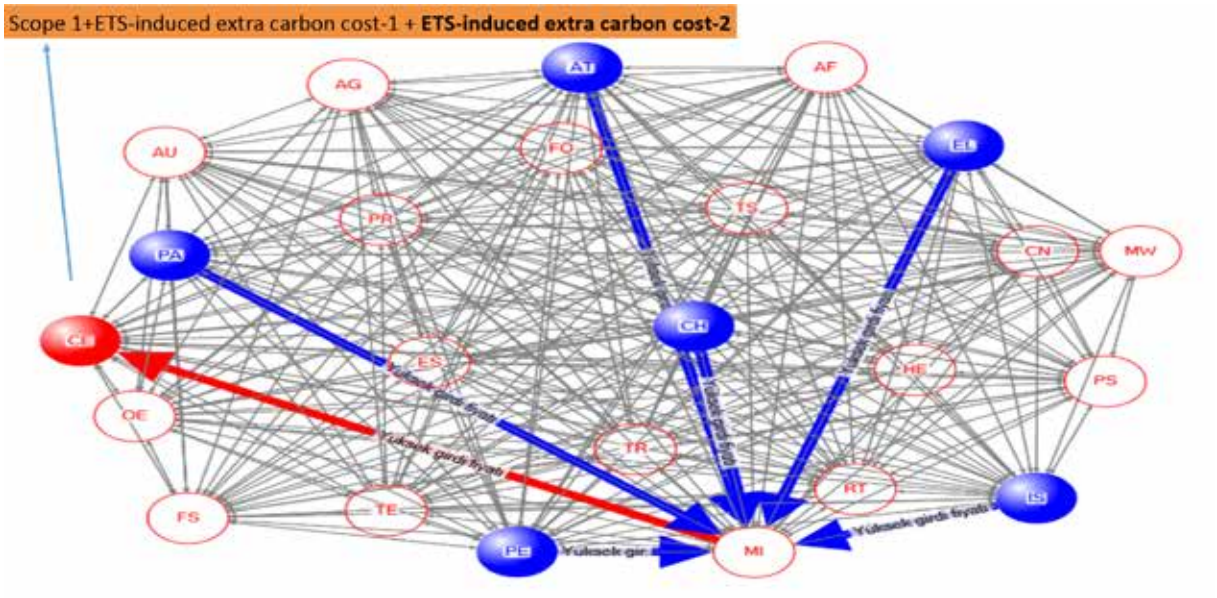


Figure 4. Indirect Carbon Costs-2 under the ETS



chased from the MI sector. This is also the case for the inputs purchased from the remaining 15 sectors.

In sum, a cement factory operating in the EU faces not only direct carbon costs (Scope 1) but also indirect carbon costs for both the Scope 2 emissions attached to the electricity purchase and the Scope 3 emissions attached to the additional purchased inputs (see Figure 5).

This cost disadvantage is the reason behind the carbon leakage risk in EITA sectors. It is the reason why EITA-sector plants are supported through the free allocation of allowances and other measures. To eradicate the carbon leakage risk, CBA should reflect all these extra costs in the price of the goods imported to the EU region.

Leaving aside the "measurement problem" that will be described in the proceeding section, the sources of the carbon costs that the cement sector would face while crossing EU borders are shown in Figure 6. The figures show the amount of the embodied carbon induced by the cement exports (to

Figure 5. Direct and Indirect Carbon Costs under the ETS

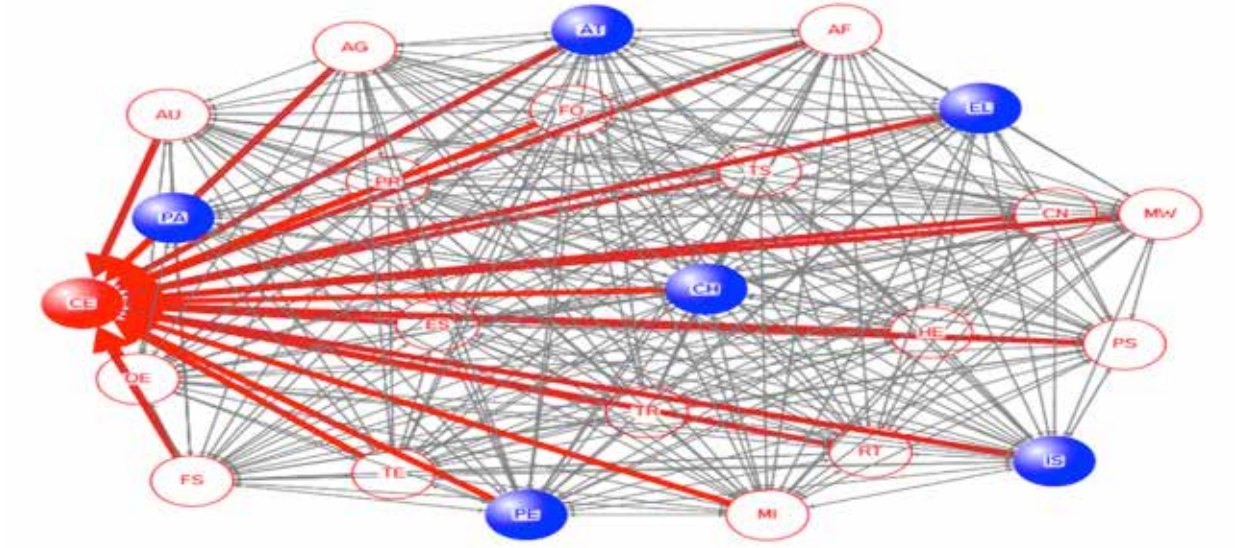
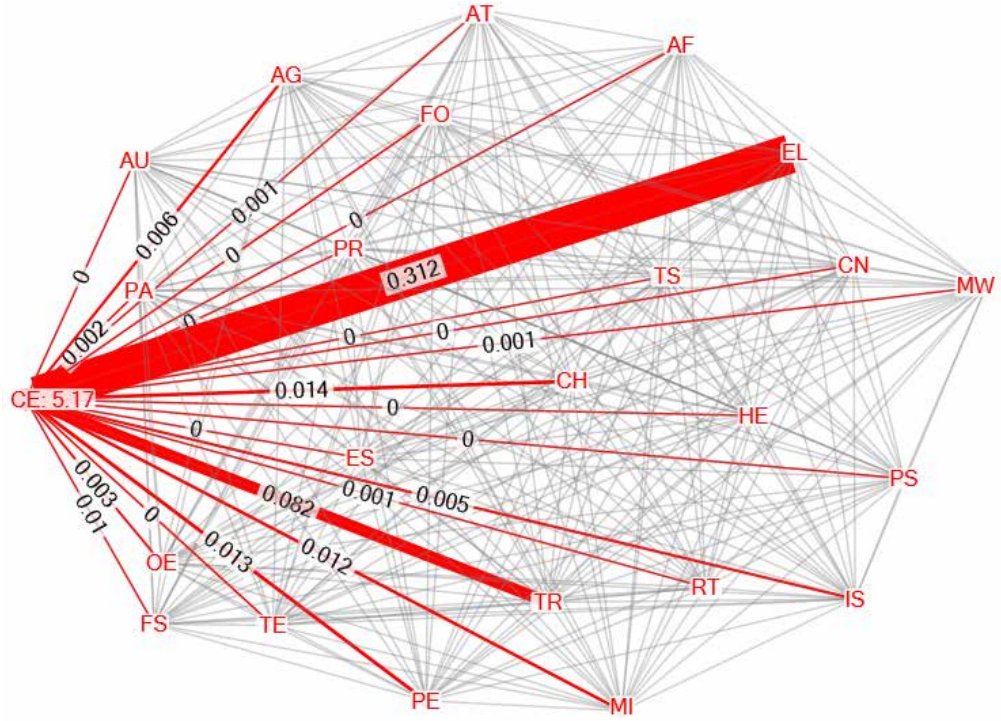


Figure 6. Scope 1, Scope 2, and Scope 3 Emissions Embodied in Cement Exports to the EU28 Market in 2018



the EU28 market) in the overall economic structure in 2018.

As can be seen from Figure 6, the Scope 1 emissions embodied in cement exports to the EU28 market in 2018 was 5.17 Mt CO_2eq. The purchased electricity generated 0.312 Mt CO_2eq of emissions for CE exports to the EU28 market (i.e., Scope 2 emissions), which were followed by 0.082 Mt produced by road transportation (TR), 0.014 Mt produced by CH, and 0.005 Mt produced by IS. The total of Scope 3 emissions was 0.142 Mt CO_2eq. On the condition that the cement industry faces a 30-euro carbon tax for each ton of GHG emissions embodied in the exported cement, Yeldan et al. (2020) calculated the total carbon costs of cement exports to the EU28 market as 167.8 million euro, which is 13.2% of the cement export revenues generated from the EU28 market.[11]

Measurement Problem

Two points need to be clarified. The first one is the question of how the carbon flow among the sectors can be measured. The measurement presented above is made by using a top-down, input-output methodology. Yet, in ETS all measurements are made at the plant level. It is expected to be the same when CBA takes effect. While it is easier to measure the Scope 1 and Scope 2 emissions embodied in production, it is more difficult to measure the Scope 3 emissions generated by inputs purchased from other sectors, e.g., road transportation or agriculture, at the "plant level." As mentioned above, this measurement problem does not apply to the plants operating in the EU but to foreign producers. Again, EU producers already face higher input prices, which forces them to be more carbon efficient. The fact that the Scope 3 emissions of a cement factory in the EU are not measured or taxed does not necessarily mean that they are not accounted for. The directive "A European Strategy for Low-Emission Mobility" might have already increased the unit price of inputs purchased from the road transport (TR) sector, for example. The regulation-induced increase in transportation costs is one of the factors that forces companies to shift to less costly transportation modes (e.g., railways instead of road transport). This is one signal that can be expected from any carbon regulation system. Therefore, for the EU, taxing the Scope 1 GHGs emissions of energy-intensive industries under the ETS and regulating other emissions gener-

ated by transport or heating/cooling of buildings under different frameworks would be enough to control most of the emissions inside the EU. However, this is only valid for emissions within the EU's borders. For CBA to expand emissions regulations, the ETS should also be reformed.

Taking into account the difficulties in measuring Scope 3 emissions at the plant level outside of the EU, instituting a similar carbon pricing scheme (and similar transport/energy efficiency regulations) for the EU's trading partners is the only way for the EU to maintain its competitiveness. While this is the best solution for the EU, this does not necessarily mean that CBA would be unfavorable for trading partners, including Turkey. CBA would increase the costs of Turkish exports to the EU market. Yeldan et al. (2020) estimated the total carbon cost of Turkish exports will be 1.1 or 1.8 billion euro depending on the 30- or 50-euro unit price of EUA. These are the amounts that need to be transferred to the EU ETS for not having a carbon pricing system in Turkey. Instead, by instituting a carbon pricing system, Turkey can retain them in the country which can be used in increasing the energy and carbon-efficiency of its sectors. Therefore, it can be argued that by incentivizing the institution of ETS-type carbon pricing systems, the CBA would benefit not only the EU but also its trading partners.

What Kind of a Carbon Pricing System?

It is important to pay attention to the tenets of the carbon pricing system that will be established. Not any carbon pricing system would make Turkish exports "totally immune" to CBA. As its name suggests, CBA aims to level the carbon costs of intra-EU and extra-EU producers. The price of EUA and the benchmark values used to calculate the number of allowances allocated freely have already been determined under the ETS. Therefore, "total immunity" would require extra-EU carbon pricing schemes to have the same fundamental values (emissions prices, benchmark values, etc.). If not, some complexities will likely emerge, similar to the ones surrounding the measurement problem. For extra-EU countries that are convinced of the necessity of a carbon pricing system, the best solution would be to "link" their systems to the ETS.

If Turkey were to implement a carbon pricing system that is linked to the ETS (like in Iceland, Switzerland, and Norway), Turkish exporters would not face any measurement problem or any additional carbon tax at the EU border. To what extent can the EU impose extra-EU countries to link their systems to the ETS is questionable, though.

A dilemma emerges at this point. While the existence of ETS-linked systems in EU trading partners would solve the measurement problem, it would reduce the EU's CBA revenues, since by introducing ETS-linked systems, extra-EU producers would be taxed in their home country. If there is no carbon-pricing system for trading partners, the EU starts to earn CBA revenues but then will face the measurement problem (and allegations of protectionism, discrimination, etc.). The EU may consider applying the CBA within a narrow framework to avoid these allegations, but this will then undermine carbon leakage objectives.

Hence, the institution of ETS-linked carbon pricing systems in extra-EU countries would be the "best" choice both from the EU's and trading partners' perspectives.

As such, the EU would get rid of the measurement problem and related allegations, and the trading partners would retain their carbon revenues at home rather than paying the EU ETS.

Carbon Pricing System Design Efforts in Turkey

In the global fight against climate change, the World Bank initiated a technical support program titled Partnership of Market Readiness (PMR) in 2011 to help countries reduce GHG emissions through effective employment of market-based emissions reduction instruments. Turkey became a partner of this program in 2013.[12]

The first step in establishing any carbon pricing system is to set up a mechanism to correctly monitor, report, and verify emissions. Since 2013, PMR-Turkey has been conducting research on the possible effects of different carbon pricing schemes on

the Turkish economy and the implementation of the monitoring, reporting, and verification guidelines.[13] Turkey took this step in 2014 by issuing the Monitoring-Reporting-Verification (MRV) Guideline.[14] This was followed by a communique and sectoral training sessions. The communique, "The Verification of the Greenhouse Gas Emissions and the accreditation of the Verification Bodies," was issued in Turkey's Resmi Gazete (no: 30258) in December 2017.[15] According to the regulation, plants operating under the sectors listed in Appendix-1 of the communique are required to undertake annual monitoring, reporting, and verifying processes.

The processes that are monitered under the Turkish MRV are listed in Table 1.

Table 1. Monitored processes under the Turkish MRV

Activity Group No	The Scope of the Accreditation	
1a	Fuels burnt in the plants (only Category A and Category B plants using commercial standard fuels)	
1b	Fuels burnt in the plants (with no restriction)	
2	Oil refining	
3	3.1	Coke production
	3.2	Metal ore roasting & sintering (sulfur ore included)
	3.3	Production of iron & steel
4	4.1	Production or processing of ferrous metals
	4.2	Production or processing of secondary aluminum
	4.3	Production or processing of non-ferrous metals
5	Primary aluminum production (CO_2 and PFC emissions)	
6	6.1	Production of cement clinker
	6.2	Production of lime and calcination of dolomite and magnesite
	6.3	Manufacturing of glass
	6.4	Manufacturing of ceramic products
	6.5	Manufacturing of mineral wool
	6.6	Drying or calcination of gypsum and the production of other gypsum products
7	7.1	Production of pulp
	7.2	Production of paper
8	8.1	Production of carbon black
	8.2	Production of ammonia
	8.3	Production of bulk organic chemicals
	8.4	Production of hydrogen and synthesis gas
	8.5	Production of Na_2CO_3 and $NHCO_3$
9	9.1	Nitric acid production (CO_2 and N_2O emissions)
	9.2	Adipic acid production (CO_2 and N_2O emissions)
	9.3	Glyoxal and glyoxylic acid production (CO_2 and N_2O emissions)
	9.4	Caprolactam production

Source: https://www.resmigazete.gov.tr/eskiler/2017/12/20171202-4-1.pdf.

Plants operating under these activity areas are required to upload their GHG emissions data on the online platform of the Ministry of Environment and Urbanization's Greenhouse Gas Monitoring and Reporting System.[16] These data are published in aggregates in Turkey's Greenhouse Gas Inventory, but emissions data at the plant level is not made public.

Emissions and Potential Revenues under an ETS-type System in Turkey

What percentage of emissions can be covered, and how much revenue can be generated when Turkey sets up a carbon pricing system that is linked to the ETS?

The EU ETS covers around 11,000 plants that operate under seven carbon- and energy-intensive sectors. By using the methodology employed in Yeldan et al. (2020), emissions and revenues have been calculated using data in Turkey. The Scope 1 emissions of EL, PA, PE, CE, CH, IS, and AT and their share in total emissions and revenues generated (assuming the carbon price as 30-euro/ton) are listed in Table 2.

According to our calculations, the sum of the Scope 1 emissions levels of seven energy- and carbon-intensive sectors in Turkey is 269.2 Mt CO_2eq, which accounts for 51.2% of total emissions (520.9 Mt CO_2 as of 2018). At this point, a comparison with the EU's ETS would be useful. The emissions coverage of the ETS in the EU28+ISL region was 43% in 2018. Although there is no reason for them to be equal, methodological differences between the EU's ETS, which monitors emissions at the plant level, and input-output analysis employed in this study may explain the differences in coverage rates. Moreover, under the EU's ETS, only plants with a certain capacity (power plants over 200 MW capacity) are taxed, but in the input-output analysis, there is no such restriction, and the calculations cover all aggregate emissions generated by the respective sector.

Table 2. Scope 1 Emissions and Carbon Revenues of Carbon- and Energy-Intensive Sectors in Turkey

Model Sectors	Scope 1 GHG Emissions (CO_2e, Mton)	Share (%)	Carbon Revenue (millions euro; ton CO_2e = 30 euro)
EL: Electricity	154.9	30	4,647
CE: Cement	75.1	14	2,253
IS: Iron-Steel	17.6	3	528
CH: Chemicals	10.1	2	303
PE: Refinery products	6.7	1	201
AT: Air Transport	3.8	1	114
PA: Paper	1	0.2	30
Total	**269.2**	**51.2**	**8,076**

Source: TURKSTAT 2018 Greenhouse Gas Inventory and author's calculations

It can be seen from the last column of Table 2 that if the Scope 1 emissions of the indicated sectors were taxed, the total revenue that can be generated would be 8 billion euro, which was 1.2% of Turkey's GDP in 2018. The 14 billion euro collected under the ETS, on the other hand, was 0.1% of the GDP of the EU28+ISL in the same year. Note that the free allocation of allowances to industries under the ETS reduce revenues, while the calculations above take into account "all" emissions.

It is expected that the prospective Turkish carbon pricing system would also allocate free allowances to the Turkish EITA sectors, which would help the two ratios converge. For a study on the determination of the Turkish EITA sectors, see PMR (2018).[17]

Another point concerning the calculation that needs to be considered is the level of detail of sectoral breakdown. The facilities and product benchmarks under the ETS have been determined by eight-digit NACE codes. However, Turkey does not produce this data. For example, cement, glass, and ceramics products that have different energy and carbon intensities have been grouped under the C23 coded cement sector. However, the benchmark for the 23.51.11.00-coded white cement clink-

er and 23.11.12.14-coded float glass have been determined as 0.987 and 0.453 (tons of GHG per ton of production), respectively. Therefore, the single number calculated for the C23 cement sector does not represent the cost faced by a typical facility but an average for the entire sector.

Concluding Remarks

This policy brief analyzes the details of the CBA mechanism of the EGD announced in December 2019 and its possible effects on the Turkish economy. The implementation of the CBA is still unclear and is expected to take effect in early 2022. The expectation that it will be compatible with the ETS helps us to make some early deductions. One needs to have plant-level emissions data in order to be able to calculate the exact impact of the CBA on Turkish sectors. Since this data is not available, the analysis conducted here employed a top-down input-output methodology.

Our methodology suggests that the CBA will cost Turkish exporters 1.1–1.8 billion euro annually. Facility-based data will generate a much clearer picture. Note that the calculations reflect only the "measurable" costs. As argued by Yeldan et al. (2020), the costs of having an inactive climate policy, especially while the EU's new regime inaugurated with the EGD is being established, will gradually increase. Therefore, it would make more sense to view the CBA as an opportunity for transforming the Turkish economy rather than a risk. The revision of the Turkish INDC in parallel with the revised GDP path would reflect Turkey's true responsibilities. Ratification of the Paris Agreement in the Turkish parliament would be the first step needed to begin the climate-friendly transformation of the Turkish economy. Prioritizing the establishment of the carbon pricing system, which would already reach a certain level of maturation before 2022 when the CBA will take effect, may help keep carbon costs to a minimum.

Appendix

Table A1. Model Sectors

Model Sectors	NACE Rev2 Sector Codes
AG: Agriculture	A01 - A03
MI: Mining	B05, B06 - B09
FD: Food	C10 - C12
TE: Textiles- Apparel	C13 - C15
OE: Other Economies	C16, C30 -C33, E36 - E39, G45, G46, N80 - N82, O84
PA: Paper[a]	C17, C18
PE: Refinery Products[a]	C19
CH: Chemicals[a]	C20 - C22
CE: Cement[a]	C23
IS: Iron-Steel[a]	C24
MW: Machinery	C25 - C28
AU: Automotive	C29
EL: Electricity[a]	D35
CN: Construction	F41 - F43
RT: Retail Trade	G47
TR: Land-Sea Transport	H49, H50
AT: Air Transport[a]	H51, H52
PS: Postal Services	H53
AF: Accommodation and Food	I55, I56
PR: Professional Services	J58 - J63, M71 - M75, N77 - N78, S94 - S96
FS: Financial and Real Estate Services	K64 - K66, L68, M69-M70
TS: Tourism	N79, R90 - R93,
ES: Education Services	P85
HE: Health Services	Q86 - Q88

[a]Sectors covered under the EU ETS.

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9 | Plants' emissions are grouped under three sections. Scope 1 emissions are from 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.

10 | See the appendix for sector details and corresponding NACE Rev2 codes.

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Ahmet Atıl Aşıcı is a 2020/21 Mercator-IPC Fellow. Aşıcı works as an associate professor of economics at Istanbul Technical University, Department of Management Engineering.

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İstanbul Politikalar Merkezi
Bankalar Caddesi Minerva Han No: 2 Kat: 4
34420 Karaköy-İstanbul
T +90 212 292 49 39
ipc@sabanciuniv.edu - ipc.sabanciuniv.edu

IPC
ISTANBUL POLICY CENTER
SABANCI UNIVERSITY
STIFTUNG MERCATOR INITIATIVE