IMPACT OF CARBON BORDER ADJUSTMENT MECHANISM ON IRON-STEEL AND CEMENT SECTORS IN TURKEY: A SOCIAL ACCOUNTING MATRIX MULTIPLIER ANALYSIS

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ABSTRACT

IMPACT OF CARBON BORDER ADJUSTMENT MECHANISM ON IRON-STEEL AND CEMENT SECTORS IN TURKEY: A SOCIAL ACCOUNTING MATRIX MULTIPLIER ANALYSIS

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The iron-steel and cement sectors are essential elements of the global economy and also significant greenhouse gas (GHG) emitters. The most important GHG emission sources of the industrial processes and product use (IPPU) sector in Turkey are CO_2 emissions from these two sectors, nearly three quarters of total emissions by IPPU. Emissions by IPPU have become critical especially after the European Green Deal (EGD) and the concomitant carbon border adjustment mechanism (CBAM).

Although the impact of carbon pricing on national economies are widely researched, there are very few studies that focus on carbon pricing in Turkey. In this thesis, I first construct an up-to-date social accounting matrix (SAM) of the Turkish economy for 2019. Next, I investigate the carbon cost and potential impacts of CBAM by using SAM multiplier analysis. The results show that carbon cost of CBAM on the Turkish exporters, under three different carbon price scenarios (€45-7€1-€100/tCO_2e), ranges between €1.8-€2.8-€4 billion annually. The results of SAM multiplier analysis indicate that decrease in iron-steel exports by €0.22-€0.36-€0.50 billion leads to €0.17-€0.27-€0.38 billion decrease in economywide GDP and €0.42-€0.67-

€0.94 billion decrease in total output, under the three price scenarios and without considering free allocation. Decrease in cement exports by €0.05-€0.08-€0.12 billion leads to €0.06-€0.10-€0.14 billion decrease in GDP and €0.14-€0.22-€0.37 billion decrease in total output under the same price levels and allocation policy. This thesis also provides an evaluation of free allocation under CBAM for iron-steel and cement sectors and discusses the results from the perspective of free allocation.

Keywords: Social Accounting Matrix, Multiplier Analysis, Carbon Border Adjustment Mechanism, Turkey

ÖZ

SINIRDA KARBON DÜZENLEME MEKANİZMASININ TÜRKİYE’DEKİ DEMİR-ÇELİK VE ÇİMENTO SEKTÖRLERİNE ETKİSİ: SOSYAL HESAPLAR MATRİSİ ÇARPAN ANALİZİ

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Demir-çelik ve çimento sektörleri, küresel ekonominin temel unsurları ve aynı zamanda önemli miktarda sera gazına sebep olmaktadırlar. Türkiye'deki endüstriyel prosesler ve ürün kullanımı (IPPU) sektörünün en önemli sera gazı emisyon kaynakları, bu iki sektörden kaynaklanan CO_2 emisyonlarıdır ve IPPU'nun toplam emisyonlarının yaklaşık dörtte üçünü oluşturmaktadır. IPPU kaynaklı emisyonlar, özellikle Avrupa Yeşil Mutabakatı ve buna eşlik eden sınırda karbon düzenleme mekanizması (SKDM) sonrasında kritik hale gelmiştir.

Karbon fiyatlandırmasının ülke ekonomileri üzerindeki etkisi yaygın olarak araştırılsa da Türkiye'de karbon fiyatlandırmasına odaklanan çok az çalışma bulunmaktadır. Bu tezde, öncelikle 2019 yılı Türkiye ekonomisi için güncel bir sosyal hesaplar matrisi (SHM) oluşturuyorum. Sonrasında, SKDM’nin karbon maliyeti ve potansiyel etkilerini SHM çarpan analizi kullanarak araştırıyorum. Sonuçlar, SKDM’nin Türk ihracatçıları üzerindeki karbon maliyetinin, üç farklı karbon fiyatı senaryosu altında (45€-71€-100€/tCO_2e), yıllık 1,8-2,8-4 milyar € olarak değiştiğini göstermektedir. SHM çarpan analizinin sonuçları, üç fiyat senaryosu altında ve ücretsiz tahsisat dikkate alınmadığında, demir-çelik ihracatındaki 0,22-0,36-0,50 milyar € düşüşün ekonomi genelinde GSYİH'de 0,17-0,27-0,38 milyar € düşüşe ve toplam çıktıda 0,42-0,67-0,94 milyar € düşüşe yol açtığını göstermektedir., Aynı fiyat seviyeleri ve tahsisat politikası altında, çimento ihracatındaki 0,05-0,08-0,12 milyar € düşüşün ise GSYİH'de 0,06-0,10-0,14 milyar € düşüşe ve toplam çıktıda 0,14-0,22-0,37 milyar € düşüşe yol açtığını göstermektedir. Bu tez ayrıca SKDM kapsamında demir-çelik ve çimento sektörleri için ücretsiz tahsisatın bir değerlendirmesini sunmakta ve sonuçları ücretsiz tahsisat perspektifinden tartışmaktadır.

Anahtar Kelimeler: Sosyal Hesaplar Matrisi, Çarpan Analizi, Sınırda Karbon Düzenleme Mekanizması, Türkiye

To my lovely, deceased grandmother and to my family

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I want to express my endless thanks to my family for always believing in me and always being there for me. As my most important happiness source in life, I also want to thank my excellent and beloved sisters, Yasemin and Sudenaz, for always cheering my up with their wonderful energy.

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LIST OF ABBREVIATIONS

BAU	Business-As-Usual
BEC	Broad Economic Categories
BF	Blast Furnace
BOF	Basic Oxygen Furnace
CBAM	Carbon Border Adjustment Mechanism
CBRT	Central Bank of the Republic of Turkey
CCSU	Carbon Capture Storage and Utilization
CGE	Computable General Equilibrium
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COP	Conference of Parties
CP	Carbon Price
CRF	Common Reporting Format
EAF	Electric Arc Furnace
EI	Export Intensity
EU	European Union
EGD	European Green Deal
ETS	Emission Trading System
Eq.	Equation
GAMS	General Algebraic Modeling System
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GSYİH	Gayri Safi Yurt İçi Hasıla
HS	Harmonized System
IEA	International Energy Agency
INDC	Intended Nationally Determined Contribution
I-O	Input-Output

IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IPR	Import Penetration Ratio
MEUCC	Ministry of Environment, Urbanization and Climate Change
MTF	Ministry of Treasury and Finance
NACE	Nomenclature des Activités Économiques dans la Communauté Européenne
N_2O	Nitrous Oxide
NCCAP	National Climate Change Action Plan
NDC	Nationally Determined Contribution
NIR	National Inventory Report
PMR	Partnership for Market Readiness
PSB	Presidency of Republic of Turkey-Presidency of Strategy and Budget
ROW	Rest of the World
SAM	Social Accounting Matrix
SITC	Standard International Trade Classification
SSI	Social Security Institution
TRY	Turkish Lira
TurkStat	Turkish Statistical Institute
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WTO	World Trade Organization

CHAPTER 1

INTRODUCTION

Climate change is one of the biggest problems of history and it continues to cause substantial damages and harmful impacts. One of the latest reports of the Intergovernmental Panel on Climate Change (IPCC) emphasizes that the climate change problem is "human-induced and beyond the natural climate variability" IPCC (2022, p.11), thus demandingglobal ambitious action to tackle, especially considering the remaining carbon budget. International efforts to limit the adverse impacts of climate change has set the international and legally binding objective of the Paris Agreement in 2015 as to limit the global warming well below 2°C, preferably to 1.5°C, as compared to pre-industrial levels (United Nations, 2015). If necessary actions cannot be taken on time and global warming reaches to and beyond 1.5°C, earth systems would have to face substantial, complex and in some cases irreversible adverse risks and hazards to ecosystems and human being (IPCC, 2022). For the pathway consistent with 1.5°C global warming target IPCC (2018) states:

> "*with no or limited overshoot of 1.5°C, global net anthropogenic CO_2 emissions decline by about 45% from 2010 levels by 2030, reaching net zero around 2050*" (p.12).

In line with the global mitigation efforts, net zero commitments of countries gained momentum recently and as of May 2022, these commitments, covers the 88% of global emissions (Net Zero Tracker, 2022)[1]. Carbon pricing is one of the most important policy tools to reduce emissions by internalizing the social cost of GHG

[1] Retrieved May 29, 2022, from https://www.zerotracker.net/

emissions and to incentivize climate action. However, it cannot be sufficient and achieve the expected outcomes alone, esppecially if all parties are not ambitious enough. Differences in climate policies of countries and/or regions and also differences in the level of carbon prices lead to carbon leakage risk[2]. In the context of European economies, Carbon Border Adjusment Mechanism (CBAM) is proposed to address and eliminate this risk. Recently, the proposal for CBAM started to be largely discussed, both in academia and among the policy makers and managed to gain support. In its root, CBAM proposes to treat both domestic and foreign-based products similarly in terms of climate change related policies. One of the solid examples of CBAM, in compliance with WTO was proposed by European Green Deal (EGD) in 2019. EU is ambitious about its climate objectives and calls for its trade partners to set their sights as high and to increase collective climate efforts

Turkey announced its 2053 Net Zero Emission Target and ratified Paris Agreement in October 2021. Long-term climate change strategy and action plan of Turkey are in preparation by the associated ministry and institutions. Moreover, Turkey is closely following the developments in EU as its most important trading partner. Following the announcements on Fit for 55 package[3] by the European Commission, Turkey published Green Deal Action Plan in July 2021, to adopt to the impacts of the EGD, with CBAM being one the most important items. To present the new climate change vision and green transformation of the country, first Climate Council of Turkey was held in the February 2022. The council declaration states that the efforts for the establishment of the Emissions Trading System (ETS) would be accelerated and the studies for the implementation of the ETS should be completed in 2024. The pilot process, which will take at least one year, should start in 2024,

[2] Companies may decide to move their production from a country with stringent policies, to a country with less-stringent policies or imports from such countries may increase and that results with increase of total emissions. This situation is known as carbon leakage (European Commission, 2022a).
[3] In order to achieve the target of 55% reduction of emissions by 2030 and neutrality by 2050, EU presented Fit for 55 package to revise its legislation of climate, transport and energy. CBAM is one of the proposals under this package (Council of the European Union, 2021).

considering the EU CBAM roadmap (Ministry of Environment Urbanization and Climate Change, 2022a).

By considering the important trade relationships of Turkey with EU, effects of CBAM on Turkish economy, on exporters and carbon-intensive sectors will be important and needs to be precisely examined. This thesis analyzes the possible impacts of CBAM by using SAM multiplier analysis. Aim and contributions of the thesis are presented in the following sub-section and structure of the thesis is given next.

1.1 Aim and Contributions of the Thesis

The main aim of this thesis study is to analyze the effects of European Union's proposed CBAM on Turkish economy and to examine the effects in detail from the perspective of carbon-intensive iron-steel and cement sectors. To the best of author's knowledge that this study is one of the first studies examining the effects of CBAM with an up-to-date database and considering the exports to current member states of EU (EU-27, after Brexit). Additionally, this study is the first study to disaggregate the cement sector from the other activities of NACE 23, disaggragate iron-steel sector from other activities of NACE 24 and 25, and purely reflect the cement and iron-steel products and articles thereof. Cement and iron-steel sector in the study are determined by considering the proposed products under CBAM and fully reflects the sectors to be exposed to CBAM. Moreover, another main novelty of the thesis is that this is the one of first attempts to consider the concurrent application of free allowances with CBAM for both EU and non-EU producers. The effects of free allocation, which will be available for all sectors at carbon leakage risk until CBAM totally phases in, for cement and iron-steel exporters are considered while analyzing the results of SAM multiplier analysis with different demand ranges.

This thesis is expected to have the following contributions:

- generating an up-to-date SAM for Turkey and interpret the key characteristics of Turkish economy,
- calculation of the embedded GHG emissions of exports to EU,
- providing an important overview for Turkish industry about the cost of CBAM,
- presenting the sectoral vulnerabilities to CBAM,
- analyzing the macroeconomic impacts of CBAM on Turkish economy,
- examining the effects of free allocation for iron-steel and cement sectors,
- proposing actions to mitigate the risks and tackle with climate change for iron-steel and cement sectors.

1.2 Structure of the Thesis

This thesis includes six chapters. The appendices present the details of the data set and the model results. Following this Introduction Chapter, carbon pricing overview and developments in climate change policies in Turkey and in European Union are presented in Chapter 2. Next, Chapter 3, presents a comprehensive literature review on social accounting matrices, multiplier analysis, effects of carbon pricing mechanisms on Turkish economy and about carbon border adjustments. Methodological framework of SAM and multiplier analysis are given in Chapter 4 (SAM creation phases including data and calculations of the study are given in Appendix A). Results of analyses are discussed in Chapter 5. Final Chapter summarizes the findings and discusses climate change related policy recommendations along with directions for possible further studies.

CHAPTER 2

OVERVIEW ON CARBON PRICING, TURKEY'S SITUATION AND DEVELOPMENTS IN EUROPEAN UNION

This chapter provides a general overview on carbon pricing and related developments in both Turkey and the European Union. First part of the chapter mentions the history of carbon pricing, advantages it provides, main mechanisms to apply, and the situation of carbon pricing policies in the world. In the second part, Turkey's history and current position on climate change are presented in detail. Last part focuses on the climate change related developments and ambitious steps taken in the EU including the carbon border adjustment mechanism.

2.1 Carbon Pricing Overview

Almost all economic activities leave carbon footprint behind and increase the GHG emissions in the atmosphere (Aldy & Stavins, 2012). Nature cannot absorb additional anthropogenic emissions and has long lost its balance. Considering anthropogenic effects and the GHG emissions, earth's temperature rises, and climate change becomes a fact. Changes in climate which is due to human influence will also have a range of impacts on economies, societies, and environment and most of these effects are expected to be adverse, even leading catastrophic results. Global efforts are needed to reduce and manage the risks of climate change (Bowen, 2011; IPCC, 2014).

When the polluter does not face with any sanction to reduce emissions of its activities, it is not possible to see any reduction on emissions and cost of polluter's emissions will continue to be imposed on other people. A mechanism which will bring the cost of those emissions on polluter, not on emitter is required. Putting a price which reflects the cost of emissions means internalizing the negative externalities so that the polluter is discouraged from emitting large volumes and encouraged to find lower carbon intensive ways to produce their goods and services (Bowen, 2011; Sayegh, 2019). By internalizing the negative externalities of emissions and reflecting the cost of society on polluter, carbon pricing is one of most flexible climate change policy instruments for emission reduction. First of all, carbon pricing is not directly targeting any specific application or decision, it does not dictate but rather sends an economic signal to the polluter to give the decision to either to continue to emit higher levels and pay or to lower emissions by investing and transforming to less-carbon intensive. Thus, while minimizing the social cost of carbon, carbon pricing also encourages innovation to achieve the less cost and low-carbon solution to reduce their emissions and investment for new technologies. To put a price on carbon provides firms or individuals to consider climate change effects of their activities, integrate the external costs of them into their economic decision making and shape their investment plans, so that transition to a decarbonized economy can be achieved in a flexible way for society, environment and economy (The World Bank, 2021a).

2.1.1 History and Advantages of Carbon Pricing

The main idea behind internalizing externalities using taxes goes back to a century ago to the studies of Pigou. Pigou proposed to apply tax, which will cover the cost of harm generated, to polluters by the government so that the costs of pollution would be internalized (Pigou, 1920). Activities generating emissions also have externalities which lead to climate change and when there is no cost to polluters or to individuals reflecting these externalities, no one considers the negative effects of their activities on the earth and on the future generations (Weisbach & Metcalf, 2009a). Therefore, mainly why carbon pricing is needed from an economic perspective is about externalities. Prices of goods or services do not entirely reflect the cost to the society. Most of the prices only reflect the costs of production, transportation, delivery etc., but nothing in the price reflects that production phases of these goods or services cause climate change or will have harmful effects later. And when those are not included in the market price, market failures occur. Pigou’s solution for this problem of externality was to fix the price with an additional component that reflects the damage caused by the production activity.

Sharing the purpose of Pigou’s tax, carbon pricing is one of the most efficient and flexible ways to help reduce emissions, thereby addressing the negative externalities. Carbon pricing is expected to promote clean investments, and lead to positive behavioral changes and to accelerate the innovation in clean technology (IEA, 2020; Neuhoff, 2008; The World Bank, 2017). Baranzini et al. (2017, pp. 3-5) presents the following arguments on the position and effectiveness of carbon pricing in climate change policy:

- Since it leads to reflecting emissions of products and services and social costs related with those emissions in the prices, costs and climate change related effects will be automatically internalized by the companies and individuals (p. 3),
- Pollution control and abatement cost is minimized by addressing the heterogeneity of emitters with the signal generated by carbon price (p.3),
- It continuously promotes and incentivizes innovation of clean technologies (p.4),
- It limits the carbon and energy rebound effectively (p.4),
- It prevents carbon leakages and relocation of industries in case of a global carbon pricing (p.5),
- It reduces the need for information and decentralizes policy (p.5),
- Carbon pricing considers that consumers are caring prices rather than having environmental concerns in their purchase decisions and intervenes in the prices of goods and services naturally (p.5).

2.1.2 Carbon Pricing Mechanisms

There are two main alternatives for applying carbon price explicitly: carbon tax and cap-and-trade system (Baranzini et al., 2017; IEA, 2020; The World Bank, 2017). Additionally, carbon pricing can be catalyzed through other climate change policy instruments such as clean energy standards, fuel taxes, removal of fossil fuel subsidies and incentives for renewable energy or low-carbon technology (Aldy & Stavins, 2012). Also, policies such as new performance standards, financial incentives for sectors to adopt clean technologies, new approaches in infrastructure, developments in the design of cities can be introduced to accelerate the low carbon transition (The World Bank, 2017). In this section, the two carbon pricing mechanisms, carbon tax and ETS via cap-and-trade principle, are summarized.

Carbon Tax

Carbon tax is a mechanism in which a direct price (which is called as tax rate) for carbon content or emissions is set (Goulder & Schein, 2013). It can also be described as a dynamically efficient Pigouvian tax which provides to balance the reduced social marginal cost and benefit of an additional GHG emission (Nordhaus, 2007). Since the price is set directly, cost certainty is provided in the carbon tax, and this brings a solid base for business plan decisions. On the other hand, although carbon tax provides cost certainty, it does not provide benefit certainty which refers to the environmental benefits that arise with the implementation of a carbon tax. This is because the effects of carbon tax on emissions cannot be known in advance. The main reason behind this argument is that, under carbon tax, there is no ex-ante specified emission allowance level, i.e., the unit cost of emissions would be known but the level of emission reduction cannot be guaranteed. However, if the design of carbon tax mechanism is efficient, targeted benefit certainty would be achieved. Those uncertainty problems about environmental effects can be eliminated with dynamically designed systems in which the changes in tax rate are set dynamically with new information on the emission reduction’s costs and benefits (Weisbach &

Metcalf, 2009b). While setting a carbon tax encourages producers to produce with low-carbon technology and reduce their products' carbon intensity, it also leads consumers to consume products of lower carbon intensity and make their decisions accordingly because tax causes increase in the prices of carbon intensive products (Goulder & Schein, 2013).

Main advantages of carbon taxation are:

- It does not require huge administration efforts and costs, easy to manage, and not have high costs for authorities (Goulder & Schein, 2013b, p. 11) (The World Bank, 2017, p. 10),
- Maximum cost per unit pollution is guaranteed (The World Bank, 2017, p. 10),
- Liabilities of actors can be predicted well (The World Bank, 2017, p. 10),
- It avoids the volatility in price (Nordhaus, 2007, pp. 37-42) (Goulder & Schein, 2013b, p. 11), and,
- Revenues can be generated easily (Nordhaus, 2007, pp. 39-42) (Goulder & Schein, 2013; Nordhaus, 2007; The World Bank, 2017).

Sweden has had carbon tax (one of the first carbon tax in the world, second after Finland carbon tax in 1990, and has the highest carbon price currently) since 1991 and it helped to reduce their emissions by 29 percent over the period 1990-2019. And also, while implementing it, Sweden has actually experienced overall economic growth afterwards and country's GDP development increased 84% over the same period (Ministry of Finance, 2021).

Emission Trading System (ETS)

ETSs are market-based instruments which allow fluctuations in carbon price and create incentives for emission reductions at the most cost-effective point. There is a cap for GHG emissions that sectors can emit and it provides certainty about emission reductions (IEA, 2020). Emission allowances constituting the cap can be auctioned and can be allocated according to the characteristics of the system and allowances can be traded between the actors of the market. The main issue in this system is that the price of allowances is not certain as in carbon tax. Also, ETS needs well-established administrative and technical infrastructure and rules to prevent manipulation. Main advantages of ETS are presented below:

- There is certainty about emission quantity, it helps to achieve the stated targets of emission reduction in a least cost and flexible way (IEA, 2020, p. 24) (IETA, 2022),
- Price signal is clear (IETA, 2022),
- It promotes the operational excellence, low-carbon technologies, and innovation (IEA, 2020, p. 55) (IETA, 2022),
- It provides incentives for the transition to clean energy (European Commission, 2015, p. 14) (IEA, 2020, p. 55),
- Auction revenues can be used to finance measures tackling climate change (European Commission, 2015, p. 5) (IEA, 2020, p. 52),
- It supports multilateral cooperation (IEA, 2020, p. 55) (European Commission, 2015; IEA, 2020; IETA, 2022).

EU ETS, which is supranational, and the first international ETS was introduced in 2005; it was also the largest carbon pricing mechanism until China established its national ETS in 2021. EU ETS effectively reduced the emissions of the covered installations under the ETS about 35% between the period of 2005 and 2019. After the establishment of Market Stability Reserve in 2019, higher carbon prices observed and that lead to 9% annual emission reduction (European Commission, 2021f).

It is important to highlight that carbon pricing is a very important tool for the transition to a low carbon economy by internalizing the social cost of emissions, but it is not enough if it is not designed well as a policy. Main points to consider having a well-working and efficient carbon pricing policy are as follows:

- Carbon price should be high enough to drive decarbonization (The World Bank, 2021b, p. 25),
- All technical and regulatory aspects of the carbon pricing policy should be adapted to the existing regulatory and bureaucratic content (OECD & World Bank, 2015, p. 11),
- It needs to be applied with other climate policies and measures (OECD & World Bank, 2015, p. 16),
- Effective carbon pricing policies should maintain competitiveness, ensure environmental integrity and minimize social costs (OECD & World Bank, 2015, p. 4),
- Clarity in design and implementation is a must (OECD & World Bank, 2015, p. 24).

2.1.3 Carbon Pricing Around the World

There are 68 operating carbon pricing initiatives covering the 23% of GHG emissions globally as of April, 2022 (Figure 2.1). 36 of these initiatives are carbon taxes while the rest, 32, are ETSs. Increase in coverage is observed as a result of four new initiatives launched and revenues generated from all these initiatives are increased quite a lot, 60%, as compared to previous year and reached to $84 billion (The World Bank, 2022).

Although more countries are interested in carbon pricing and number of initiatives around the world is increasing, the level of price and the sectoral coverage is not sufficient enough yet. World Bank stated a carbon price range of $50-100 per ton CO_2e by 2030 to reach below 2°C target. Unfortunately, less than 4% of the global GHG emissions are priced within this range or above. Additionally, to reach 1.5°C target, higher carbon prices are necessary, as a reference it is stated that $160/t$CO_2$e would be the carbon price by 2030 for this target (The World Bank, 2021b). Allowance prices in some of the ETSs around the world such as EU ETS, Quebec, UK ETS, RGGI (USA Regional Greenhouse Gas Initiative), China ETS, NZ ETS and South Korea are compiled and given in the Figure 2.2.

Another reason behind the increased activity in carbon markets is about net zero commitments of both countries and corporate companies. As of May 2022, 127 countries, 702 companies and 235 cities (out of 198 countries, 2,000 companies, 1,177 cities) have net zero, carbon neutral or similar decarbonization commitments. Those commitments cover the 88% of emissions globally and 90% of the GDP (Net Zero Tracker, 2022). Additionally, companies in the world are being for adopting carbon pricing mechanisms and implementing internal system of carbon pricing to guide decisions on investment. According to the survey of Carbon Disclosure Project, in 2020, about 2,000 companies (out of 6,000 companies) use or intended to use (within next two years) internal carbon pricing with a median price of $25/tCO_2e$ (CDP, 2021).

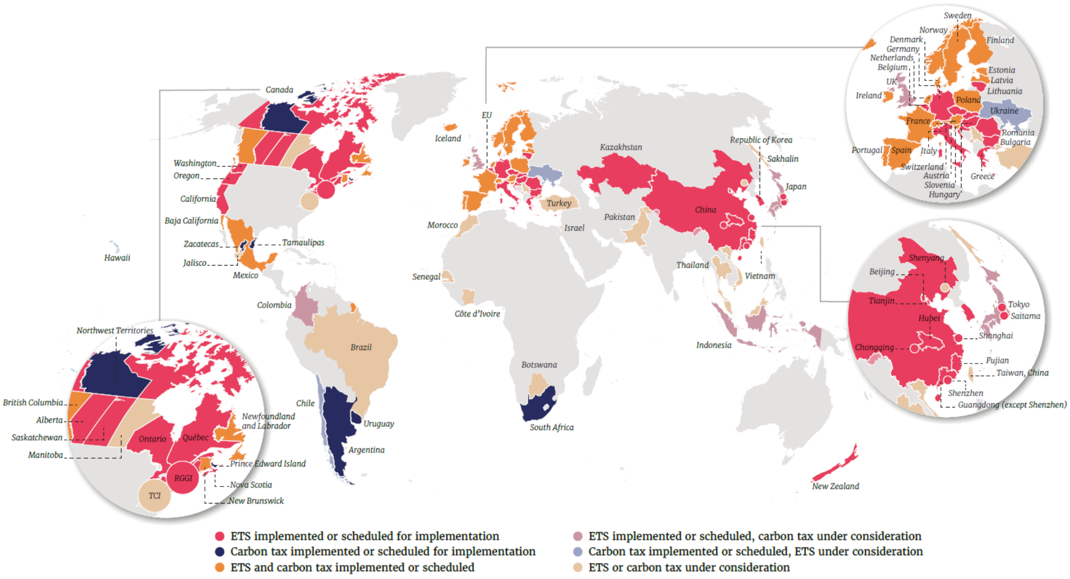

Figure 2.1 Carbon Pricing Initiatives Around the World (The World Bank, 2022)

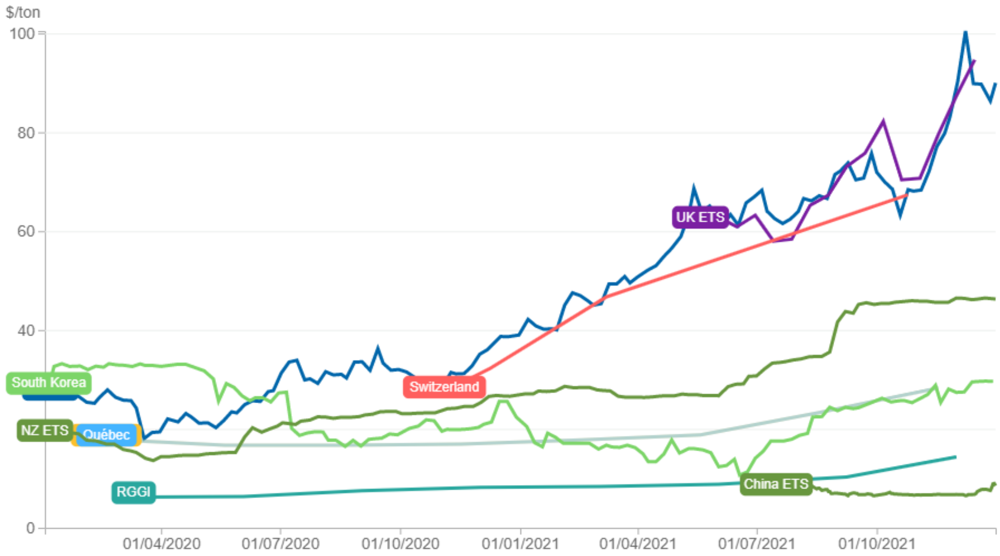

Figure 2.2 Allowance Prices of Various ETSs During 2020 and 2021 (ICAP, 2022)

2.2 Turkey's Position on Climate Change Policy

The important milestones in the Turkey's history of climate change policy and position are compiled and summarized in the Figure 2.3.

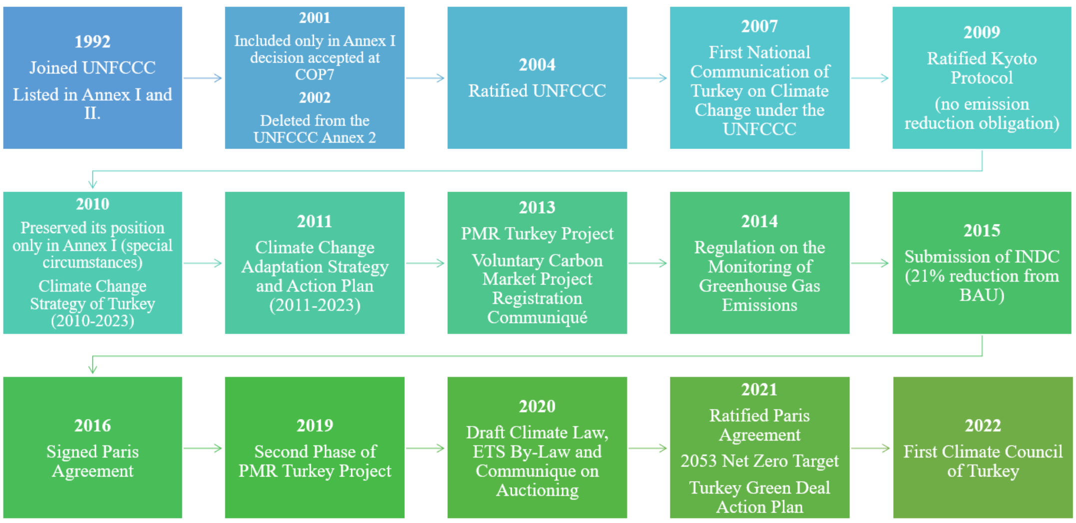

Figure 2.3 Milestones of Turkey's Climate Change Policy and Position

Source: Compiled by the author (Boer et al., 2020; Forestry, 2007; Ministry of Environment and Urbanization, 2010, 2011; Republic of Turkey, 2015a; Talu & Kocaman, 2019; United Nations, 1992)

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 and entered into force in 1994 (UNFCCC, 2022). Convention has following annexes (i) Annex I countries: OECD members, EU countries, countries in the transition process to a market economy; shall commit to take necessary measures to tackle climate change, reduce emissions and protect the resources: (ii) Annex II countries: OECD members and EU countries; shall provide financial resources and assistance to developing countries (United Nations, 1992).

As an OECD member, Turkey was placed in both Annex I and Annex II. Turkey negotiated its special conditions (insisted on not having historical responsibilities as compared to other developed countries in the Annex II) and these conditions are accepted officially in 2001, COP7 in Marrakesh. Following this decision, Turkey was deleted from the Annex II of the convention in 2002 and only remaining in Annex I (in a different position than remaining Annex I parties). Turkey became a party to UNFCCC in 2004 and ratified the Kyoto Protocol in 2009. The special conditions of Turkey were confirmed once more in COP16, 2010 in Cancun and continue to be included only in Annex I. As being an Annex I country, Turkey did not receive finance from Green Climate Fund but did not have any emission limitation commitment either. Within the responsibilities of being an Annex I country and a party to Kyoto Protocol, Turkey prepared its climate change strategy, action plan and required reports to be submitted to UNFCCC Secretariat such as national communication on climate change, emissions inventory (United Nations, 1998).

INDC of Turkey, in which up to 21% GHG emissions reduction from the business-as-usual level by 2030 is proposed, was submitted in 2015 (Figure 2.4). Policies on energy, industry, transport, buildings, transformation, agriculture, waste and forestry are presented to achieve the stated target (Republic of Turkey, 2015a). Turkey’s target is stated as critically insufficient by Climate Action Tracker and found as not realistic in academic studies (Climate Action Tracker, 2021; Kat et al., 2018).

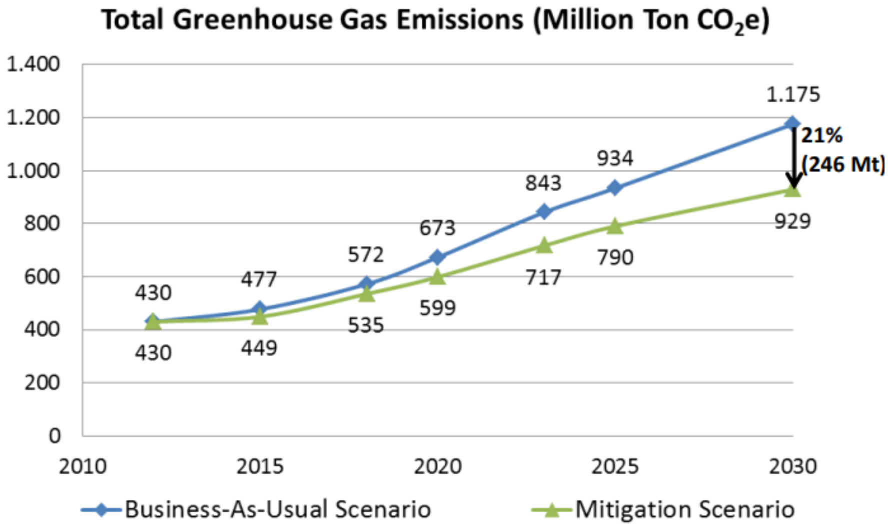

Figure 2.4 INDC of Turkey (Republic of Turkey, 2015a)

2.2.1 PMR Turkey Project

In 2011, Turkey became a member of PMR Partnership Assembly and in the end of the same year, Turkey completed the bilateral signing for PMR proposal. In 2013, proposal of Turkey was shared with all stakeholders and PMR Turkey project started that year. Studies and trainings about monitoring, reporting and verification (MRV) of GHG emissions were carried out between 2014 and 2016. During this time, sectoral pilot MRV studies were conducted, analytical reports about the roadmap for an ETS and assessments about emission reduction policies were prepared. In 2017, with the participation of real sector representatives, meetings about carbon pricing and sectoral impacts were carried out. Second analysis about various market-based policy options was conducted. Communication and awareness-raising activities such as Climate Change Summit, Communication Workshop and Media Training were coordinated in 2018. Moreover, carbon leakage risk was evaluated within the scope of the project, a closure conference related to the results of the assessment was carried out and an analytical report of the conference was published in 2018. Also, the analytical report related to fiscal and sectoral effects of carbon pricing was published and first phase of the project was finished at the end of 2018. In 2019, second phase of PMR started and studies about the ETS simulation (Turksim), cap and allocation determination were conducted. Additionally, legal base of ETS was started to be drafted. Turksim was launched in the 2019 UN Climate Change Conference of the Parties in Madrid (COP25). Views of all stakeholders of a possible carbon pricing mechanism in Turkey were taken through stakeholder meetings held during 2020. Studies about the ETS registry system, Paris Agreement Article 6 mechanisms, gap analysis about the existing regulations and carbon pricing communication strategy were conducted in in the same year. Later, drafts of Climate Change Law, ETS By-Law and Communique on Auctioning was prepared and opened for the opinion of stakeholders and public views (Boer et al., 2020; Ministry of Environment and Urbanization, 2020).

Although there is no announced political decision yet, one of proposed policies as a result of Climate Council is about the introduction of Turkey's national carbon pricing mechanism and with the help of PMR Turkey, ensuring technical readiness for an appropriate carbon pricing mechanism.

2.2.2 Voluntary Carbon Markets in Turkey

The voluntary market includes projects which are independently verified, and generated carbon credits can be purchased globally by individuals and companies. Although Turkey currently does not have any compliance carbon market, Turkey has been hosting projects traded in the Voluntary Carbon Market since 2005 (Ministry of Environment Urbanization and Climate Change, 2014). The Voluntary Carbon Market Project Registration Communiqué of Turkey regarding the registration projects and monitoring of obtained carbon certificates from projects in the Voluntary Carbon Market entered into force on October 9, 2013.

Projects traded in the Voluntary Carbon Market are evaluated and credited mostly under three standards: Gold Standard, Verified Carbon Standard (Verra, VCS), Global Carbon Council (GCC). Current status of the projects in Turkey as of April

2022 is summarized in the table below. The annual emission reduction of 224 active projects whose crediting period still continues is approximately 19 million tCO_2e.

Table 2.1 Projects in Turkey under Voluntary Carbon Market

Standard	Submitted Project		Certified and Active Projects/	
	#	Annual Emission Reduction (tCO_2e/year)	#	Annual Emission Reduction (tCO_2e/year)
Gold Standard	299	Not published	122	10,805,847
VCS	164	14,232,011	110	8,239,078
GCC	26	1,082,851	2	77,249
Total	**489**	**-**	**224**	**19,122,174**

Source: Compiled by the author (GCC, 2022b, 2022a; Gold Standard, 2022a, 2022b; Verra, 2022)

2.2.3 Green Deal Action Plan of Turkey

Due to important trade relationship with European Union, Turkey is closely following the developments in the EU. Following the European Green Deal, under the coordination of Ministry of Trade, Green Deal Working Group is created with the participation of other ministries. This group carried out several technical meetings, sectoral consultations, high level diplomatic meetings. After European Commission announced the adoption of Fit for 55 package in 14 July, 2021, Green Deal Action Plan of Turkey (prepared by Ministry of Trade) was published on July 16, 2021. This plan is important in terms of the transformation of the industry and maintaining the competitiveness of sectors in the international area while ensuring a sustainable growth (Ministry of Trade, 2021). Within this context, action plan includes nine main subjects given below:

- Carbon border adjustments
- Green and circular economy
- Green finance
- Clean, affordable, and secure energy supply
- Sustainable agriculture

- Sustainable smart mobility
- Combating climate change
- Diplomacy
- Information and awareness-awareness raising activities

Under those main policy areas, 32 objectives and 81 actions are described. The objectives of the action plan aim to promote the transition to a sustainable and efficient economy in line with Turkey's development goals so that Turkey does not lose its global competitiveness and can take place in new markets (Ministry of Trade, 2021).

As it is closely related with the subject of this thesis, actions stated under the carbon border adjustment item are given below. This thesis contributes to the first action by studying the effects of CBAM on carbon-intensive sectors.

- The impacts of CBAM on the energy- and resource-intensive sectors will be modelled with different scenarios and necessary sectoral actions will be determined.
- For the sectors under CBAM, sectoral and country-wide roadmap for promoting the emission reduction will be prepared.
- Establishment of a carbon pricing mechanism in Turkey and also supportive mechanisms (about additional cost burden) for sectors will be evaluated.
- The position of the country on carbon pricing will be shaped by considering EU CBAM and Turkey’s studies on national carbon pricing mechanism.
- Existing system on monitoring of GHG emissions will be reviewed and improved when necessary.
- The methodology and standards to be determined by the EU will be followed closely, studies for certification activities will be carried out within this scope and technical support regarding reporting will be provided.

2.2.4 Latest Development on Turkey's Climate Change Efforts

Turkey announced its 2053 Net Zero Emission Target at the 76th session of United Nations General Assembly held in New York on September 27, 2021. Following this target, the "Proposal Regarding Approval of the Paris Agreement" on October 7, 2021, was unanimously accepted in the Turkish Grand National Assembly and the Paris Agreement entered into force as of November 10, 2021 in Turkey (Turkish Presidency, 2021b). Following this decision, name of the Ministry of Environment and Urbanization is changed into "Ministry of Environment, Urbanization and Climate Change", and Climate Change Presidency under the ministry and Climate Change Adaptation Board including other ministries and institutions are established. (Turkish Presidency, 2021a).

Ministry of Environment, Urbanization and Climate Change (MEUCC) and the United Nations Development Programme (UNDP) will be working together to establish the long-term climate change strategy of Turkey and the related action plan to achieve net zero target was announced in December 2021. Studies regarding the revision of the nationally determined contribution also started during this time. Aim is to complete the strategy document until the end of 2022 (UNDP, 2021).

After becoming a party to the Paris Agreement, Turkey has announced the initiation of green transformation, in line with net zero emission target. In this context, all departments (central and provincial) of the MEUCC gathered together in a consultation meeting with the theme of "Turkey on the Road to Green Development" in the first week of February 2022. The closing declaration of the meeting highlights that emission reduction, adaptation, regulations and disaster prevention will be the main areas of climate change efforts of Turkey (Ministry of Environment, 2022).

Apart from the internal meetings of the ministry, actions were set to form a Climate Council to include the views of stakeholders on this multilateral issue. The first Climate Council of Turkey was held in Konya between 21-25 February 2022 with the main theme "2053 net zero emission target: Turkey's green development revolution" by the MEUCC. The working groups of the Council were formed for the seven areas listed below to present Turkey's new climate change vision and green transformation in a participatory manner and to contribute to the Turkey's green transformation roadmap:

1. GHG Reduction-1 (Energy, Industry, Transportation)
2. GHG Reduction-2 (Agriculture, Waste, Buildings, Sink Areas)
3. Science and Technology
4. Green Finance and Carbon Pricing
5. Adaptation to Climate Change
6. Local Authorities
7. Migration, Just Transition and Other Social Policies (Ministry of Environment Urbanization and Climate Change, 2022a)

In the opening speech of the council, Minister of the Environment, Urbanization and Climate Change stated that the decisions of the commissions would be reflected in the Climate Law whose preparations still continue. The opening remarks also stated that the climate support package of 3 billion 157 million dollars, which was agreed upon as a result of international negotiations, would be used within three years in all sectors supporting green development. The declaration announced aftermath of the council includes 217 policy recommendations, 76 of which were identified as high-priority (Ministry of Environment Urbanization and Climate Change, 2022b). Some of those recommended policies which are related with the subject of this thesis study are given below:

- Within the framework of the 2053 net zero emission target, the long-term shares of the manufacturing industry sector and sub-sectors should be determined, and projections should be made. In addition, sectoral road maps and support mechanisms should be established to reduce GHG emissions in the industry, especially in carbon-intensive sectors.

- It has been decided to accelerate the efforts for the establishment of the ETS. It is stated that the studies for the implementation of the ETS should be completed in 2024 and that the pilot process, which will take at least one year, should be started in 2024, considering the EU's CBAM calendar.
- For the activities within the scope of the Regulation on GHG Emission Monitoring, ETS phases should be implemented gradually in 5-year periods. The expansion of the scope should be evaluated by considering national and international climate policies.
- For current carbon prices globally and for the EU's CBAM, economic, financial, social, and technical impact analysis regarding the sectors should be made, considering the risk of carbon leakage in the to be established ETS.
- All of the auction revenues to be generated from the national ETS should be used in a way that will ensure a fair transition to a low carbon economy in line with the updated NDC and in line with the green development objectives. At least 50% of the aforementioned revenues should be allocated to support activities aimed at reducing greenhouse gas emissions, primarily modernization and innovation-oriented activities aiming at the green transformation of the real sector.
- A clear target date to exit from the coal was demanded by young climate ambassadors and many non-governmental organizations during the council meetings. However, the council declaration states that "in order to reduce emissions from coal electricity generation without hindering Turkey's right to economic and social development, studies including supply security, macro-economic and social effects should be carried out and a road map should be determined".

2.3 Climate Change Policy Developments in European Union

European Union presented its long term vision and commitment to achieve net zero emissions by 2050 in 2018 via "A Clean Planet for all" strategy (European Commission, 2018). After almost one year, on November 19, 2019, EU announced that it would follow a concrete and binding route within the context of tackling climate change and disclosed the EGD. EGD outlines the new industrial policy and economic growth strategy of the European Union. It aims to enrich the target of making the European continent climate neutral by 2050, to increase 2030 climate ambition, to protect industry and employment within the EU, and to make EU an effective player in reducing global GHG emissions.

EU alone would not be able to stop global warming, as the phenomenon is a global issue and international cooperation is needed. EGD aims to affect partners or neighbors of EU for a sustainable growth road map and a just transition. Fundamental policies that are needed to fully deliver the EGD are given in the Figure 2.5.

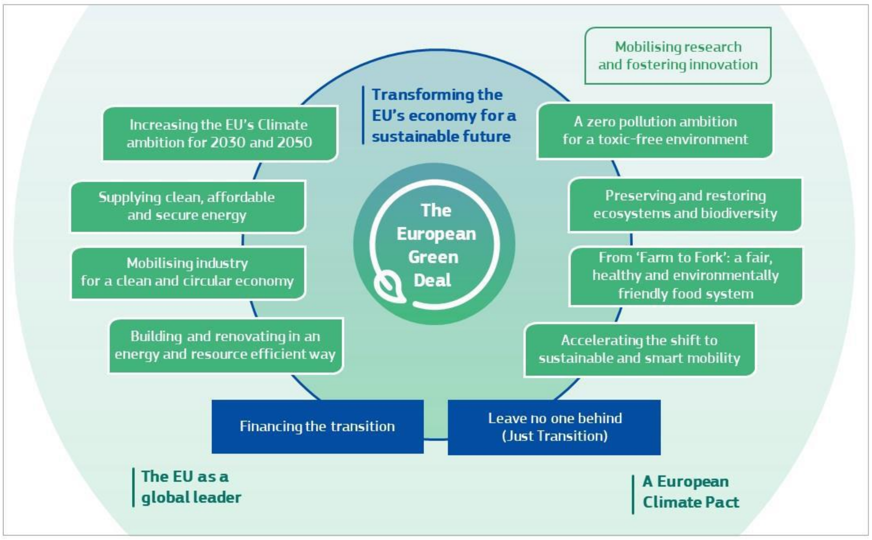

Figure 2.5 The European Green Deal (European Commission, 2019c)

Figure 2.5 indicated that policies (new or renewed) in almost all areas such as food, industry, transport, etc. are needed to achieve the objectives of EGD. Within the scope of increasing 2030 and 2050 ambition levels of EU, one major issue emphasized is that, as the differences among the countries worldwide exist, the carbon leakage risk will continue for EU industries, therefore a carbon border adjustment is to be proposed to protect the competitiveness of the EU. In addition, within the scope of transforming industry, steel and cement sectors are stated as the vital sectors for the economy of EU due to their supply role in various value chains. Therefore, decarbonization of these sectors would be important to mobilize all value chain and industry in general. (European Commission, 2019c).

24% reduction in GHG emissions is achieved in EU between 1990 and 2019 while the cumulative growth rate of the EU economy during this period was 60%. Here, one observes that decoupling growth from emissions is possible to achieve when the regulatory framework is well set and there are roadmaps for the industry. To enrich this decoupling, European Climate Law, published in 2021, presented the regulatory framework for the 2050 net zero target of EU and made it legally binding. Additionally, intermediate target of reducing emissions at least by 55% by 2030 (as compared to 1990) is included in the law (European Commission, 2021h). By referring to this 55% reduction target, EU presented Fit for 55 package which includes proposals to ensure legislation is in line with the climate goals of EU. Proposals of the packages include:

- Emission Trading System,
- Emission reduction targets of member states,
- Carbon border adjustment mechanism,
- Emissions and removals from LULUCF,
- Renewable energy,
- Energy efficiency,
- Alternative fuels infrastructure,
- CO_2 emission standards for cars and vans,
- Energy taxation,
- Sustainable aviation fuels,

- Greener fuels in shipping,
- Social climate fund (Council of the European Union, 2021).

The changes proposed to the EU ETS aim to achieve 61% reduction by 2030 as compared to 2005 in the ETS covered sectors. Phase out of free allocations for aviation and also for sectors to be covered by CBAM is proposed as well (Council of the European Union, 2021). A CBAM, to prevent the imports of carbon intensive products to EU, and relocation of production to countries with less stringent regulations and as a result, increasing emissions globally although emissions in EU are decreased. As in compliance with WTO rules, CBAM is presented as the new mechanism of EU to address carbon leakage risk. EU ETS was addressing this risk through free allocation of allowances under EU ETS and compensations for electricity costs. But these are not permanent solutions to this risk, and they do not provide the necessary signal to further abate emissions and to make investments as compared to full auctioning. Emission allowances under EU ETS are allocated to companies through auctioning unless they are not at risk of carbon leakage. If they are, allowances are allocated for free to those sectors (European Commission, 2021g). Total GHG volume of all sectors is limited by a cap on the number of allowances. Companies can also trade allowances within the cap (European Commission, 2021e). The working mechanism of EU ETS is presented in the Figure 2.6.

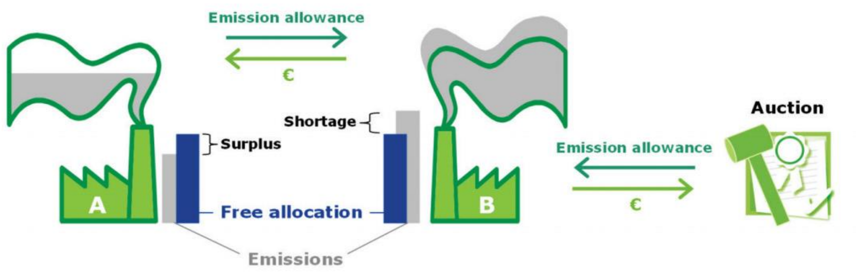

Figure 2.6 Working Mechanism of EU ETS (ECA, 2020)

Currently, EU ETS is in the fourth phase covering the period of 2021-2030 in which the cap has an annual reduction factor of 2.2% and almost 57% of the cap is auctioned while the remaining part is allocated for free. Free allocation for the installations is calculated based on the benchmark values, sectoral carbon leakage risk and the level of historical activity. Annual allocation of allowances is calculated with the following equation:

$$F_{p,k} = BM_p * HAL_p * CLEF_{p,k} \qquad \text{(Eq. 2.1)}$$

where;

$F_{p,k}$: Annual allocation for product p in year k (EUA/year),

BM_p : Product benchmark value of product p (EUA/unit of product),

HAL_p : Historical activity level for product p (unit of product),

$CLEF_{p,k}$: Carbon leakage exposure factor for product p in year k (European Commission, 2019b).

Updated benchmark values for products which serve as the base for free allocation published in 2021 and covers values valid for the 2021-2025 period. Corresponding benchmark values for cement and iron-steel sector are given in the table below.

Table 2.2 Benchmark Values of Cement and Iron-Steel Sectors

<table>
<tr><th>Product</th><th>Benchmark Value for 2021 - 2025</th><th>Unit</th></tr>
<tr><td>Coke</td><td>0.217</td><td rowspan="5">tCO_2e/t product</td></tr>
<tr><td>Sintered ore</td><td>0.157</td></tr>
<tr><td>Hot metal</td><td>1.288</td></tr>
<tr><td>EAF carbon steel</td><td>0.215</td></tr>
<tr><td>EAF high alloy steel</td><td>0.268</td></tr>
<tr><td>Fuel benchmark</td><td>42.6</td><td rowspan="2">tCO_2e/TJ</td></tr>
<tr><td>Heat benchmark</td><td>47.3</td></tr>
<tr><td>Grey cement clinker</td><td>0.693</td><td rowspan="2">tCO_2e/t product</td></tr>
<tr><td>White cement clinker</td><td>0.957</td></tr>
</table>

Source: (European Commission, 2021d)

Although allocation of allowances freely prevents the risks of carbon leakage, carbon price signal is weakened due to it as compared to full auctioning. The other measure is to provide incentives for indirect electricity costs. As EU has ambitious targets for 2030 and 2050, CBAM as part of the Fit for 55 package is proposed as the new measure to prevent carbon leakage risk. Phase in and out of CBAM and free allocation will go concurrently and gradually, so that traders will get used to the new implication (Figure 2.7). Until the complete phase out of free allocations, CBAM will also reflect the free allocations in the certificates as in EU ETS (European Parliament, 2021).

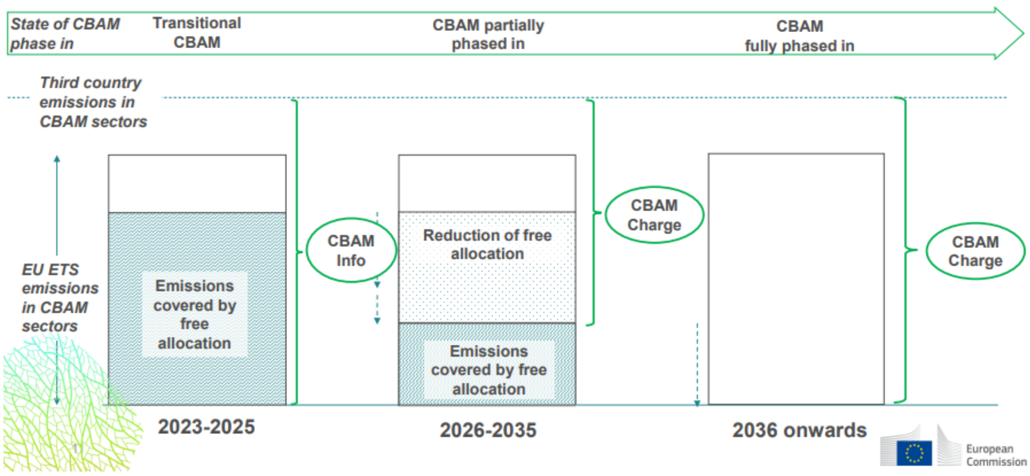

Figure 2.7 Phase-in and Phase-out of CBAM and Free Allocations Stated in the First CBAM Proposal (European Commission, 2021c)

While the process of proposals continues, a draft report on the CBAM proposal is published and it highlighted one more time that ultimate aim with the CBAM is the complete replacement of free allocations is aimed with CBAM. In this report, definition of embedded emissions and coverage of CBAM are expanded, duration of pilot period decreased. Main differences are summarized in Table 2.3.

Table 2.3 CBAM Proposal in Fit for 55 Package and Draft Report on CBAM Proposal

Proposed Subject	**CBAM Proposal 14.07.2021**	**Draft Report on Proposal 21.12.2021**
Transitional Period	2023-2025	01.01.2023-31.12.2024
Embedded Emissions	Direct emissions released during the production of goods	Direct and indirect emissions released during the production of goods and its upstream products
Sectors	Cement Electricity Fertilisers Iron and steel Aluminium	Cement Electricity Fertilisers Iron and steel Aluminium Chemicals Polymers
Free Allocation Phase-out Period	2026-2035	01.01.2025-31.12.2028
CBAM Factor[4]	-	For sectors except cement: 90% in 2025 70% in 2026 40% in 2027 0% by the end of 2028 For cement sector: 0% as 01.01.2025

Source: (Committee on the Environment Public Health and Food Safety, 2021; European Commission, 2021g)

European Commission published a communication in March 2022 titled "European Growth Model: Towards a Green, Digital and Recilient Economy" which outlines the reforms and investments that are needed to deliver the EGD and to reach the objectives of EU while strengthening the resilience economically and socially. Communication states that annual investments need to be increased to €520 billion

[4] A factor reducing the free allocation of allowances (Committee on the Environment Public Health and Food Safety, 2021)

per year, €390 billion for decarbonization efforts and €130 billion for other environmental efforts (European Commission, 2022c).

In March 2022, Council of the European Union published draft regulation about CBAM. As in the previous texts related CBAM, the draft highlights that, in order not to have more favorable treatment for products in EU than the imported products, there will be a transition phase in which free allocation of allowances and CBAM will be combined and applied transitionally. CBAM certificates will be issued to reflect the free allocation of allowances (considering benchmark values used in EU ETS-Table 2.2) for the goods under CBAM (Table 2.4). Any date regarding the fully phase out of free allowances and fully phase in of CBAM is given in this draft regulation. While CBAM phases continue progressively, free allowances will be phased out (Council of the European Union, 2022). In this latest draft, a minimum threshold, €150 per consignment, is introduced so as to avoid excessive burden. Under this threshold, CBAM will not be applied.

Table 2.4 Goods under CBAM in the Draft Regulation of 15.03.2022

CBAM Proposal	**HS Code**	**Greenhouse Gas**
Cement	252310 – 252321 – 232329 - 252390 252330 - addition in this draft	CO_2
Electricity	271600	CO_2
Fertilisers	280800 – 283421 – 3102 – 3105 (except 310560) 2814	CO_2 and N2O CO_2
Iron and steel	72 (except 7202 and 7204) 7301-02-03-04-05-06-07-08-09-10-11 7326 - addition in this draft	CO_2
Aluminium	7601, 7603-04-05-06-07-08 7609-10-11-12-13-14 – 7616 - addition in this draft	CO_2 and PFCs

Source: (Council of the European Union, 2022; Committee on the Environment Public Health and Food Safety, 2021; European Commission, 2021g)

In this latest draft, a minimum threshold, €150 per consignment, is introduced so as to avoid excessive burden. Under this threshold, CBAM will not be applied.

As stated, there is an absolute cap for installations, but CBAM would not have any cap for imported goods in order not to limit the trade flows. Carbon cost applied for the imported goods will be equivalent of costs that would be generated if these products were treated under EU ETS. Also, EU ETS price will be reflected on CBAM on weekly basis so as to ensure it as an effective measure that prevents carbon leakage (Council of the European Union, 2022).

The draft states that during the transition period (starting from 2023, until 2025) of CBAM, following data should be reported by the importer and no financial adjustment will be on place in that period:

- total quantity of imported goods,
- total embedded emissions (direct emissions as a result of production),
- total indirect emissions (emissions from generation of electricity that is used during the production),
- carbon price due for embedded emissions in country of origin (Council of the European Union, 2022).

On May 17, 2022, Committee on the Environment, Public Health and Food Safety of European Parliament voted on CBAM and stated their official position including below main points:

- include not only direct emissions but also indirect emissions at the beginning for sure,
- extend the sectoral coverage with organic chemicals, polymers and hydrogen,
- phase out of free allowances gradually between 2026 and 2030,
- full implementation including all EU ETS sectors by 2030 (European Parliament, 2022).

Following this vote of the environment committee, EU Parliament will vote on the CBAM within 2022 and as a result of this session, it will be clear how CBAM will operate. As seen from all these developments in EU, there is a strong determination on reaching the climate objectives and the EU to have international leadership on climate ambition. One objective frequently mentioned is that international efforts and cooperation among partners are needed to achieve Paris Agreement goals and to fight climate change. As one of the Turkey’s most important trading partners, developments in EU triggers the ambition in Turkey and also in the world.

CHAPTER 3

LITERATURE REVIEW

Climate change continues to be one of the most significant problems globally. International cooperation and action are needed to tackle with it and to keep global temperature rise below the stated limits (1.5°C by 2100). Unilateral policies are not enough to achieve the needed emission reductions and differences in climate policies and carbon prices of countries lead to competiveness and leakage risks. To adress and eliminate these risks, measures are necessary and the effectiveness of these measures and effects on the countries found an important place on the literature.

In this regard, this chapter presents a literature review about the three main topics and organized as follows. First, literature about the use of social accounting matrices and the multiplier analysis is reviewed and presented. Next, studies about the effects of different carbon pricing mechanisms in Turkey's economy and sectors are discussed. In this section, other than the carbon pricing, emission reduction projections, climate policies' effects and decarbonization strategies of Turkey are also mentioned. The last part focuses on the carbon border adjustments, evolution of it until the EU's proposed CBAM and on the effects of CBAM.

3.1 Literature Review on Social Accounting Matrices and Multiplier Analysis

A social accounting matrix (SAM) is a flexible, comprehensive, square matrix data system which reflects the relations, linkages and interdependencies within socio-economic system (Defourny & Thorbecke, 1984; Pyatt & Round, 1985; Pyatt & Thorbecke, 1976; Round, 2003; Thorbecke, 2000, 2003). SAM can be used as the database of SAM multiplier analysis and computable general equilibrium (CGE) models (Round, 2003; Thorbecke, 2003). Both direct and indirect impacts of an exogenous shock on the economy, e.g., increase in demand, change in exports, can be identified through SAM multiplier analysis (Thorbecke, 2000). Early studies of SAM multiplier analysis were carried out for Sri Lanka (Pyatt & Round, 1979), South Korea (Defourny & Thorbecke, 1984), Indonesia, Vietnam, Ghana during the last quarter of the 20th century (Round, 2003).

First SAM studies for Turkey are carried out for the year 1973 (Dervis et al., 1982; Şenesen, 1991). However, these attempts did not include some key dimensions such as income distribution, household surveys etc. De Santis & Ozhan (1997), Karadag & Westaway (1999), Yeldan & Köse (1996) generate more detailed and comprehensive SAMs for the year 1990 (De Santis & Ozhan, 1997; Karadag & Westaway, 1999; Yeldan & Köse, 1996).

Telli (2004) generates Turkish aggregated SAMs with an assembly-line system for all years starting from 1996 to 2003 through a practical, flexible, and consistent way. A comprehensive methodology is presented for all accounts of SAM and how to ensure harmonization of government accounts, balance of payments accounting system, national income accounting and input-output (I-O) accounts with SAM is analyzed and presented in detail (Telli, 2004). Erten (2009) followed a similar path and developed a methodology to create sectorally disaggragated SAMs for Turkey's 1998-2006 period. Two different I-O tables of Turkey (1998 and 2002) are used in SAM series, instead of using one-year I-O table to better represent the developments in economic dynamics and to be able to reflect those dynamics to other years that do not have an I-O table through time-dependent function structures (Erten, 2009).

A two-regional (west and east) SAM of Turkey for 2002 is created in Eda (2011) and multiplier analysis is applied to examine various shocks of regional effects of export demand, increase in rural production and household income increase (Erdoğan, 2011). Gök and Karadağ (2013) also generates SAM of Turkey for the same year using 2002 I-O table as the basis and in order to be able focus on the analysis of household's welfare and distribution of income in which the SAM is disaggregated into ten household accounts (Gök & Karadağ, 2013).

Şenerdem (2013) follows the methodology of Telli (2004) and Erten (2009) and generates SAM of Turkey for the year 2010 although latest released I-O table was available for 2002. SAM multiplier analysis is used to analyze the effects of a reform in the electricity sector. By using unconstrained SAM multiplier analysis, weights of different sectors (in terms of GDP, output, and demand) in the economy are evaluated. Electricity sector which provides an important input for the other sectors is analyzed in detail and the results show that unconstrained multipliers of electricity sector are larger than the other sectors due to its strong linkages with the rest of the economy. By analyzing all multipliers of the electricity sector, the study shows that a unitary exogenous demand shock would lead to almost seven times the amount of this shock in the whole production of the economy. Later, constrained multiplier analysis in which supply is not unlimited (better reflects the situation in Turkey since supply of electricity is inelastic and it is hard to meet the increase in demand easily) is carried out with four cases: constant supply of electricity either with endogenous private investments or with endogenous government expenditures; exogeneous supply of electricity and endogenous exports; fixed supply of coal, oil, natural gas and electricity and endogenous private investments. When supply is constrained, positive effects of the increased electricity demand shock would be limited comparing to unconstrained case and not only electricity sector but all sectors would be affected from those limitations in supply (Şenerdem, 2013).

Latest published I-O table of Turkey is for the year 2012, therefore the recent SAM studies takes 2012 I-O table as their basis. Alkan et al. (2018) creates an environmentally extended SAM for 2012 and analyzes the effectiveness of Turkey's National Climate Change Action Plan (NCCAP) and Turkey's INDC document submitted in 2015 in terms of reduction in emissions. Alternative policies to reach the targets of INDC are proposed and the results show that it is impossible to reach those targets with policies stated in NCCAP and INDC (Alkan et al., 2018).

Karapınar et al. (2019) generates the 2012 SAM, defines emissions as a factor (valued at 7.5 USD/tCO_2e) and links carbon tax and ETS into SAM. By using the proposed SAM as a database, CGE modeling is carried out to examine the effects of ETS and carbon tax in Turkey. Given the fact that over-optimistic assumptions for the growth of GDP is used in Turkey's 2015 INDC; a more realistic scenario for 2030 is created and that a carbon pricing would be required to reach the reduction target is illustrated. ETS is found as a better mechanism than carbon tax with stronger economic growth, higher welfare of households and lower rate of unemployment (Karapinar et al., 2019).

Some of the studies in the literature uses the latest 2012 I-O table but generates updated SAMs for the upcoming years using up to date data such as growth rates, GDP and/or national income accountings. Karaca (2018) developes the 2012 SAM, updates it to 2016 SAM by using domestic product growth rate and analyzes the effects of an exogenous increase on exports shock (1% of GDP) with SAM multiplier analysis. 0.24% of GDP increase in agriculture and 1.78% of GDP increase in the production of industry and services are found as the results of the increase in exports (Karaca, 2018). Acar et al. (2021) generates 2018 SAM through expansion of the disaggregated input-output data with current macro-level data (Acar et al., 2021). Study of this thesis will follow a similar pathway to generate 2019 SAM of Turkey.

3.2 Literature Review on the Effects of Carbon Pricing in Turkey and on the Decarbonization Pathway of the Country

Economic impacts of emission reduction policies in compliance with the Kyoto Protocol and different abatement policies that can be applied in Turkey are evaluated for 2006-2020 period by Telli et al. (2008) using a CGE model. Interventions implemented in the study were quota-based instruments and taxation with and without abatement investments. The study finds that 36.8% decrease in GDP by 2020 is expected under the 60% direct emission quota over 2006-2020 and burden of CO_2

taxation accompanied with the quota equals to 20% to the GDP. Additionally, under the energy taxation scenario, GDP decreases by 8.8% while emissions decrease by 25.8% if 20% energy tax is implied by 2020. It is underlined that in order to reduce the burden of taxation on production sectors, outputs and on the employment, various incentives on the current taxes such as reduction of taxes on employment and using revenues of energy or emission taxation to support the sectors (agriculture, coal mining, petroleum and gas, petroleum, electricity, cement, paper, iron-steel, transportation, remaining manufacturing sectors and services) would be needed (Telli et al., 2008).

Turkey had a post-Kyoto vision on creating an ETS stated in the 2011-2023 National Climate Change Action Plan. Akın Olçum & Yeldan (2013) examines the economic impacts of different ETS regimes such as a national ETS and an ETS linked with EU ETS with for 2020. The results illustrate that welfare losses in Turkey would have the tendency to decrease as EU increases its target on emission reduction when there are policies for domestic abatement. Additionally, Turkey would face with efficiency losses at an increasing rate as the target of emission reduction increases from market segmentation because there is an increase in total compliance cost to reach the same cap. The authors state that if Turkey participates in the EU ETS and imports permits in the market, an expansion in the energy sectors and in the carbon-intensive sectors would be the case since burden of abatement cost of Turkey would be also on EU under the 20-20-20 emission target of EU (Akın Olçum & Yeldan, 2013).

Voyvoda et al. (2015) examines the Turkey's responsibility to the fight against climate change in terms of emission reduction and required policies within the scope of 2°C temperature target. Below given three policy instruments are identified within "Climate Policy Package" scenario and potential impact of these policies on macroeconomic indicators are analyzed:

- A carbon tax is introduced.
- Collected carbon tax is used to generate electricity from renewable energy sources (through a renewable investment fund).

- Autonomous increases in energy efficiency, without any additional efficiency policy, just depending on market conditions and technological developments, is observed.

This study finds that if “Climate Policy Package” is applied, it is possible to have CO_2 emissions (506 $MtCO_2$) 23% below the business as usual (BAU) scenario and reduce the carbon emission intensity of the economy (annual CO_2 emissions/GDP) by 20%. The package takes into account a significant shift in energy use from natural gas and coal to renewable resources (solar and wind). With this transition, the expectation is that coal imports will decrease by 25% and natural gas imports by 35%, compared to the reference scenario (Yeldan et al., 2015).

The impacts of taxation (if Turkey introduces a carbon tax based on polluter pays principle) in Turkey are analyzed by Yeldan et al. (2016). Tax burden of Turkey to achieve INDC target of 21% reduction by 2030 is calculated as 4.62% of its national income. This would lead to production decreases especially in carbon intensive sectors and a loss of 8.7% is expected in the national income by 2030 as compared to the reference scenario. If the strategy is designed only for taxation of energy, then it would be costly for the whole economy. Therefore, “neutral taxation” approach (through reducing employment taxes) is introduced as an alternative scenario in order to optimize losses in sectoral production. It is seen under this scenario that the loss in national income by 2030 would be 3.7%, a smaller loss compared to base path scenario while increasing employment (Yeldan et al., 2016).

Impacts of an ETS, including nuclear and renewables, and no-nuclear scenario, are examined and BAU emissions 30% lower than the Turkey’s INDC is found in Kat et al. (2018). The study indicates that ETS would result in emission reductions and minimize the negative effects on growth rates. The study also provides projections for the carbon price to meet the emission reduction targets, i.e., \$50/tCO_2 and \$70/tCO_2 in 2030 with and without nuclear power, respectively.

Alkan et al. (2018) assesses the emission reduction levels of policies stated in the Turkey's INDC and National Climate Change Action Plan and finds that only 3.2% emission reduction can be achieved with the submitted INDC policies. Here, it seems impossible to reach the submitted emission target with these policiess.

Another study that analyzes the possible economic and environmental impacts of carbon taxation in Turkey is Aydın (2018). The results of the CGE model proposed in this study indicates that the carbon taxation (7, 20 and 35 USD per ton of carbon) would effectively reduce emissions while decreasing the GDP, i.e., 35 USD per ton of carbon scenario would decrease the emissions by 17% while GDP decreases by 0.328% and 8.3 billion USD revenue will be generated. The recommendations in this study is to use this revenue to ease the negative effects of taxation of household welfare and to finance the technological transformation of sectors in line with low-carbon development (Aydın, 2018).

Şahin et al. (2022) is the first study which reveals the decarbonization pathway of Turkey and frames the elements of transformation Turkey's economy should go through to achieve net zero in 2050. This report is one of the science-based climate policy discussions regarding Turkey's new emission reduction path and the roadmap for required transformation. In the study, to reach the 1.5-degree target, the share of Turkey (7.95 $GtCO_2$) from the remaining global carbon budget (580 $GtCO_2$) in accordance with the principle of fair sharing and equity is calculated and it is foreseen that the cumulative emissions in the Net Zero Scenario (NZS) will remain within the limits of Turkey's carbon budget[5]. The study implies that in NZS, CO_2 emissions from all sectors decrease by 32% in 2030 to 287 million tons, and in 2050 to 132 million tons with a decrease of nearly 70% when process emissions from

[5] In the Net Zero Scenario, cumulative CO_2 emissions resulting from energy consumption between 2018 and 2050 remain below Turkey's carbon budget (7.95 $GtCO_2$) determined on the basis of fair sharing and equity, with 7.4 $GtCO_2$. However, when the industrial process emissions, which have limited intervention options for emission reduction, are included, the cumulative emissions increase to 9.4 $GtCO_2$, exceeding Turkey's carbon budget (Şahin et al., 2022).

industry are included (in the baseline scenario, 700 $MtCO_2$ is predicted in 2050). The residual emission level in 2050, when industrial processes are not included, decreases by 80% compared to the 2018 level and reaches to 74 $MtCO_2$ and falls 43% below the 1990 level. 15 $MtCO_2$ of residual emissions would be due to the electricity sector and emissions from buildings would reach to net zero, while the largest part of the total residual emissions in 2050 comes from industrial processes. Also, the largest part of the residual emissions from energy consumption comes from industry and transportation. According to the results of this study, Turkish economy can be decarbonized to a large extent within 30 years by leaving fossil fuels, switching to renewable energy, energy efficiency and electrification in related sectors. Since electricity generation sector has the fastest reduction potential, it would be aimed to halve the emissions from the electricity sector by 2030. Emissions from energy consumption of industry and other production sectors can be reduced by 26% in 2030 and 67% in 2050, compared to 2018 levels. However, research and development studies on energy efficiency, electrification, new technologies, green hydrogen and CCSU are required to reduce emissions from industrial processes faster (Şahin et al., 2022).

3.3 Literature Review on the Effects of Carbon Border Adjustment Mechanism

Climate related policies to achieve emission reductions taken in some regions of the world would not guarantee a decrease in the global emissions for which one of the main reasons is known as the carbon leakage. It is a threat for global efforts to reduce emissions, for countries having ambitious policies, for the implication of international agreements (i.e. Kyoto Protocol, Paris Agreement) and also for international competitiveness of companies and countries (Babiker & Rutherford, 2005; King & van den Bergh, 2021). Fourth Assessment Report of the IPCC represented through which way carbon leakage may occur:

- Carbon-intensive production relocates in non-constrained countries,
- Lower demand for oil and gas leads to a decrease in price of those fuels internationally and consumption of those increases in non-constrained countries,
- Both income and demand of energy changes due to improved terms of trade (IPCC, 2007).

Babiker (2005) analyzes the level of carbon leakage under the Kyoto Protocol policies by considering relocation of industries, international trade on a wider perspective, economic of scales, etc. He finds that if most of the countries or regions are not included in global scale, it would not be possible to achieve intended emission reductions globally. For example, emission abatement efforts of OECD countries would lead to relocation of companies and have an increase on carbon-intensive production in non-OECD countries that do not have emission reduction targets and policies. A carbon leakage rate[6] of 130% is found under the case of decreasing OECD emissions which resulted in increased emissions globally due to relocation of industries away from countries with emission control policies (Babiker, 2005).

Various policy alternatives to tackle with carbon leakage, to provide a competitive market for all and to prevent relocation of companies are given below (Neuhoff, 2008):

- Free allocation of allowances and/or state aid,
- Border adjustments (in compliance with WTO requirements),
- Sectoral agreements led by governments.

Neufhoff (2008) mentions that international climate policy cooperation would be strengthened and also developing countries would be supported through carbon

[6] Babiker (2005) described the carbon leakage rate in a country/region having no emission reduction controls as its emissions change as a fraction of emission reduction by the countries/regions with emission control policies

border adjustments and using their revenues. Additionally, since the ambition of countries would increase as a result of those adjustments, because countries with no or less-ambitious climate policies are expected to have tendency to apply more ambitious policies and establish carbon pricing mechanisms or increase the carbon prices (Neuhoff, 2008).

Although one-sided domestic climate policies cannot force to price emissions on other countries, it is possible to support their domestic mechanism through border adjustments in order to eliminate carbon leakage and protect the competitiveness. Böhringer et al. (2012) finds that the negative effects on carbon-intensive production sectors of countries with carbon pricing mechanisms are mitigated and carbon leakage is decreased effectively through carbon border adjustment mechanisms. The study also indicates that including proses emissions in adjustment mechanisms generates more effective results compared to the case which includes only the fuel combustion emissions. Moreover, if revenues generated through border tariffs do not turn back to exporter countries (to cut existing labor taxes), then there would be quite negative distributional effects (Böhringer et al., 2012).

Another study about the assessment of various policies against carbon leakage are carried out by Fischer & Fox (2012). Following four policies complementing domestic climate regulation and/or carbon pricing mechanisms are assessed i.e., import tax, export rebate, full border adjustment and output-based rebating. Most effective policy is found as the full border adjustment (combined adjustment including following policies: import tax-embodied emissions of imports are priced and export rebate-embodied emissions in exports are rebated) (Fischer & Fox, 2012).

Tang et al. (2013) proposes a multi-sectoral recursive dynamic CGE model to examine the effects of border tax adjustments on international trade of China until 2030 under various carbon price scenarios ranging between 20-100 USD/tCO_2. A decrease in both imports and exports of China is seen under all scenarios. Although exports are affected directly (through cut in the level of exports price) while imports of China are affected indirectly, i.e., it is found that the imports would suffer more as compared to exports (due the effects on country's whole economy such as decrease in production, in demand etc.). Steel, cement, glass, non-metallic mineral products sectors are found as the most affected sectors (Tang et al., 2013).

Aldy (2017) approaches from a different perspective and focused on the possible risks and unfavorable results of anti-leakage policies such as carbon border tax, free allocations of allowances, output-based tax credits, subsidy for production, etc. Distributional, efficiency and international relations risks are the risks related to those competitiveness policies. Some of the stated risks of free allocation of allowances to carbon-intensive trading sectors include:

- not being able to use revenues that can be generated from those allowances (if not freely allocated) to other possible mechanisms such as supporting households, decreasing current labor or income taxes, supporting research and development for energy efficiency and emission reduction
- companies having free allocations may choose not to invest on clean production and just focus on efficiency improvements and follow a less ambitious emission reduction policy (Aldy, 2017)

After United States of America (USA) announced its withdrawal from the Kyoto Protocol (which means not to have obligations to limit emissions and not to contribute to emission reduction objectives), discussions about carbon border adjustments gained momentum. Moreover, a possible withdrawal of USA from Paris Agreement results in a similar reaction. Recently, increasing urgent need to cooperate globally to fight climate change and to create the same level for both domestic and foreign-based products in terms of emission policies, border adjustments started to be supported and encouraged more. Additionally, today it is easier to track emissions data, WTO-compatible options of border adjustments are studied more and there is positive acceleration in climate negotiations, therefore those current policy and legal framework makes border adjustment implications more possible (Mehling et al., 2019).

CBAM of EU firstly announced in the European Green Deal in 2019 without giving the details of the mechanism. Here the emphasis is that, to decrease the carbon leakage risk, an alternative measure which is a CBAM in compliance with WTO rules will be proposed by the European Commission (European Commission, 2019c). A resolution regarding the WTO-compatible EU CBAM is adopted by the European Parliament on March 10, 2021. It is stated that imports of EU correspond to more than 20% of the EU's CO_2 emissions (European Parliament, 2021). The findings of European Court of Auditors' (ECA) special report are also highlighted in the resolution that current measures in EU ETS (such as free allocation of allowances) did not promote the decarbonization well enough on certain sectors. It is mentioned in the ECA report that more than 40% of available allowances during the third and fourth phases of EU ETS were freely allocated instead of auctioning and this led sectors to slow the decarbonization process and instead of real decarbonization investments, sectors focused only on modernization, improving the efficiency of their process and continue to produce with fossil fuels (ECA, 2020). To achieve a decarbonized economy in EU and also to create an incentive for trade partners to decarbonize, a CBAM which complies with free trade agreements of EU, as well as with WTO requirements is advocated by the European Parliament (European Parliament, 2021).

Aşıcı (2021) examines the effects of CBAM as a part of EGD. The study was conducted before the resolution published in March 2021. He condusts an input-output analysis in a top-down approach and it calculates that cost of CBAM to Turkish exporters in the EU market would be between €1.1 to €1.8 billion (assuming unit carbon price is €30 to €50/ton GHG) (Aşıcı, 2021b). Following this study, potential effects of CBAM among Turkish sectors, effect of EGD on Turkish economy from a macroeconomic perspective and also the expected benefits if Turkey adopts a more ambitious climate policy are analyzed in Acar et al. (2021), in the context of a a dynamic applied general equilibrium model. The business as (un)usual scenarioimplies that Turkey's GDP by 2030 will decrease between 2.7% and 3.6% due to CBAM (assuming unit carbon price is 30 to 50 €/ton GHG), but if Turkey follows the alternative more active scenario (have a carbon pricing mechanism, redistributing revenues of this mechanism to efficiency investments, increasing the efficiency of electricity sector), carbon burden of Turkey could decrease. From the sectoral perspective, cement and electricity sectors are found as the most vulnerable sectors to CBAM (Acar et al., 2021).

Bektaş (2021) focused on the EGD and planned carbon border adjustment mechanism as important developments that will affect the trade from the perspective of energy intensive sectors of Turkey. Possible impacts of the implementation of EU's plans and measures can be taken for iron-steel industry to be less-negatively affected from the developments in EU are examined. GDP is found as the most important increasing factor for the differentiation in emissions. Therefore, the study highlights that Turkey should focus on low carbon development and reduce the emissions. Energy intensity of sectors, energy mix of sectors and emission factor leads to reduction in emissions. Energy consumption is critical in iron-steel industry, and to further advance the energy efficiency, to use latest technology, to consider green hydrogen and other carbon-free gases, to increase resource efficiency and to encourage the use of renewable sources are among further recommendations (Bektaş, 2021).

Following the resolution in March 2021, European Commission submitted its regulation proposal to establish a CBAM on July 14, 2021 as part of "Fit for 55 Package". One of the reasons of the proposals is that as differences between the partners of EU in terms of climate ambition arise, it would not be possible to eliminate the carbon leakage risk and achieve a decrease in global emissions to reach Paris Agreement objectives. Six different alternatives for CBAM (all compatible with WTO rules) are evaluated with the proposal:

Alternative 1. Import carbon tax, carbon intensity of products,

Alternative 2. Replicate of EU ETS regime (but not linked to it), CBAM certificates based on embedded emission intensity, carbon price based on averages of EU producers default value,

Alternative 3. Same as alternative 2, but carbon price based on actual emissions from exporters (to be reported by the importer),

Alternative 4. Same as alternative 3, but also includes phasing out of free allocations of allowances within EU ETS during a 10-year period (10% decrease each year) starting in 2026,

Alternative 5. Like alternative 3, but also includes value chain coverage for carbon-intensive materials,

Alternative 6. Excise duty, covers carbon-intensive materials in both imported and domestic products, assumes measures in EU ETS (such as free allocation) continues (European Commission, 2021g).

Impact assessment for each of these six alternatives is carried out and alternative 4 is found to be the preferred option with its high advantages as compared to other five (European Commission, 2021g).

CBAM is seen as a risk for Turkish exporters as almost half of the country’s exports is with the EU. So called GHG vulnerability is a new version of the economic vulnerabilities that are associated with EGD and related regulations. Aşıcı (2021) describes the GHG vulnerability as the combined result of GHG intensity of sectoral exports and effects of possible decrease in EU exports due to this intensity on economic growth and employment. The GHG vulnerability of Turkish manufacturing and other carbon-intensive sectors is analyzed and the measures that can be taken to minimize the risk are evaluated. Aşıcı (2021) notes that total value of exports to EU-28 was 296 billion TRY, while the total value added was 3.7 trillion TRY in 2018. It is important for Turkish exportings sectors to have a transformation by considering the GHG intensity. The study also states that a feasible aim should be to separate GHG emissions from the value added and to converge the sectoral

GHG intensity to EU sectoral averages. The results indicate that the share of sectors experiencing absolute divergence/separation in 2018 total emissions is only 8.1%; the share of relatively diverging sectors is 54.8%; the share of relatively concentrated sectors is 31.7%. The non-metallic mineral products (NACE code: C-23) and chemical products (NACE code: C-20) sectors producing possible CBAM effected products such as cement and fertilizer are found as relatively concentrated, and the C23 sector further diverges from the EU-28 average. Considering all the possible medium and long-term effects of EU regulations about zero pollution, circular economy, transportation, agriculture etc. on Turkish sectors, the recommendation is to have green transformation program for Turkey similar to the EU (Aşıcı, 2021c).

As the progress continues on the CBAM proposal in the EU, a draft report is presented in the European Parliament's Committee on the Environment, Public Health and Food Safety in December 2021. WTO compatibility of proposed CBAM is highlighted in this report and mentioned that:

> "*Article XX of the General Agreement on Tariffs and Trade (GATT) allows World Trade Organization (WTO) members to implement measures that are necessary to protect human, animal or plant life or health, or natural resources*." (European Commission, 2021g).

Accordingly, current anti-leakage mechanisms under EU ETS, free allocation of allowances and financial compensations for costs of electricity-related emissions weaken the price signal of carbon pricing mechanism and leads to decrease in the abatement investment incentives. CBAM (coherent with EU ETS) is introduced as the new and better solution to carbon leakage problem and should replace free allowances and financial compensations through "a gradual yet rapid transition". Another important feature of this draft is expanding the definition of embedded emissions and including indirect emissions to the scope of CBAM (Committee on the Environment Public Health and Food Safety, 2021). However, latest draft regulation published in March 2021 about establishing a CBAM states that CBAM initially will be applied to direct emissions and after a transition period and with further analysis, it will be applied to indirect emissions and mirror the scope of EU ETS. The draft emphasizes that European Commission will work on the scope extension of the regulation to include indirect emissions as soon as possible and also to include other goods (Council of the European Union, 2022).

On May 17, 2022, members of European Parliament (MEPs) in the Committee on the Environment, Public Health and Food Safety stated their official and ambitious views regarding CBAM and adopted that scope stated by the European Commission at the final draft is not wide enough and it should be broadened with polymers, organics chemicals and hydrogen. Additionally, they voted that CBAM should cover not only direct emissions but also indirect emissions. MEPs also commented on the implementation phase of CBAM and stated that full implementation including all EU ETS sectors should be by 2030, and at that year, with the total phase in of CBAM, free allowances for all parties need to be phased out (European Parliament, 2022).

It is important to mention that anti-leakage policies such as proposed CBAM of EU need to be considered as short to medium term solution and multilateral, coordinated and harmonized climate policy process globally in the long run should be aimed. Unilateral policies can be supported via those anti-leakage mechanisms but broader perspective and mechanisms such a carbon price globally is needed to achieve objectives of Paris Agreement and tackle climate change. As the progress continues on climate negotiations and differences in emission reduction policies and climate ambition among countries exist, carbon leakage would continue to be an important concern and anti-leakage measures would be needed until a global common policy occurs (King & van den Bergh, 2021).

CHAPTER 4

METHODOLOGY AND DATA

Methodological framework and data and calculations of the study are given in this chapter and supported by the appendices. Main approach of the study relies on Social Accounting Matrix (SAM) and SAM Multiplier Analysis which are presented in the following two sub-sections. All the procedures regarding the establishment of 2012 and 2019 SAMs of Turkey are given in Appendix A and summarized in Section 4.3. Key statistics obtained from 2019 SAM are presented in Section 4.4 and allocation of GHG emissions to SAM sectors are given in Section 4.5.

4.1 Methodological Framework

The fundamental of this study is based on the latest released 2012 I-O table of Turkey. Taking it as the basis and collecting additional data, i.e., general government budget statistics, social funds, interest payments, required to create the SAM; Turkey's 2012 SAM including 14 sectors is created. To reflect the latest developments and changes in the Turkish economy and GHG emissions inventory, SAM is then updated to 2019 and balanced using an optimization program. To the best of our knowledge, this study represents the most recent SAM for Turkey.

For the SAM sectors, respective GHG emissions (including process emissions and fuel consumption emissions) are allocated. Later, by calculating GHG intensity and applying input-output analysis, GHG emissions embodied in the exports to the EU is calculated. As the next step, three different carbon price scenarios are determined and carbon costs of exports under these scenarios are calculated. To reflect the sectoral vulnerability to carbon border adjustment mechanism (CBAM), shadow tax rates of each sector are calculated. After that, SAM multiplier analysis is carried out to examine the effects of a unitary exogenous export demand shock on GDP, sectoral outputs, and demand to analyze the same amount of shock's effects on each sector. Given the linearity of the model, after this unitary evaluation, the model is applied for different magnitudes of the shock by considering carbon costs generated by CBAM. Finally, decrease in sectoral exports by the amount of respective carbon cost is given as an exogenous shock and SAM multiplier analysis with different demand ranges is carried out to examine the effects of this shock on GDP, sectoral outputs, and demand for each sector. Results are analyzed in detail for cement and iron-steel sectors and for their reflections on the Turkish economy.

Workflow of the study is summarized in the figure below.

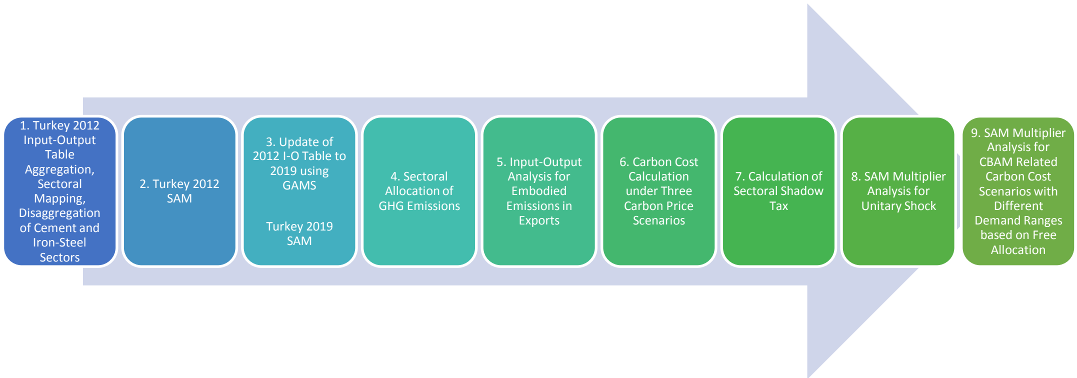

Figure 4.1 Workflow of the Study

Fundamentals of SAM and multiplier analysis together with the strengths of the methodology are presented in the Section 4.2. First three steps of the above given workflow regarding the creation phases of SAM Turkey are mentioned in Section 4.3 and all procedures used to create 2012 and 2019 SAMs including the non-linear optimization model that has been developed using General Algebraic Modeling System (GAMS) to balance the SAM for the year 2019 are given in detail in Appendix A. Key statistics obtained from the 2019 SAM are given in Section 4.4 and allocation of emissions to SAM sectors are presented in Section 4.5.

4.2 Social Accounting Matrices: Introduction

4.2.1 Fundamentals of SAM

SAM is a representation of the economy linking national accounts with social and other micro-statistics and shows the transactions and interlinkages between the accounts. There are three main features of a SAM:

- It is a square matrix: rows represent income, columns represent expenditures. Totals of rows and columns are equal. Transactions and flows from column accounts to row accounts are shown in the cells.
- It provides a comprehensive representation: All activities among the agents of the economy (households, government, factor markets, production, commodities, rest of the world, etc.) are captured.
- It is flexible: It allows to make disaggregation according to the expected outcomes and focus of the studies (IFPRI, 2010; Pyatt, 1988; Pyatt & Round, 1977; Pyatt & Thorbecke, 1976; Round, 2003; Thorbecke, 2003).

As stated by Thorbecke (2003), no standard disaggregation and classification exists for SAM. SAM should be designed and organized based on specific characteristics of the country/region, the study targets and intended focus areas of the study. Main accounts of SAM are production activities, commodities, factors (labor and capital), institutions (household, government), capital (investment) and the rest of the world (Thorbecke, 2003).

Circular flow of income within the economy and the structure of SAM, corresponding to this income flow, used in this study are given in Figure 4.2 and Table 4.1, respectively.

Column A of Table 4.1 represents the expenditures of production activities which consist of buying intermediate inputs and value added distributed to labor (as wages) and capital (as profits). Sales to supply to domestic market and exports generate the activities row which represents the gross production of activities.

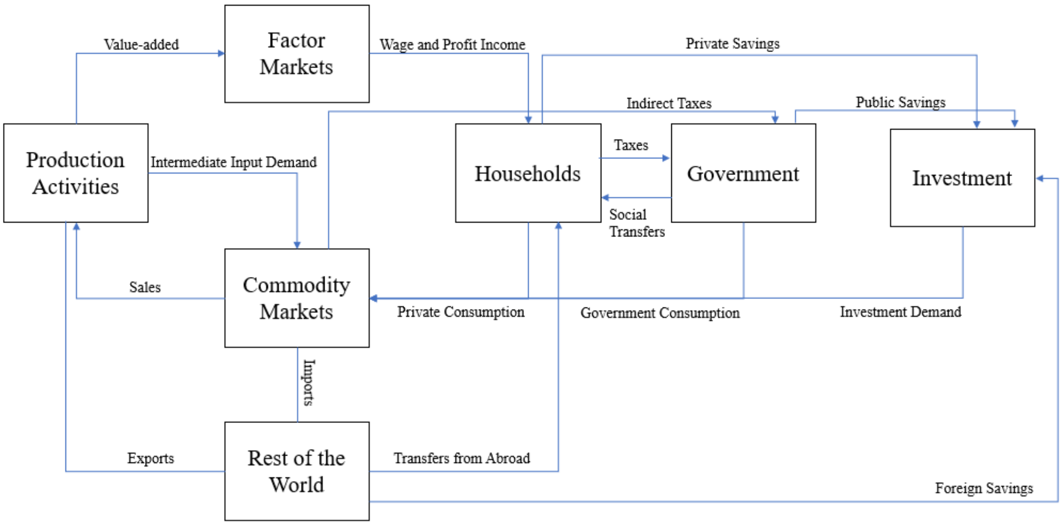

Figure 4.2 Circular Flow of Economy

Source: Prepared by the author

Commodities account purchases goods and services from both domestic market and from the abroad market (as imports) and pays related taxes and tariffs. Row of commodities represents the aggregate demand and consists of intermediate input demand, consumption, and investment.

Although activities and commodities are shown as aggregated single accounts, disaggregation according to sectors is possible and 14 sectors are used in this study (see Section 4.3).

Household takes factor incomes (wage income and profit income), social transfers from government and remittances from rest of the word. Incomes of government come from taxes, non-tax payments and foreign savings. Household spends income on the consumption, payments to government and on private savings. Public consumption, transfers to household, interest payments on foreign borrowing and public savings constitute the total public expenditure represented in the government column. Public and private savings are collected from household and government and used for investment.

Foreign exchange earnings generated from exports, foreign savings (to government) and remittances (to household) are represented in the rest of the world column. Imports and interest payments on foreign borrowing consists of foreign exchange expenditure.

Table 4.1 Structure of the Social Accounting Matrix

	Activities (A)	Commodities (B)	Factors of Production		Household (E)	Government (F)	Saving Investment (G)	Rest of World (H)	TOTAL (I)
			Labor (C)	Capital (D)					
1		Supply for domestic market						Exports	**Gross production**
2	Intermediate input demand				Private consumption	Government consumption	Investment		**Aggregate demand**
3	Wages								**Labor income**
4	Profits								**Capital income**
5			Wage income	Profit income		Social transfers		Transfers from abroad / remittances	**Private income**
6		Indirect taxes on inputs & tariffs			Direct taxes & non-tax payments			Foreign saving	**Public income**
7					Private savings	Public savings			**Total savings**
8		Imports				Interest payments on foreign borrowing			**Foreign exchange expenditure**
9	**Gross output / Production expenditure**	**Total absorption**	**Total wages**	**Total profits**	**Total private expenditure**	**Total public expenditure**	**Total savings**	**Foreign exchange earnings**	

Source: Prepared by the author, based on (Dervis et al., 1982; Erdoğan, 2011; Robinson et al., 1998; Telli, 2004; Thorbecke, 2003)

4.2.2 Strengths of SAM

As a comprehensive data framework, SAM provides the socio-economic structure of the economy and allows policymakers or researchers to analyze the various transactions, interconnections, relations and to examine the impacts of different policies (Thorbecke, 2003). Main strengths of SAM are given below:

- Data from various resources is represented in one structure in an organized, balanced way, therefore it allows to present all the socio-economic characteristics of the economy within given year.
- Linkages and flows within the economy, different transactions among accounts are reflected.
- Coverage of socio-economic structure allows to assess the effects of policies.
- SAM multipliers capture both direct and indirect effects of an exogenous shock on the economy.
- SAM is a consistent and reliable database for various modelling studies such as computable general equilibrium modelling, multiplier models, fixed-price multiplier models, etc.

SAM can be regarded as the expanded version of input-output tables (Fathurrahman, 2014; International Labor Organization, 2017). It takes I-O table as the basis and broadens itself with national accountings, income distribution, survey statistics, etc. and includes the economy’s social characteristics. The main advantage of SAM over I-O model is its ability to reflect the circular interdependencies of the economy within activities, income distribution and demand (Thorbecke, 2000).

An exogenous shock on the economy generates both direct and indirect effects. Direct effect means the effect of the given shock on the directly affected sector(s). Since, directly affected sector(s) have linkages to the rest of the economy and to other sectors, there will be indirect effects of these shock. Indirect affects have consumption and production linkages. I-O multipliers capture only the production linkages, while SAM multipliers capture all direct and indirect effects of the shock on the economy (Dautaj Şenerdem, 2013; IFPRI, 2010).

4.2.3 SAM Multiplier Analysis

SAM provides the framework for the estimation of the impacts of exogenous shocks. If there is enough labor and capacity, corresponding change in output can meet any exogenous demand change without any price effect. Impact of any exogenous shock given to the economy flows through the SAM accounts. Both direct and indirect effects (consumption and production linkages) of the shock on the endogenous accounts can be achieved with the SAM multiplier analysis (IFPRI, 2010).

Simplified SAM structure which takes activities, commodities, factors, and household as endogenous accounts; government, investment, and rest of the world as exogenous accounts are shown in the Table 4.2.

Total exogenous income to households such as from workers' remittances or social transfers from government are represented as E4 and total exogenous demand for activities because of demand in export are represented as E1. E2 represents the aggregate exogenous demand for commodities generated due to investment and public consumption. A5, B5 and D5 represent the leakages due to imports, due to private, public, and foreign savings, taxes, and other payments. The changes in exogeneous column generate effects on the endogenous account's income such as on the gross production output, factors' income, private income of households (Thorbecke, 2000).

Average expenditure propensities matrix (A_{SAM}) is obtained from the endogenous part of the schematic matrix by dividing an element in any cell in endogenous accounts to the total of the corresponding column account. For example, in the A_{SAM} below, a_{A2} is equal to A2/A6.

$$A_{SAM} = \begin{bmatrix} 0 & a_{B1} & 0 & 0 \\ a_{A2} & 0 & 0 & a_{D2} \\ a_{A3} & 0 & 0 & 0 \\ 0 & 0 & a_{D4} & a_{D4} \end{bmatrix}$$

Each total income (F_i) shown in Table 4.2 can be obtained by multiplying the average expenditure propensities (coefficients) by the sum of corresponding column account and adding the exogenous income (E_i).

$$F_i = A_{SAM}F_i + E_i \qquad \text{(Eq. 4.1)}$$

Equation 4.1 is re-written as:

$$F_i = (1 - A_{SAM})^{-1}E_i$$

$$= M_{SAM}E_i \qquad \text{(Eq. 4.2)}$$

Equation 4.2 called as multiplier formula shows that total endogenous income F_i can be obtained multiplying exogenous injection (E_i) by the M_{SAM}, which is called as accounting multiplier matrix. For example, when there is an increase in exogenous demand equals to E_i, after taking all direct and indirect effects into consideration (included through accounting multiplier matrix), there will be an increase in the total income which is equal to F_i. Equation 4.2 allows to calculate the multiplier effects of any exogenous shock (i.e. change in export demand, increase in investment of government spending) (IFPRI, 2010; Thorbecke, 2000).

Table 4.2 Simplified Schematic SAM

			A	B	C	D	E	F
			Endogenous Accounts				**Exogenous Accounts**	**TOTAL**
			Activities	**Commodities**	**Factors**	**Household**	**Sum of Other Accounts**	
1	**Endo**	**Activities**	0	B1	0	0	E1	**F1=A6**
2		**Commodities**	A2	0	0	D2	E2	**F2=B6**
3		**Factors**	A3	0	0	0	0	**F3=C6**
4		**Household**	0	0	C4	D4	E4	**F4=D6**
5	**Exo**	**Sum of Other Accounts**	A5	B5	0	D5	E5	**F5=E6**
6	**TOTAL**		**A6=F1**	**B6=F2**	**C6=F3**	**D6=F4**	**E6=F5**	

4.3 Social Accounting Matrix of Turkey

It is challenging to build a SAM for a recent year. Therefore, the standard approach is to build a consistent SAM for a chosen year which has all the data needed and to update it for the more recent year which may not have the detailed data for all the accounts, or which may not possess sectoral detail but does have aggregate data. When constructing the SAM for a recent year, inconsistencies need to be balanced using methods such as RAS method, cross-entropy method, optimization with The General Algebraic Modeling (Robinson et al., 1998). A similar approach is followed in this study. Since the latest input-output table of Turkey is for the year 2012, and all the other data required to create SAM is available for 2012; firstly, 2012 SAM of Turkey is created for 14 production sectors. Since the recent national GHG inventory is for 2019 and national accountings are complete and available for 2019, 2019 is chosen as the year of recent SAM. All data necessary to create the 2019 SAM are collected and inserted, since there is no detailed I-O table for that recent year, the share among sectors in the 2012 SAM are taken as the basis and respective aggregate data of 2019 disaggregated accordingly. As the final step, 2019 SAM is balanced by using a non-linear optimization mathemarical programming model developed in GAMS. All the steps followed are presented in Appendix A and 2019 SAM of Turkey created are given in Table 4.3.

Table 4.3 Turkey 2019 Disaggregated SAM (balanced)

		ACTIVITIES (1)														COMMODITIES (2)																				
	Billion TL	AGR	MIN	FOD	CHE	TRA	ELEC	CEM	MNR	IRO	MET	CON	OTH	WAS	SER	AGR	MIN	FOD	CHE	TRA	ELEC	CEM	MNR	IRO	MET	CON	OTH	WAS	SER	LAB (3)	CAP (4)	HH (5)	GOV (6)	S-I (7)	RoW (8)	TOTAL
1	AGR															463.00																			31.77	494.77
1	MIN																27.42																		18.19	93.11
1	FOD																	155.39																	81.85	506.41
1	CHE																		71.99																107.12	303.82
1	TRA																			238.38																651.33
1	ELEC																				####														0.59	332.53
1	CEM																					12.47													6.25	34.26
1	MNR																						31.80												20.74	113.69
1	IRO																							74.23											106.86	308.02
1	MET																								11.32										38.77	71.38
1	CON																									295.37										807.03
1	OTH																										289.19								611.79	1,401.95
1	WAS																											32.21							3.32	91.32
1	SER																												1,100.82						187.85	3,195.61
2	AGR	103.10	0.51	155.75	2.25	0.04	0.00	0.02	0.07	0.00	0.00	0.44	28.65	0.04	16.21																	159.97		43.55		510.60
2	MIN	1.29	5.99	1.87	7.21	0.76	70.59	5.11	16.96	18.37	4.80	15.48	100.95	0.33	8.41																	16.19		9.78		284.09
2	FOD	28.15	0.18	82.70	0.74	0.61	0.08	0.03	0.11	0.14	0.04	0.55	3.94	0.26	82.15																	334.41		3.81		537.90
2	CHE	28.73	2.32	14.25	131.33	5.33	0.21	1.50	4.99	7.01	1.83	32.12	91.14	3.36	37.19																	40.73	28.15	1.23		431.43
2	TRA	9.53	7.66	21.79	15.24	132.91	1.71	1.57	5.20	15.58	4.07	24.22	49.93	3.40	104.58																	242.54	1.70	18.65		660.28
2	ELEC	2.86	3.36	4.56	6.60	1.53	168.79	1.77	5.88	10.40	2.72	1.51	19.31	6.69	42.54																	60.61		0.00		339.13
2	CEM	0.08	0.14	0.27	0.41	0.35	0.07	0.94	3.11	0.29	0.08	18.14	1.05	0.06	3.00																	1.93		0.64		30.53
2	MNR	0.28	0.47	0.91	1.37	1.17	0.24	3.17	10.53	0.98	0.25	61.48	3.57	0.19	10.15																	4.93		1.62		101.31
2	IRO	0.14	1.12	1.23	2.66	1.64	0.14	0.21	0.71	54.04	14.12	81.94	76.54	0.59	8.35																	6.28		43.96		293.65
2	MET	0.08	0.67	0.73	1.57	0.97	0.08	0.13	0.42	32.03	8.37	48.57	45.37	0.35	4.95																	0.96		6.71		151.94
2	CON	0.67	0.18	0.50	0.42	0.52	0.66	0.03	0.11	0.50	0.13	96.00	1.48	5.29	21.81																	4.85	0.02	687.26		820.46
2	OTH	17.42	10.08	10.96	11.26	64.46	2.82	2.47	8.20	5.69	1.49	69.22	404.04	3.51	132.89																	353.76	0.22	345.40		1,443.90
2	WAS	1.56	0.02	0.38	1.22	0.14	0.03	0.07	0.22	47.44	12.39	0.47	4.85	17.21	8.40																	16.22	20.53	-0.81		130.33
2	SER	24.52	12.19	54.74	38.22	70.39	15.75	4.20	13.95	23.85	6.23	123.57	183.70	16.27	649.94																	1,212.74	617.95	150.11		3,218.34
	3	13.92	13.19	44.37	31.16	77.53	10.17	4.61	15.29	33.04	5.36	77.11	156.36	7.71	864.48																					1,354.32
	4	262.45	35.03	111.39	52.15	292.98	61.17	8.42	27.94	58.67	9.51	156.20	231.06	26.06	1,200.57																					2,533.60
	5																													1,354.32	2,533.60		81.29		0.96	3,970.18
	6															-8.25	29.19	74.16	20.69	8.94	6.96	0.41	1.36	17.86	2.90	13.43	186.36	5.62	70.24			243.69			142.05	815.60
	7																															1,270.37	41.52			1,311.89
	8															55.85	179.99	39.18	214.03	0.00	0.23	2.11	7.00	74.63	116.43		467.38	36.72	140.35				24.22			1,358.11
	TOTAL	494.77	93.11	506.41	303.82	651.33	332.53	34.26	113.69	308.02	71.38	807.03	1,401.95	91.32	3,195.61	510.60	284.09	537.90	431.43	660.28	339.13	30.53	101.31	293.65	151.94	820.46	1,443.90	130.33	3,218.34	1,354.32	2,533.60	3,970.18	815.60	1,311.89	1,358.11	

4.4 Key Statistics from Turkey 2019 Disaggregated SAM

Social accounting matrices represent valuable information about the characteristics of the country. Therefore, in this section, 2019 SAM of Turkey is analyzed and key structural characteristics of production in economy are discussed in terms of GDP, value added, trade, trade intensities, activity production, demand, household and macroeconomic values and shares.

GDP Shares

Key statistics summarized below:

- Turkey heavily depends on Ser with 53.1% share to GDP at factor cost.
- Oth and Tra also constitutes a large share of GDP at factor cost.
- Following largest sectors are Agr and Con, respectively.
- Contribution of iron-steel sector to total GDP is 2.4%.
- Contribution of Cem sector to total GDP is 0.3%.
- Capital contributes more to GDP than the labor.

Table 4.4 Gross Domestic Product (GDP) at Factor Cost (kTRY) and Sectoral GDP Shares

SAM Sector	Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr
GDP at factor cost	276,371,822	48,219,734	155,767,623	83,312,435	370,511,539	71,347,664	13,029,083	43,229,633
GDP shares (%)	7.1%	1.2%	4.0%	2.1%	9.5%	1.8%	0.3%	1.1%

SAM Sector	Iro	Met	Con	Oth	Was	Ser	TOTAL
GDP at factor cost	91,708,939	14,867,452	233,312,981	387,418,441	33,776,390	2,065,050,301	3,887,924,038
GDP shares (%)	2.4%	0.4%	6.0%	10.0%	0.9%	53.1%	100.0%

Value Added Shares

Key statistics summarized below:

- Agr, Tra, Elc and Was are the four most capital-intensive sectors.
- Ser and Oth are more labor-intensive than the other sectors.

Table 4.5 Value-Added Shares

SAM Sector	Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr
Labor	5	27	28	37	21	14	35	35
Capital	95	73	72	63	79	86	65	65

SAM Sector	Iro	Met	Con	Oth	Was	Ser	TOTAL
Labor	36	36	33	40	23	42	35
Capital	64	64	67	60	77	58	65

Activity Production in Gross Output Shares

The share of each payment in gross output represents the production input required to produce a unit of sectoral output and this allows to examine the linkages among sectors (IFPRI, 2010). Factors and commodities' payment share in the gross output are calculated and given in Table 4.6. Key statistics summarized below:

- Ser and Oth offers the most important intermediate inputs in Turkey.
- Following Ser and Oth; goods of Tra, Che, Agr, Elc, Min and Iro are important inputs.
- 30.8% share value of food output is from agriculture inputs. This means that for each 100 TRY-worth of food output, 30.8 TRY must be spent on agriculture inputs.
- 15% share value of cement output is from mining inputs, 5% from electricity, 4% from chemicals, 5% from transportation, 9% from minerals and 12% from services. This means that for each 100 TRY-worth of cement output, 15 TRY must be spent on mining inputs and 5 TRY on electricity.
- Capital constitutes 25% and labor constitutes 13% of cement output.
- 6% share value of iron-steel output is from mining inputs, 5% from transportation, 3% from electricity, 2% from chemicals, 28% from metals, 15% from waste and 8% from services. 19 TRY on capital and 10 TRY on labor must be spent for 100 TRY-worth of iron-steel output.
- 21% share value of Elc output, 15% of Cem output, 6% of Iro output and 7% of Oth output is from Min inputs.

Table 4.6 Activity Production Shares

		Activities														
		Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr	Iro	Met	Con	Oth	Was	Ser	Total
Commodities	Agr	20.8	0.5	30.8	0.7	0.01	0.0	0.1	0.1	0.001	0.001	0.1	2.0	0.04	0.5	3.7
	Min	0.3	6.4	0.4	2.4	0.1	21.2	14.9	14.9	6.0	6.7	1.9	7.2	0.4	0.3	3.1
	Fod	5.7	0.2	16.3	0.2	0.1	0.02	0.1	0.1	0.05	0.1	0.1	0.3	0.3	2.6	2.4
	Che	5.8	2.5	2.8	43.2	0.8	0.1	4.4	4.4	2.3	2.6	4.0	6.5	3.7	1.2	4.3
	Tra	1.9	8.2	4.3	5.0	20.4	0.5	4.6	4.6	5.1	5.7	3.0	3.6	3.7	3.3	4.7
	Elec	0.6	3.6	0.9	2.2	0.2	50.8	5.2	5.2	3.4	3.8	0.2	1.4	7.3	1.3	3.3
	Cem	0.02	0.1	0.1	0.1	0.1	0.02	2.7	2.7	0.1	0.1	2.2	0.1	0.1	0.1	0.3
	Mnr	0.1	0.5	0.2	0.5	0.2	0.1	9.3	9.3	0.3	0.4	7.6	0.3	0.2	0.3	1.1
	Iro	0.03	1.2	0.2	0.9	0.3	0.04	0.6	0.6	17.5	19.8	10.2	5.5	0.6	0.3	2.9
	Met	0.02	0.7	0.1	0.5	0.1	0.02	0.4	0.4	10.4	11.7	6.0	3.2	0.4	0.2	1.7
	Con	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	11.9	0.1	5.8	0.7	1.5
	Oth	3.5	10.8	2.2	3.7	9.9	0.8	7.2	7.2	1.8	2.1	8.6	28.8	3.8	4.2	8.9
	Was	0.3	0.02	0.1	0.4	0.0	0.01	0.2	0.2	15.4	17.4	0.1	0.3	18.8	0.3	1.1
	Ser	5.0	13.1	10.8	12.6	10.8	4.7	12.3	12.3	7.7	8.7	15.3	13.1	17.8	20.3	14.7
Labor		2.8	14.2	8.8	10.3	11.9	3.1	13.5	13.5	10.7	7.5	9.6	11.2	8.4	27.1	16.1
Captal		53.0	37.6	22.0	17.2	45.0	18.4	24.6	24.6	19.0	13.3	19.4	16.5	28.5	37.6	30.1
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Trade Shares and Intensities

Trade shares are calculated and given in Table 4.7. Key statistics are:

- When sectoral shares of import and export are evaluated, it is seen that most of Turkey's foreign exchange is generated by Oth, Ser, Che, Min and Iro sectors.
- Turkey relies on exports of Oth, Ser, Iro, Che and Fod. Turkey's imports are mainly from Oth, Che, Ser and Min.
- Turkey exports more cement and iron-steel than it imports.

Table 4.7 Trade Values (kTRY) and Shares

SAM Sector	Agr	Min	Fod	Che	Tra	Elec	Cem
Imports	55,851,709	179,989,598	39,175,246	214,030,718	63	230,596	2,108,478
Exports	31,770,610	18,193,378	81,848,094	107,116,327	-	593,796	6,250,110
Import Share	4.2	13.5	2.9	16.0	0.000005	0.02	0.16
Export Share	2.6	1.5	6.7	8.8	-	0.05	0.51

SAM Sector	Mnr	Iro	Met	Oth	Was	Ser	TOTAL
Imports	6,995,789	74,632,353	116,433,160	467,377,953	36,721,709	140,351,157	1,333,898,530
Exports	20,737,449	106,858,256	38,768,273	611,790,856	3,324,929	187,852,126	1,215,104,204
Import Share	0.52	5.60	8.73	35.04	2.75	10.52	100
Export Share	1.71	8.79	3.19	50.35	0.27	15.46	100

In order to evaluate the importance of trade relatively, import penetration ratios (IPR) and export intensities (EI) are calculated according to below given formulas. While IPR reflects the imports' share in total demand (demand for all goods and services) and EI reflects the exports' share in gross output (IFPRI, 2010).

$$IPR = \frac{Imports}{Total\ Demand}$$

$$EI = \frac{Exports}{Gross\ Output}$$

Calculated IPRs and EIs are given in the table below. Key statistics related to them are summarized below:

- Share of imports in the value of total demand is 15% and share of exports in the value of gross output is 14%.
- Met sector faces the most competition from imports with 77% of total demand supplied by foreigners. Min and Che sectors also face high competition from imports (63% and 50%).
- Met and Oth exports almost half of what they produce (54% and 44%, respectively.)
- 18% of cement output, and 35% of iron-steel output is exported.
- Imported cement accounts for 7% of total cement demand. It can be said that Turkey is fairly self-sufficient in cement sector.
- Imported iron-steel accounts for 25% of total iron-steel demand.

Table 4.8 Trade Intensities

SAM Sector	Agr	Min	Fod	Che	Tra	Elec	Cem
Import Penetration Ratio	10.9	63.4	7.3	49.6	0.000010	0.07	6.91
Export Intensity	6.4	19.5	16.2	35.3	0.00	0.18	18.24

SAM Sector	Mnr	Iro	Met	Oth	Was	Ser	TOTAL
Import Penetration Ratio	6.91	25.41	76.63	32.37	28.18	4.36	15
Export Intensity	18.24	34.69	54.31	43.64	3.64	5.88	14

Demand Shares

Demand values and demand shares by commodity are given in Table 4.9 and Table 4.10.

Key statistics summarized below:

- Most (49%) of the household demand is for services.
- Goods of Oth (14%) and Fod (14%) are the following large components of private consumption spending.
- Investment generates demand mainly for Con (52%) and later for Oth (26%) commodities and Ser (11%)
- Government spends money mostly for services (92%).

Table 4.9 Demand Values (kTRY)

		Intermediate Demand	Private Consumption	Government Consumption	Investment	Total
Commodities	Agr	307,081,513	159,970,948		43,547,268	510,599,729
	Min	258,124,132	16,193,246		9,776,373	284,093,751
	Fod	199,681,376	334,405,106		3,811,050	537,897,533
	Che	361,312,153	40,727,395	28,153,251	1,232,654	431,425,453
	Tra	397,387,279	242,540,928	1,697,837	18,649,982	660,276,026
	Elec	278,520,039	60,607,787			339,127,826
	Cem	27,966,523	1,931,909		635,503	30,533,935
	Mnr	94,763,696	4,925,595		1,620,278	101,309,570
	Iro	243,416,259	6,280,677		43,957,970	293,654,905
	Met	144,276,643	958,067		6,705,433	151,940,143
	Con	128,334,509	4,854,996	16,169	687,256,692	820,462,366
	Oth	744,512,270	353,763,855	223,503	345,397,134	1,443,896,762
	Was	94,398,887	16,218,557	20,527,888	-812,502	130,332,830
	Ser	1,237,537,192	1,212,743,444	617,953,754	150,108,489	3,218,342,879
Total		4,517,312,471	2,456,122,508	668,572,403	1,311,886,326	8,953,893,707

Table 4.10 Demand Shares by Commodity

		Intermediate Demand	Private Consumption	Government Consumption	Investment	Total
Commodities	Agr	7	7		3	6
	Min	6	1		1	3
	Fod	4	14		0.3	6
	Che	8	2	4	0.1	5
	Tra	9	10	0.3	1	7
	Elec	6	2			4
	Cem	1	0.1		0.05	0.3
	Mnr	2	0.2		0.1	1
	Iro	5	0.3		3	3
	Met	3	0.04		1	2
	Con	3	0.2	0.002	52	9
	Oth	16	14	0.03	26	16
	Was	2	1	3	-0.1	1
	Ser	27	49	92	11	36
Total		100	100	100	100	100

Household Shares

Household income values' share are given in Table 4.11. Household expenditure values and shares are given in Table 4.12.

Key statistics obtained from the household account are:

- Capital is the most important source of income for households. They earn most of their income from capital (64%).
- Households do not so reliant on government and foreign remittances.
- Households spend 6% share of their income on paying taxes.
- Households save 32% share of their income.
- Households spend 8% of their income on Fod, 6% on Tra, 9% on Oth, 4% on Agr and 2% on Elc.

Table 4.11 Household Income Values (kTRY) and Shares

SAM Sector	Labor	Capital	Government	ROW	TOTAL
Income Value	1,354,320,671	2,533,603,366	81,293,973	960,923	3,970,178,934
Income Share	34	64	2	0.02	100

Table 4.12 Household Expenditure Values (kTRY) and Shares

		Intermediate Demand	Private Consumption
Commodities	Agr	159,970,948	4
	Min	16,193,246	0.4
	Fod	334,405,106	8
	Che	40,727,395	1
	Tra	242,540,928	6
	Elec	60,607,787	2
	Cem	1,931,909	0.05
	Mnr	4,925,595	0.1
	Iro	6,280,677	0.2
	Met	958,067	0.02
	Con	4,854,996	0.1
	Oth	353,763,855	9
	Was	16,218,557	0.4
	Ser	1,212,743,444	31
Government		243,690,687	6
Saving Investment		1,270,365,739	32
Total		3,970,178,934	100

Macroeconomic Shares

Macroeconomic values and macro statistics are calculated and given in Table 4.13 and Table 4.14. Key statistics regarding macroeconomy are presented below:

- GDP at factor cost is total capital and labor value added and in 2019 SAM is equal to 3.9 trillion TRY.
- GDP at market prices is found with the formula below:

  GDP = C + I + G + E – M (IFPRI, 2010)

  where C is private consumption, I is investment, G is government consumption, E is exports, and M is imports.
- GDP at market prices in 2019 SAM is 4.3 trillion TRY.

- The recurrent fiscal balance is 41 billion TRY or 1% of GDP at market prices. The fact that it is positive means that Turkey ran a recurrent fiscal surplus in 2019.
- The share of imports and exports in GDP (trade-to-GDP ratio) is 59%, indicating that Turkey is quite an open economy since total trade accounts more than half of its GDP (59%).
- Additionally, Turkey imported more goods and services than it exported in 2019. Trade deficit was 118.8 billion TRY.

Table 4.13 Macroeconomic Values in 2019

Macroeconomic Indicator	Value (kTRY)
GDP at factor cost	3,887,924,038
Recurrent fiscal balance	41,520,587
Savings	1,270,365,739
Imports	1,333,898,530
Exports	1,215,104,204
GDP at market prices	4,317,786,909
Trade deficit	-118,794,327

Table 4.14 Macroeconomic Statistics

Macroeconomic Indicator	Ratio (%)
Trade-to-GDP ratio	59
Fiscal balance-to-GDP ratio	1
Private savings-to-investment ratio	97

4.5 GHG Emissions of SAM Sectors

GHG emissions of SAM sectors are compiled from Common Reporting Format (CRF) table of Turkey submitted to UNFCCC, National Inventory Report (NIR) and energy balance table regarding 2019.

In 2019, total of 506 Mt CO_2e of GHG[7] is emitted to the atmosphere in Turkey (TurkStat, 2021c). Residential emissions have been left aside and the remaining emissions (462.4 Mt CO_2e) are allocated to the 14 sectors[8].

Sectoral shares of emissions are visualized in Figure 4.3, emission values are given in Table 4.17 and disaggregated values of emissions are presented in Appendix C. GHG emissions from Cem (51.4 Mt CO_2e) constitutes 10.2% and Iro (15.1 Mt CO_2e) constitutes 3% of total GHG emissions in 2019.

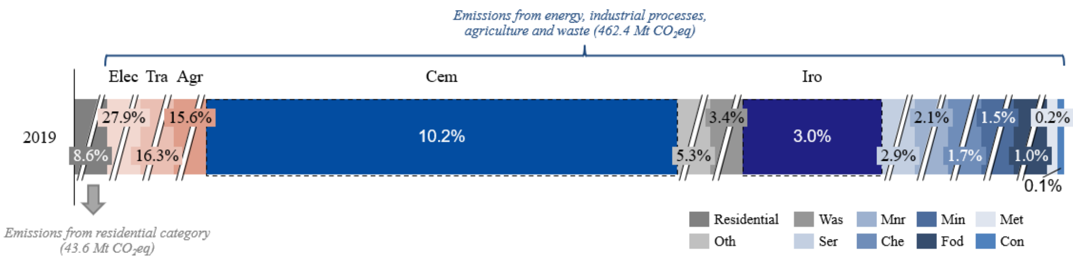

Figure 4.3 Sectoral Shares of GHG Emissions in 2019

Iro and Cem sectors are not only essential elements of the economy and but also significant GHG emitters. When we separately examine the process emissions, as it can be seen from the Figure 4.4 that the most important emission sources of the industrial processes and product use (IPPU) are Iro and Cem sectors: nearly three quarters of total emissions, 73%, of IPPU are coming from Cem and Iro processes.

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[7] Except LULUCF
[8] Sectoral emissions include both fuel consumption and process emissions.

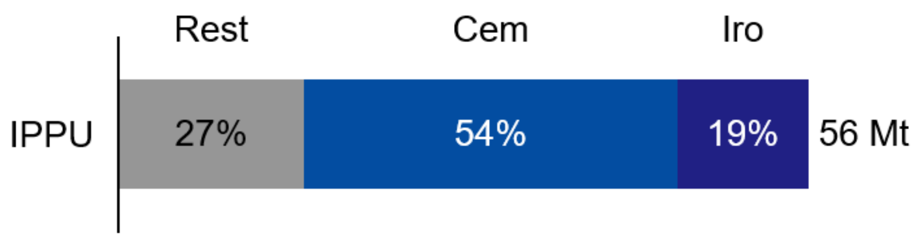

Figure 4.4 Share of Cem and Iro Process Emissions in IPPU in 2019

CO_2 emissions of cement production is given under the mineral production category in NIR. Although CO_2 emissions from cement production is given in NIR, share of cement in the fuel combustion emissions from non-metallic minerals is not given separately. To disaggregate the fuel combustion emissions of cement sector from the fuel combustion emissions of non-metallic minerals, share of cement sector CO_2 emissions within mineral production in 2019 is calculated (see Table 4.15). This share is assumed as the same for fuel consumption and used to calculate the fuel combustion emissions of cement production and of production of other than cement non-metallic mineral products. Emissions levels of the iron-steel sector is given in the NIR, therefore no additional disaggregation is applied.

Table 4.15 Share of CO_2 Emissions from Mineral Production in 2019

Category	**CO_2 Emissions**	**Share of Emissions**
Mineral Industry	36,826.8	100%
Cement Production	30,423.1	83.7%
Lime Production	2,786.8	7.2%
Glass Production	717.2	1.3%
Other Process Uses of Carbonates	2,899.6	7.8%

Source: Author's calculation from NIR CO_2 Values (TurkStat, 2020)

Construction sector emissions are not available as separate. This data is given under the CRF 1.A.2 manufacturing industries and construction category's g-other sector. In order to calculate emissions of this sector, fuel consumption data given in energy table and respective emission factors specified for fuel types under 1.A.2.g are used (Table 4.16).

Table 4.16 GHG Emissions of Construction Sector

	Energy Balance Table	Implied Emission Factors of UNFCCC			GHG Emissions of Construction (kt)		
	Consumption (TJ)	CO_2 (t/TJ)	CH_4 (kg/TJ)	kt N_2O (kg/TJ)	CO_2	CH_4	N_2O
Liquid Fuels	632	70.48	2.30	0.43	44.5	0.0015	0.0003
Solid Fuels	41	102.57	10.00	1.50	4.2	0.0004	0.0001
Gaseous Fuels	12,067	53.67	1.00	0.10	647.7	0.0121	0.0012
				Total	**696.4**	**0.014**	**0.0015**

Table 4.17 Sectoral GHG Emissions

SAM Sector	UNFCCC CRF Categories	CO_2eq (kt)	Share
Agr	Category 3 Category 1.A.4.c	78,885.8	16%
Min	Category 1.B.1 Category 1.B.2.a.1-2-3 Category 1.B.2.b.1-2-3 Category 1.B.2.c	7,772	2%
Fod	Category 1.A.2.e	5,180	1%
Che	Category 2.B Category 1.A.2.c	8,723	2%
Tra	Category 1.A.3	82,427	16%
Elec	Category 1.A.1.a Category 1.B.2.b.4-5	140,980	28%
Cem	Category 2.A.1 Category 1.A.2.f share	51,449	10%
Mnr	Category 2.A.2 Category 2.A.3 Category 2.A.4 Category 1.A.2.f share	10,829	2%
Iro	Category 2.C.1 Category 1.A.2.a	15,153	3%
Met	Category 2.C.2 Category 2.C.3 Category 2.C.5 Category 1.A.2.b	1,113	0.2%
Con	Category 1.A.2.g	697.25	0.1%

Table 4.17 Sectoral GHG Emissions (continued)

SAM Sector	UNFCCC CRF Categories	CO_2eq (kt)	Share
Oth	Category 1.A.1.b-c Category 1.A.2.d-g Category 1.B.2.a.4 Category 2.D-E-F.6	27,057	5%
Was	Category 5	17,248	3%
Ser	1.A.4.a Category 2.F.3	4,918	3%
Total GHG Emissions of SAM Sectors		**462,431**	**91%**
Residential Emissions	Category 1.A.4.b	43,653	9%
Turkey's 2019 GHG Emissions (except LULUCF)		**506,084**	**100%**

CHAPTER 5

ANALYSIS OF CARBON BORDER ADJUSTMENT MECHANISM'S EFFECTS, RESULTS AND DISCUSSION OF MULTIPLIER ANALYSIS

This chapter presents the results of SAM multiplier analysis carried out for shocks corresponding to the decrease in sectoral exports by the amount of respective carbon costs. In the chapter, first, a brief information about the EU's proposed CBAM is given. Then, sectoral exports to EU are analyzed. To find the embedded emissions in the exports, I-O analysis is conducted, and three different carbon price scenarios are adopted. With the emissions and carbon prices, sectoral carbon costs are calculated. Since the revenue of each sector differs, carbon cost may not fully represent the vulnerability of sectors. Therefore, shadow tax rates are calculated. Finally, possible effects of carbon costs generated due to CBAM on the exporting sectors are analyzed using SAM multiplier analysis. In the analysis, first of all, effects of a unitary exogenous shock for each sector are examined to check the sectoral linkages within the economy and to compare an equal shock's impacts for each sector. As the model is linear, later on exogenous shock is given as decrease in exports by the amount of respective carbon cost and effects are evaluated.

CBAM and free allocation of allowances will be applied concurrently until free allowances totally phased out. It is stated in the latest draft regulation that CBAM will not create favorable conditions for EU producers and will not restrict trade. Carbon price and free allocations will be equally applied for EU producers and exporters (Council of the European Union, 2022). Until free allowances are phased out completely, the CBAM will be applied only to the proportion of emissions that does not benefit from free allowances under the EU ETS, thus ensuring that all parties are treated in an even-handed way compared to EU producers (European

Commission, 2021b). This means that whole carbon cost will not be the burden for Turkish exporters, but carbon costs for the amount of emissions which are above the calculated allowances to be freely allocated will be their potential carbon cost burden. Therefore, analysis is completed with difference ranges (10% to 100%) in demand response based on free allocation coverages of sectors and results are discussed for the cement and iron-steel sectors in detail considering the free allocation of allowances.

5.1 EU Carbon Border Adjustment Mechanism Proposal

The European Union stated its 2030 and 2050 climate ambitions and made it legally binding through the European Climate Law (European Commission, 2021h). It is aimed to cut emissions at least 55% be 2030 and to reach net zero emission by 2050. Current legislation of EU is not aligned with those ambitions and is not enough to meet the goals, therefore a policy revision package called “Fit for 55” is presented by the EU Commission in July 14, 2021. The package includes various legislation proposals (such as changes to EU ETS, introduction of CBAM, revision of effort sharing regulation, renewable energy directive, allocation of social climate fund, etc.) to ensure setting the required climate policy framework in order to reach EU’s climate targets. As of May 2022, progress continues, and adoption of the package is not completed yet.

CBAM, which was mentioned in the EGD and European Climate Law, is one of the proposals of the Fit for 55 package and is seen as one of the most essential parts since it aims to eliminate carbon leakage risk while being compatible with WTO rules. It aims to protect the competitiveness of EU industries and the economy (European Commission, 2021g). Carbon leakage refers to increase in total emissions as a result of relocation of production to countries with less stringent emission policies. EU already has some special conditions (higher share of free allowances and compensating the increases in electricity costs) to sectors with carbon leakage risk in order to protect their competitiveness (European Commission, 2022a). However, EU Commission states that free allocation under the EU ETS weakens the price signal that the system provides for the installations receiving it compared to full auctioning. It thus affects the incentives for investment into further abatement of GHG emissions. Therefore, CBAM proposed to address carbon leakage will be gradually phased in and free allocation of allowances will be phased out over time (European Commission, 2021g).

In the CBAM proposal published on July 14, 2021, the sectors given below are included and the proposal mentions that it will apply to direct emissions emitted during production process:

- Cement
- Iron and steel
- Aluminium
- Fertilizers
- Electricity

It is stated that there will be a transition phase of three years with reporting responsibilities starting from 2023 until the end of 2025 and adjustment will be effective financially for the importers starting from 2026. The free allocation of allowances will gradually be phased out as from 2026 and will be phased out completely in 2035.

As the progress continues on the CBAM proposal, a draft report is presented in the European Parliament’s Committee on the Environment, Public Health and Food Safety and it is proposed:

- to expand the products covered in CBAM and include:
    - chemicals (organic chemicals, hydrogen, anhydrous ammonia, ammonia in aqueous solution) and
    - polymers (plastics and articles thereof),

- to extend the type of emissions covered by including indirect emissions,
- to shorten the transitional period by one year, ending on December 31, 2024,
- to speed the phase-out of free allowances and introducing CBAM factor (a factor reducing the free allocation of allowances) (see Figure 5.1),
    - The CBAM factor shall be equal (for all sectors except cement) to 100% for the period from January 1, 2023 until December 31, 2024, 90% in 2025, 70% in 2026, 40% in 2027, and reach 0% by the end of 2028.
    - 0% CBAM factor would apply as early as 1 January 2025 for cement sector[9]. (Committee on the Environment Public Health and Food Safety, 2021)
- to be fully operational as of January 1, 2029 so as to align with 2030 climate goals.

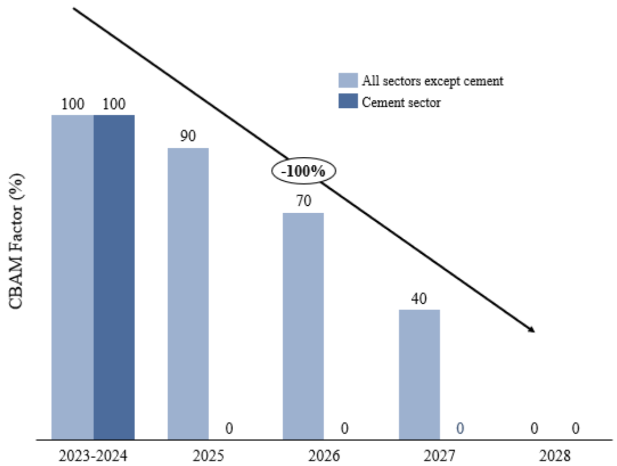

Figure 5.1 CBAM Factors in Draft Report of Committee on the Environment, Public Health and Food Safety on December 21, 2021

[9] Cement sector's trade intensity (10.1%) is the lowest among other sectors in CBAM and carbon leakage risk is low, therefore an incremental phase out is not necessary for cement sector and CBAM factor of %0 for cement would be valid by 2025 (Committee on the Environment Public Health and Food Safety, 2021).

Council of the European Union reached to a general approach and published "Draft regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism" on March 15, 2022. Cement, electricity, fertilizers, aluminum, iron & steel sectors are stated as the sectors under the scope of CBAM for the beginning. Different from the first proposal on July 14, 2021, goods of aluminum and iron & steel sectors are extended down the value chain (Table 2.4). CBAM will mirror and complement the functions of EU ETS on the imports and gradually free allowances under EU ETS will be phased out about which no date is specified in the draft regulation. This leaves an important point to be addressed by the European Commission. Additionally, direct emissions will be in scope and possible extension of coverage to indirect emissions and to other sectors will be evaluated by the Commission and be reported to European Parliament and to Council of the European Union (Council of the European Union, 2022). And with the vote of Committee on the Environment, Public Health and Food Safety of European Parliament in May 17, 2022 regarding the inclusion of indirect emissions, broadened the coverage of sectors, earlier phase in of CBAM and phase out of free allowances by 2030, it can be expected that EU will continue to increase their ambition until the publication of final regulation of CBAM (European Parliament, 2022).

5.2 Sectoral Exports of Turkey to European Union

Turkey's total goods and services exports were worth €190.9 billion in 2019. EU was the largest export partner of Turkey as a group and constitutes the 43.3% of Turkey's exports, corresponding to €82.8 billion export revenue (€68.9 B from goods and €13.9 B from services). By considering EU's important place in the Turkey's exports, it is expected to have considerable effects of CBAM on Turkish industries (Acar et al., 2021; Yeldan et al., 2020).

As seen from Figure 5.2, export of Cem and Mnr had a volume of €4.2 B and 43% of these exports, worth of €1.8 B, went to EU. Cem sector exports to EU were worth of €120 M and Mnr sector exports were worth of €1.7 B. On the other hand, Iro supplied €16.8 billion worth of goods in terms of export (corresponds to 35% of Turkey’s iron-steel output) and 35% of it, worth of €5.9 billion, were the exports to EU.

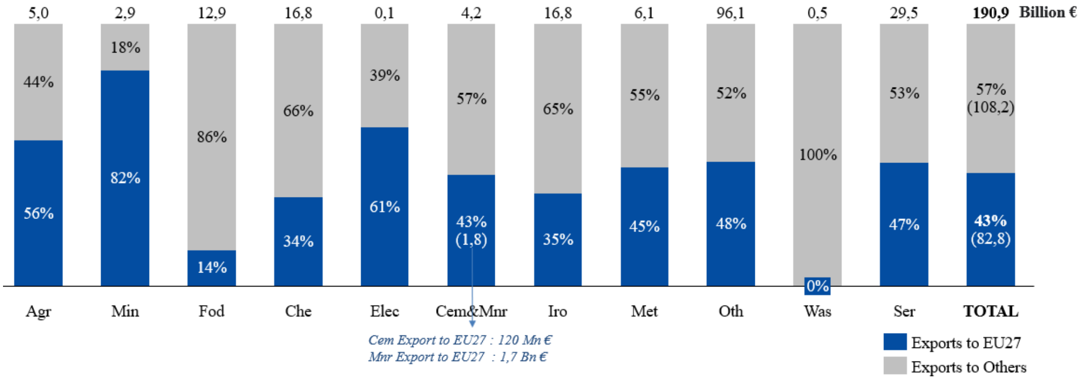

Figure 5.2 Sectoral Exports (EU-27 Differentiated) of Turkey in 2019

Within exports to EU, Oth sector has the largest share, which is 55.2% (worth of €45.7 B), as it is an aggregated SAM category and includes the highest number of commodities. Iro constitutes 7.2% with export value of €5.93 B and Cem has 0.1% share with €0.12 B.

Share of exports to EU is presented in the Figure 5.3 and detailed information of Turkey’s exports to EU (in HS codes) is given in the Appendix D.

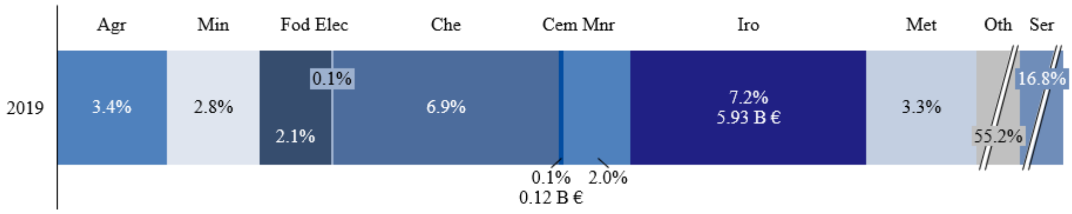

Figure 5.3 Share of Exports to European Union

5.3 Input-Output Analysis for Embodied Emissions of Exports to EU

I-O analysis (using below equation) is carried out to calculate the sectoral GHG emissions embodied in the exports to the EU and to disaggregate different scopes of emissions (Acar et al., 2021).

$$GHG = K_{GHG}(I-A)^{-1}EX_{EU} \qquad \text{(Equation 5.1)}$$

where,

EX_{EU} : the diagonalized vector of exports to EU

$(I-A)^{-1}$: the Leontief inverse

K_{GHG} : the diagonalized GHG intensity vector

GHG : 14*14 matrix of GHG emissions embodied in exports to EU

- Scope 1: diagonal entries of the matrix
- Scope 2: entries of electricity sector row
- Scope 3: sum of rest of the column entries

GHG intensity (tCO_2e/MTRY) reflects the amount of GHG emissions per sectoral supply value and given in the table below.

Table 5.1 Sectoral GHG Intensity Values

SAM Sector	Emission (Mt CO_2e)	Total Supply (MTRY)	GHG Intensity (tCO_2e / MTRY)
Agr	78.89	550,623	143.27
Min	7.77	273,101	28.46
Fod	5.18	545,586	9.49
Che	8.72	517,848	16.84
Tra	82.43	651,334	126.55
Elec	140.98	332,761	423.67
Cem	51.45	36,373	1,414.47
Mnr	10.83	120,684	89.73

Table 5.1 Sectoral GHG Intensity Values (continued)

SAM Sector	Emission ($Mt\ CO_2e$)	Total Supply (MTRY)	GHG Intensity (tCO_2e / MTRY)
Iro	15.15	382,648	39.60
Met	1.11	187,812	5.93
Con	0.70	807,035	0.86
Oth	27.06	1,869,330	14.47
Was	17.25	128,041	134.70
Ser	14.92	3,335,959	4.47

Results of I-O analysis revealed that Turkish exports to the EU in 2019 contained 39.6 Mt CO_2e emissions; 15 Mt CO_2e scope 1 emissions, 10.9 Mt CO_2e scope 2 emissions and 13.7 Mt CO_2e scope 3 emissions (Figure 5.4).

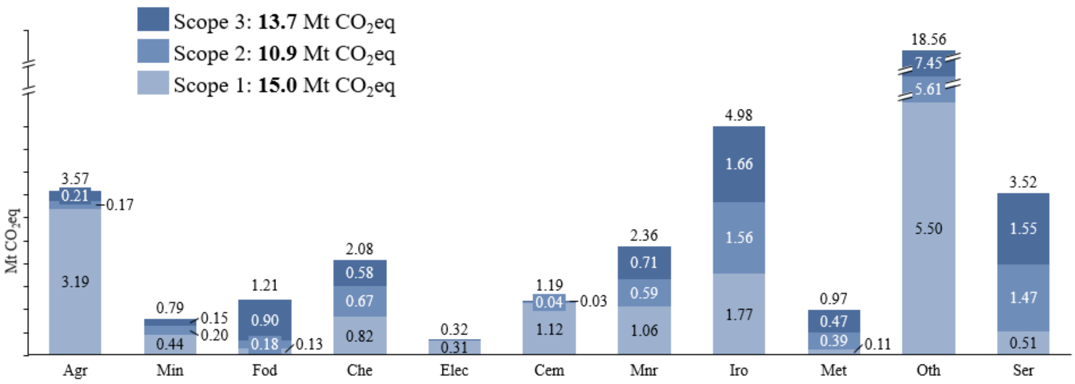

Figure 5.4 Emissions Embodied in Exports to European Union

Oth sector has the majority of GHG emissions, almost half of it. The main reason is that it includes the highest number of commodities, highest export value and an aggregated SAM sector which includes the rest of NACE C codes. Apart from Oth sector, Iro sector has higher GHG emissions, followed by Agr, Ser, Mnr, Che and Cem sectors.

5.4 Carbon Price Scenarios

To achieve necessary changes in line with the objectives of Paris Agreement, an effective level of carbon price is needed. Carbon prices should be high enough to have the adequate price signal and deliver the expected emission reductions by driving such as fostering low-carbon investments, innovation, changing behaviors (The World Bank, 2017). Three carbon price scenarios for CBAM are taken in this study based on different carbon price estimations, suggestions, and EU allowance prices.

CP_1 (Min price): \$50/tCO_2e – €45/tCO_2e [10]

High-Level Commission on Carbon Prices stated that \$50-\$100/tCO_2e is the price range by 2030 consistent with the Paris Agreement goals (The World Bank, 2017). Kaufman et al. finds that \$52/tCO_2e as the carbon price in 2025 which is consistent with the 2050 net zero target (Kaufman et al., 2020). IMF proposes international carbon price floor of \$50/tCO_2e for high income emerging market economies by 2030 to keep global warming below 2°C (Parry et al., 2021). By considering these findings, \$50 - €45/tCO_2e is taken as the minimum carbon price in this study

CP_2 (Avg price): 80 \$/tCO_2e – 71 €/ tCO_2e

Proposal of IMF includes an international carbon price floor of \$75/tCO_2e for advanced market economies by 2030 (Parry et al., 2021). \$40-\$80/tCO_2e is the recommended explicit carbon price range by 2020 consistent with the temperature target in the Report of High-Level Commission on Carbon Prices (The World Bank, 2017). Maximum value of this range (\$80/tCO2e – €71/tCO_2e) is taken as the average price scenario. This value is also within the 2030 illustrative carbon price

[10] *\$ - € exchange rate in 2019: 1.1199 \$ = 1 €*

range of Kaufman et al. for both 2040 and 2050 net zero pathway (Kaufman et al., 2020).

CP_3 (Max price): 112 $/t$CO_2$e – 100 €/t$CO_2$e

Carbon price range by 2030 of Kaufman et al. for 2050 net zero pathway is $75 to $125/t$CO_2$e and the benchmark value is around $100/t$CO_2$e (Kaufman et al., 2020). Reuters carried out a poll with climate economists in the latest quarter of 2021 and median carbon price forecast was $100/t$CO_2$e to reach net zero by 2050 (Bhat, 2021). The price of EU ETS carbon permits hit a record of €96.93 per tonne on February 8, 2022 and become quite close to €100 (Figure 5.5). Analysts expecting that €100 milestone will be reached within 2022. Therefore, €100/tCO_2e is taken as the maximum carbon price in this study.

Figure 5.5 European Union Allowance Prices (Ember, 2022)

5.5 Carbon Costs and Shadow Tax Rates

Although CBAM is not declared as finalized yet, adoption of the regulation is expected within 2022 and exporters to the EU will be affected from this mechanism. As Acar et al. (2021) mentions, even only scope 1 emissions are priced, both production costs and costs of sectors using those products as inputs will be affected (Acar et al., 2021). By considering the main objective of CBAM as eliminating disadvantages of EU industries and equally reflecting the social cost of carbon on the imports as reflected on the EU products, and also through the planned evaluations by European Commission to include indirect emissions in CBAM; it is expected that, not only scope 1 emissions but also scope 2 and scope 3 emissions[11] of exported goods will be affected from the CBAM after it starts to be fully operational. Additionally, European Parliament Committee on the Environment, Public Health and Food Safety clearly stated their official position and voted that CBAM should include both direct and indirect emissions (European Parliament, 2022). Therefore, the assumption taken in this thesis is that CBAM will cover all three scopes of emissions and carbon costs are calculated accordingly.

Embodied GHG emissions in exports to EU are multiplied by three carbon prices and corresponding carbon cost of CBAM on the Turkish exporters is calculated (Figure 5.6). Hence, CBAM may cost €1.8 - €2.8 - €4 billion annually if exporters were required to pay €45 - €71 - €100 per tonne of GHG emissions. Total revenue of exports to EU in 2019 is €82.8 billion and calculated carbon costs constitute 2.1%, 3.4% and 4.8% of total export revenues, respectively.

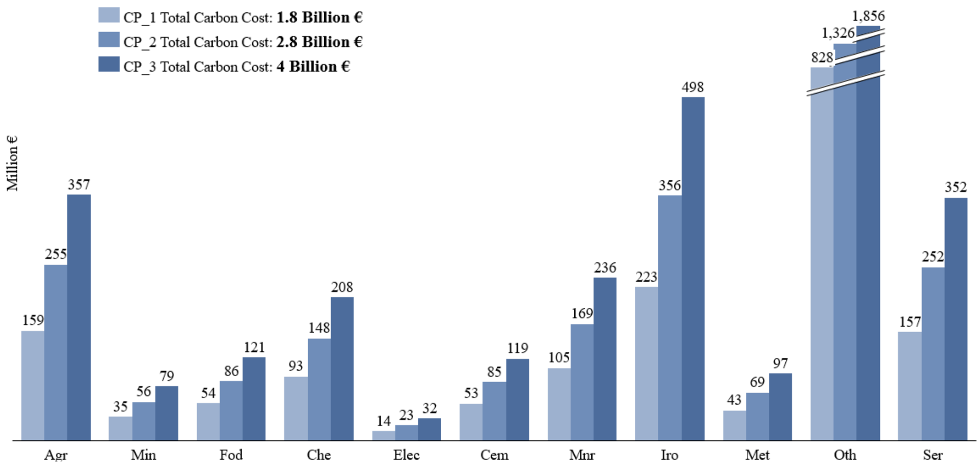

Figure 5.6 Sectoral Carbon Costs of CBAM under Different Carbon Price Scenarios

[11] Scope 1 emissions: Direct emissions from owned or controlled sources (WBCSD & WRI, 2012)
Scope 2 emissions: Indirect emissions from the generation of purchased energy (WBCSD & WRI, 2012)
Scope 3 emissions: All indirect emissions (not included in scope 2) occurring in the value chain of the company (includes both downstream and upstream emissions) (WBCSD & WRI, 2012)

As Acar et al. (2021) states that level of vulnerability of sectors to CBAM might not be quantified in the carbon costs. Therefore, to reflect the risk of decrease in sectoral revenues and differentiate the sectoral vulnerability to CBAM, shadow tax rates (carbon cost/export revenue) are calculated. Shadow tax rate shows how much the exporter should pay back per €100 of the earned export revenues. As illustrated in Figure 5.7, according to results, highest export revenue fall risk is seen on Cem sector and followed by Elec sector. Revenue fall risk of Iro is quite low as compared to Cem.

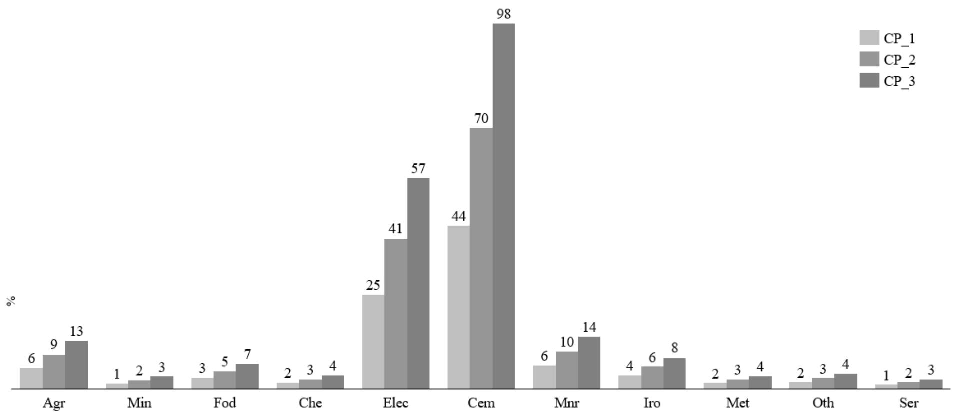

Figure 5.7 Sectoral Shadow Tax Rates under Different Carbon Price Scenarios

Net weights of the exported cement and iron-steel commodities is compiled from the United Nations database to understand the reason behind CBAM vulnerabilities better. In order to express the unit value of exports, an approximate calculation is made (trade value/net weight) and given in the last column of the Table 5.2.

Table 5.2 Netweights (ton) and Value (€) of Cem and Iro Exports to EU

SAM Sector	HS Code	Commodity	EU-27 Trade Value (€)	Netweight (ton)	Approximate Unit Value (€/ton)
Cem	252310	Cement clinkers (whether or not coloured)	35,805,192	849,080	42
	252321	Cement; portland, white, whether or not artificially coloured	32,420,771	399,384	81
	252329	Cement; portland, other than white, whether or not artificially coloured	37,701,262	719,974	52
	252330	Cement; aluminous (ciment fondu), whether or not coloured or in the form of cl	5,437,358	19,152	284
	252390	Cement; hydraulic kinds n.e.c. in heading no. 2523	147,720	1,310	113
	6810	Articles of cement, of concrete or of artificial stone, whether or not reinforced	7,744,846	36,724	211
	6811	Articles of asbestos-cement, of cellulose fibre-cement or the like	1,584,401	3,544	447
Iro	72	Iron and steel	3,411,108,213	6,318,873	540
	73	Iron or steel articles	2,523,797,678	2,056,907	1227

Source: Author's compilation (United Nations, 2022)

Commodities constituting the 97% of Cem exports' net weight (HS code: 252310, 252321, 252329) has a unit value less than €100 per ton. On the other hand, unit value of Iro products is between €540 and €1,227 per ton. Therefore, pricing carbon (€45-€71-€100 per ton GHG emissions) would have worse effects on Cem than Iro.

Average emission intensity of cement sector in Turkey is 852 kg CO_2 emissions per ton clinker, while the world average is 836 and EU average is 815 kg CO_2 emissions per ton clinker in 2018 (ZKG Cement Lime Gypsum, 2020). As the performance of Turkish cement sector is worse than both EU and world, respective cost due to high emissions intensity would be higher for Turkey.

When the emission intensities of iron-steel and cement sectors (kg CO_2/€), which is an important factor for carbon leakage risk, are examined, it is also seen that cement sector's intensity are higher than iron-steel (Figure 5.8).

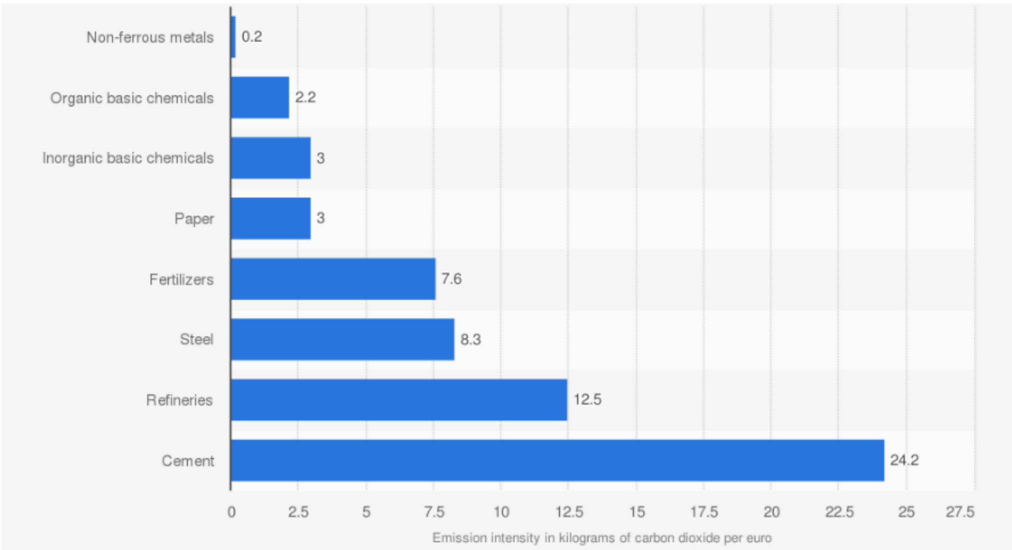

Figure 5.8 Emission Intensity of Some Sectors in EU in 2020 (kg CO_2/€)

Source: (Fertilizers Europe, 2020; Statista, 2021a)

5.6 SAM Multiplier Analysis

The multiplier analysis method adopted in this thesis is the unconstrained multiplier formula to examine the effects of a decrease in exogenous export demand. In this section, first matrix of average expenditure propensities and accounting multiplier matrix are created. Later, a unitary shock is applied for SAM multiplier analysis in order to analyze the same amount of shock's effects on each sector and then carbon costs of each sector generated due to CBAM are applied as exogenous shock and the effects of CBAM on Turkish economy is examined. Finally, results of ten different demand ranges are examined from the perspective of free allocation of allowances. Results of multiplier analysis are presented in the following sub-sections.

5.6.1 The Derivation of SAM Multipliers

Fundamentals of SAM multiplier analysis are given in Section 4.2.3 and main steps of multiplier approach followed in this study is summarized below:

- SAM is separated into endogenous and exogeneous accounts. Government, saving-investment, and ROW are taken as exogeneous account. Activities, commodities, factors of production and households accounts are determined as endogenous accounts (Erik Thorbecke, 2000).
- Average expenditure propensities matrix (A_{SAM}) of endogenous variables is generated by dividing each endogenous element by the corresponding column sum (Erik Thorbecke, 2000).
- M_{SAM}, which is accounting multiplier matrix, is created via the formula of $(1 - A_{SAM})^{-1}$.

<u>Matrix of Average Expenditure Propensities</u>

Matrix of average expenditure propensities is derived from disaggregated SAM of Turkey and given in Table 5.3.

Some evaluations obtained from matrix of average expenditure propensities are summarized below:

- Out of total agricultural production, labor receives 3% and capital receives 53. In turn, total intermediate inputs used in agriculture amount to 44%.
- Out of total cement production, labor receives 13% and capital receives 25. Total intermediate inputs used in cement sector amount to 62%.
- Out of total iron-steel production, labor receives 11% and capital receives 19%. Total intermediate inputs used in iron-steel sector amount to 70%.
- Households pay 6% of their income to taxes. 4% of household's total income was spent on agriculture commodities, 8% on food, 31% on services. Household save 32% of their income.

The final three columns in the average expenditure propensities matrix are stated exogenous accounts and they cannot generate indirect linkage effects. Therefore, cells of these accounts are left as zero, while sum of other columns (which are endogenous accounts) are equal to one (IFPRI, 2010).

Accounting Multiplier Matrix

Excel matrix algebra commands are used to create accounting multiplier matrix. Firstly, an identity matrix is generated and A_{SAM} is subtracted from this identity matrix to achieve (1-A_{SAM}). This matrix is inverted using the Excel "MINVERSE" formula and, accounting multiplier matrix, $M_{SAM} = (1 - A_{SAM})^{-1}$, is created.

Table 5.4 presents the matrix of accounting multipliers for Turkish economy in 2019.

Table 5.3 Matrix of Average Expenditure Propensities for Turkish Economy in 2019

		ACTIVITIES (1)													
		AGR	MIN	FOD	CHE	TRA	ELEC	CEM	MNR	IRO	MET	CON	OTH	WAS	SER
	AGR														
	MIN														
	FOD														
	CHE														
	TRA														
	ELEC														
1	CEM														
	MNR														
	IRO														
	MET														
	CON														
	OTH														
	WAS														
	SER														
	AGR	0.21	0.01	0.31	0.01	0.0001	0.000002	0.001	0.001	0.00001	0.00001	0.001	0.02	0.0004	0.01
	MIN	0.003	0.06	0.004	0.02	0.001	0.21	0.15	0.15	0.06	0.07	0.02	0.07	0.004	0.003
	FOD	0.06	0.002	0.16	0.002	0.001	0.0002	0.001	0.001	0.0005	0.001	0.001	0.003	0.003	0.03
	CHE	0.06	0.02	0.03	0.43	0.01	0.001	0.04	0.04	0.02	0.03	0.04	0.07	0.04	0.01
	TRA	0.02	0.08	0.04	0.05	0.20	0.01	0.05	0.05	0.05	0.06	0.03	0.04	0.04	0.03
	ELEC	0.01	0.04	0.01	0.02	0.002	0.51	0.05	0.05	0.03	0.04	0.002	0.01	0.07	0.01
2	CEM	0.0002	0.001	0.001	0.001	0.001	0.0002	0.03	0.03	0.001	0.001	0.02	0.001	0.001	0.001
	MNR	0.001	0.01	0.002	0.005	0.002	0.001	0.09	0.09	0.003	0.004	0.08	0.003	0.002	0.003
	IRO	0.0003	0.01	0.002	0.01	0.003	0.0004	0.01	0.01	0.18	0.20	0.10	0.05	0.01	0.003
	MET	0.0002	0.01	0.001	0.01	0.001	0.0002	0.004	0.004	0.10	0.12	0.06	0.03	0.004	0.002
	CON	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.002	0.002	0.12	0.001	0.06	0.01
	OTH	0.04	0.11	0.02	0.04	0.10	0.01	0.07	0.07	0.02	0.02	0.09	0.29	0.04	0.04
	WAS	0.003	0.0002	0.001	0.004	0.0002	0.0001	0.002	0.002	0.15	0.17	0.001	0.003	0.19	0.003
	SER	0.05	0.13	0.11	0.13	0.11	0.05	0.12	0.12	0.08	0.09	0.15	0.13	0.18	0.20
	3	0.03	0.14	0.09	0.10	0.12	0.03	0.13	0.13	0.11	0.08	0.10	0.11	0.08	0.27
	4	0.53	0.38	0.22	0.17	0.45	0.18	0.25	0.25	0.19	0.13	0.19	0.16	0.29	0.38
	5														
	6														
	7														
	8														
	TOTAL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

		COMMODITIES (2)																			
		AGR	MIN	FOD	CHE	TRA	ELEC	CEM	MNR	IRO	MET	CON	OTH	WAS	SER	LAB (3)	CAP (4)	HH (5)	GOV (6)	S-I (7)	RoW (8)
	AGR	0.91																			
	MIN		0.26																		
	FOD			0.79																	
	CHE				0.46																
	TRA					0.99															
	ELEC						0.98														
1	CEM							0.92													
	MNR								0.92												
	IRO									0.69											
	MET										0.21										
	CON											0.98									
	OTH												0.55								
	WAS													0.68							
	SER														0.93						
	AGR																	0.04			
	MIN																	0.004			
	FOD																	0.08			
	CHE																	0.01			
	TRA																	0.06			
	ELEC																	0.02			
2	CEM																	0.0005			
	MNR																	0.001			
	IRO																	0.002			
	MET																	0.0002			
	CON																	0.001			
	OTH																	0.09			
	WAS																	0.004			
	SER																	0.31			
	3																				
	4																				
	5															1.00	1.00				
	6	-0.02	0.10	0.14	0.05	0.01	0.02	0.01	0.01	0.06	0.02	0.02	0.13	0.04	0.02			0.06			
	7																	0.32			
	8	0.11	0.63	0.07	0.50	0.0000001	0.001	0.07	0.07	0.25	0.77		0.32	0.28	0.04						
	TOTAL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			

Table 5.4 Accounting Multipliers for the 2019 Turkish Economy

		ACTIVITIES (1)													
		AGR	MIN	FOD	CHE	TRA	ELEC	CEM	MNR	IRO	MET	CON	OTH	WAS	SER
1	AGR	1.38	0.13	0.52	0.10	0.13	0.09	0.11	0.11	0.09	0.09	0.11	0.12	0.12	0.15
	MIN	0.01	1.03	0.01	0.02	0.01	0.12	0.06	0.06	0.03	0.04	0.02	0.03	0.02	0.01
	FOD	0.20	0.14	1.30	0.10	0.15	0.10	0.12	0.12	0.11	0.10	0.12	0.11	0.13	0.18
	CHE	0.07	0.04	0.06	1.27	0.04	0.02	0.05	0.05	0.04	0.04	0.06	0.07	0.05	0.04
	TRA	0.20	0.27	0.24	0.20	1.43	0.15	0.22	0.22	0.21	0.21	0.20	0.19	0.22	0.23
	ELEC	0.10	0.15	0.10	0.11	0.09	2.05	0.19	0.19	0.16	0.17	0.10	0.10	0.24	0.12
	CEM	0.002	0.004	0.003	0.003	0.003	0.002	1.03	0.03	0.003	0.003	0.03	0.003	0.005	0.004
	MNR	0.01	0.01	0.01	0.01	0.01	0.01	0.10	1.10	0.01	0.01	0.10	0.01	0.02	0.01
	IRO	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.02	1.15	0.17	0.11	0.06	0.02	0.02
	MET	0.002	0.004	0.003	0.003	0.003	0.002	0.003	0.003	0.03	1.03	0.02	0.01	0.004	0.003
	CON	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	1.14	0.01	0.08	0.02
	OTH	0.16	0.20	0.15	0.13	0.21	0.11	0.17	0.17	0.12	0.12	0.18	1.29	0.16	0.17
	WAS	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.15	0.16	0.02	0.02	1.16	0.01
	SER	0.71	0.77	0.77	0.64	0.81	0.58	0.71	0.71	0.62	0.60	0.76	0.65	0.84	1.91
2	AGR	0.42	0.14	0.57	0.11	0.14	0.10	0.12	0.12	0.10	0.10	0.12	0.13	0.13	0.16
	MIN	0.05	0.13	0.05	0.08	0.05	0.46	0.24	0.24	0.13	0.14	0.09	0.13	0.09	0.06
	FOD	0.26	0.17	0.38	0.13	0.19	0.13	0.15	0.15	0.13	0.13	0.15	0.14	0.17	0.22
	CHE	0.15	0.10	0.13	0.59	0.08	0.05	0.12	0.12	0.09	0.09	0.12	0.15	0.12	0.08
	TRA	0.21	0.27	0.24	0.21	0.44	0.15	0.22	0.22	0.21	0.22	0.21	0.19	0.22	0.23
	ELEC	0.10	0.16	0.11	0.12	0.09	1.08	0.19	0.19	0.16	0.17	0.10	0.10	0.25	0.12
	CEM	0.003	0.004	0.003	0.004	0.003	0.003	0.03	0.03	0.004	0.004	0.03	0.003	0.01	0.004
	MNR	0.01	0.01	0.01	0.01	0.01	0.01	0.11	0.11	0.01	0.01	0.10	0.01	0.02	0.01
	IRO	0.02	0.04	0.02	0.03	0.03	0.02	0.03	0.03	0.22	0.25	0.16	0.09	0.04	0.02
	MET	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.13	0.15	0.09	0.05	0.02	0.01
	CON	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.15	0.01	0.09	0.02
	OTH	0.29	0.37	0.28	0.24	0.39	0.21	0.31	0.31	0.22	0.22	0.34	0.53	0.29	0.31
	WAS	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.22	0.24	0.03	0.03	0.23	0.02
	SER	0.76	0.82	0.83	0.68	0.87	0.62	0.76	0.76	0.66	0.65	0.81	0.70	0.90	0.98
3		0.31	0.44	0.40	0.37	0.44	0.29	0.43	0.43	0.37	0.34	0.42	0.38	0.41	0.60
4		1.21	0.98	1.03	0.69	1.13	0.81	0.83	0.83	0.74	0.69	0.81	0.70	0.95	1.01
5		1.52	1.42	1.43	1.05	1.57	1.10	1.26	1.26	1.11	1.03	1.22	1.08	1.36	1.61
6		0.20	0.20	0.21	0.17	0.21	0.20	0.20	0.20	0.18	0.17	0.19	0.20	0.20	0.21
7		0.49	0.45	0.46	0.34	0.50	0.35	0.40	0.40	0.36	0.33	0.39	0.35	0.44	0.52
8		0.32	0.34	0.34	0.49	0.29	0.45	0.40	0.40	0.47	0.50	0.42	0.45	0.36	0.28

		COMMODITIES (2)														LAB (3)	CAP (4)	HH (5)	GOV (6)	S-I (7)	RoW (8)
		AGR	MIN	FOD	CHE	TRA	ELEC	CEM	MNR	IRO	MET	CON	OTH	WAS	SER						
1	AGR	1.25	0.03	0.41	0.05	0.13	0.09	0.10	0.10	0.06	0.02	0.10	0.07	0.08	0.14	0.14	0.14	0.14			
	MIN	0.01	0.27	0.01	0.01	0.01	0.12	0.06	0.06	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01			
	FOD	0.19	0.04	1.03	0.05	0.15	0.10	0.11	0.11	0.07	0.02	0.12	0.06	0.09	0.16	0.16	0.16	0.16			
	CHE	0.06	0.01	0.05	0.58	0.04	0.02	0.05	0.05	0.03	0.01	0.06	0.04	0.04	0.04	0.03	0.03	0.03			
	TRA	0.18	0.07	0.19	0.09	1.41	0.14	0.20	0.20	0.14	0.05	0.20	0.10	0.15	0.21	0.19	0.19	0.19			
	ELEC	0.09	0.04	0.08	0.05	0.09	2.01	0.17	0.17	0.11	0.04	0.10	0.06	0.16	0.11	0.09	0.09	0.09			
	CEM	0.002	0.001	0.002	0.002	0.003	0.002	0.95	0.03	0.00	0.00	0.03	0.002	0.003	0.003	0.002	0.002	0.002			
	MNR	0.01	0.00	0.01	0.01	0.01	0.01	0.09	1.01	0.01	0.00	0.09	0.01	0.01	0.01	0.01	0.01	0.01			
	IRO	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.79	0.04	0.10	0.03	0.02	0.02	0.01	0.01	0.01			
	MET	0.002	0.001	0.002	0.002	0.003	0.002	0.003	0.003	0.02	0.22	0.02	0.01	0.003	0.003	0.002	0.002	0.002			
	CON	0.01	0.003	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.00	1.12	0.01	0.06	0.02	0.01	0.01	0.01			
	OTH	0.14	0.05	0.12	0.06	0.21	0.11	0.16	0.16	0.08	0.03	0.18	0.71	0.11	0.16	0.14	0.14	0.14			
	WAS	0.01	0.003	0.01	0.01	0.01	0.01	0.01	0.01	0.10	0.04	0.02	0.01	0.78	0.01	0.01	0.01	0.01			
	SER	0.65	0.20	0.61	0.29	0.80	0.57	0.65	0.65	0.42	0.13	0.75	0.36	0.57	1.79	0.72	0.72	0.72			
2	AGR	1.38	0.04	0.45	0.05	0.14	0.10	0.11	0.11	0.07	0.02	0.11	0.07	0.09	0.15	0.16	0.16	0.16			
	MIN	0.04	1.03	0.04	0.03	0.05	0.45	0.22	0.22	0.09	0.03	0.09	0.07	0.06	0.05	0.04	0.04	0.04			
	FOD	0.23	0.05	1.30	0.06	0.18	0.13	0.14	0.14	0.09	0.03	0.15	0.07	0.11	0.21	0.20	0.20	0.20			
	CHE	0.14	0.03	0.10	1.27	0.08	0.05	0.11	0.11	0.06	0.02	0.12	0.08	0.08	0.08	0.07	0.07	0.07			
	TRA	0.19	0.07	0.19	0.09	1.43	0.15	0.20	0.20	0.15	0.05	0.20	0.10	0.15	0.22	0.19	0.19	0.19			
	ELEC	0.09	0.04	0.08	0.05	0.09	2.05	0.18	0.18	0.11	0.04	0.10	0.06	0.17	0.11	0.09	0.09	0.09			
	CEM	0.002	0.001	0.003	0.002	0.003	0.002	1.03	0.03	0.00	0.001	0.03	0.002	0.003	0.004	0.002	0.002	0.002			
	MNR	0.01	0.004	0.01	0.01	0.01	0.01	0.10	1.10	0.01	0.003	0.10	0.01	0.01	0.01	0.01	0.01	0.01			
	IRO	0.02	0.01	0.02	0.01	0.03	0.02	0.03	0.03	1.15	0.05	0.15	0.05	0.02	0.02	0.02	0.02	0.02			
	MET	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.09	1.03	0.09	0.03	0.01	0.01	0.01	0.01	0.01			
	CON	0.01	0.003	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.004	1.14	0.01	0.06	0.02	0.01	0.01	0.01			
	OTH	0.26	0.10	0.22	0.11	0.39	0.20	0.29	0.29	0.15	0.05	0.33	1.29	0.20	0.29	0.26	0.26	0.26			
	WAS	0.02	0.004	0.01	0.01	0.02	0.01	0.01	0.01	0.15	0.05	0.03	0.01	1.16	0.02	0.01	0.01	0.01			
	SER	0.69	0.22	0.65	0.31	0.85	0.61	0.70	0.70	0.45	0.14	0.80	0.38	0.61	1.91	0.77	0.77	0.77			
3		0.28	0.12	0.32	0.17	0.44	0.28	0.39	0.39	0.26	0.07	0.41	0.21	0.28	0.56	1.26	0.26	0.26			
4		1.10	0.26	0.81	0.31	1.11	0.79	0.76	0.76	0.51	0.15	0.79	0.38	0.64	0.95	0.53	1.53	0.53			
5		1.37	0.37	1.13	0.48	1.55	1.07	1.16	1.16	0.76	0.22	1.20	0.59	0.92	1.51	1.79	1.79	1.79			
6		0.16	0.16	0.30	0.13	0.22	0.22	0.19	0.19	0.18	0.06	0.21	0.24	0.18	0.22	0.20	0.20	0.20	1.00		
7		0.44	0.12	0.36	0.15	0.50	0.34	0.37	0.37	0.24	0.07	0.39	0.19	0.29	0.48	0.57	0.57	0.57		1.00	
8		0.40	0.72	0.34	0.72	0.29	0.44	0.44	0.44	0.57	0.87	0.41	0.57	0.53	0.30	0.23	0.23	0.23			1.00

5.6.2 Unitary Shock

Firstly, SAM multiplier analysis with a unitary exogenous demand shock for all sectors is carried out to examine an equal shock's sectoral effects on GDP and sectoral outputs. Given the linearity of the model, after this unitary evaluation, the model is applied to different magnitudes of the shock by considering carbon costs generated by CBAM in the following section.

All production and consumption linkage affects are measured by SAM multipliers; changes in the endogenous accounts due to the initial exogenous injections are translated by the SAM multipliers, i.e., output, demand, GDP and income multipliers (IFPRI, 2010):

> ***The output multipliers*** *add up all linkage effects to estimate the overall change in gross output for each sector.*
>
> ***The GDP multipliers*** *combine all labor and capital earnings generated by the additional production in all sectors.*
>
> ***The demand multiplier*** *reflects how demand for commodities changes* (IFPRI, 2010).

Multiplier effects (F_i) after a unitary shock (E_i) on each sector are calculated with Equation 4.2 (given below to remind). A_{SAM} includes all the information regarding the direct and indirect effects, and multiplier embedded in M_{SAM} determines the magnitude of effects (both sectoral and overall). After applying unitary exogenous shock with the multiplier formula, generated multipliers are given in Figure 5.9, and disaggregated results are presented in Appendix F.

$$F_i = (1 - A_{SAM})^{-1} E_i$$
$$= M_{SAM} E_i \qquad \text{(Eq. 4.2)}$$

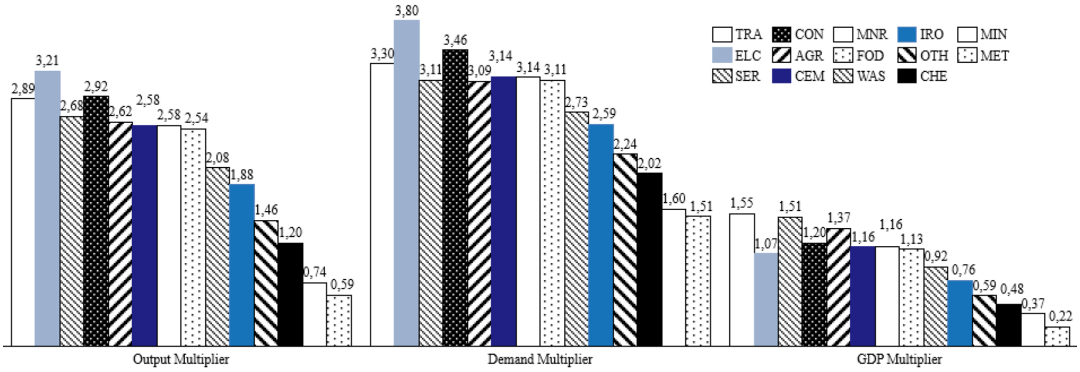

Figure 5.9 Multiplier Effects of a Unitary Shock in All Sectors

<u>General Results of Unitary Shock</u>

- Given that the electricity is an important input for almost all sectors in an integrated position, and also it is consumed directly by end users, we expect to see larger multiplier effects for electricity sector compared to all other sectors. Here, a unitary shock generates the largest output and demand multiplier effects for the electricity sector. GDP multiplier analysis shows that one-unit exogenous demand increase in this sector would result in 1.07-unit increase in GDP. Dautaj Şenerdem (2013) also reached similar results for electricity sector. Corresponding unconstrained SAM multipliers (output, demand, GDP) of electricity sector in her study were relatively quite high as compared to other sectors in Turkey (2010) which were presenting the highly integrated position of the sector (Dautaj Şenerdem, 2013).
- Transportation is the second sector showing higher multiplier effects. By considering their highly integrated position among the sectors and important relationships with the rest of the economy, decarbonization of electricity and transportation sectors should be priority. Their decarbonization will fasten the decarbonization of other sectors as well.
- Electricity and transportation sectors are followed by services and construction to deliver higher effects on the economy due to a unitary shock in exogenous demand. This implies that these sectors have strong direct and

indirect linkages and the leakages from imports and/or taxes are smaller compared to other sectors.

- The change in total demand as a result of the shock is larger than the change in output for all sectors. This shows that sectors in Turkey are highly dependent on imports (such as intermediate goods, natural gas etc.). This shows that if there was an increase in exogenous demand, not all the additional demand generated by this increase would be met by domestic production.

Cement Sector Results

- GDP multiplier corresponding to the cement sector account shows that one unit decrease in the exogenous demand (i.e. exports) will lead to a GDP decrease by 1.16 unit. GDP decreases more than the decrease in cement exports (1.16 times) once all linkages are accounted for.
- The output multiplier shows that decrease by one unit of exogenous demand in cement will cause 2.58-unit decrease in the output of producing activities. The total output multiplier effect reflects that decrease in cement exports leads to almost 2.5 times overall decrease in national output once all linkages are accounted for.
- Similarly, the unitary decrease shock in cement sector will lead to decrease in demand for all commodities by 3.14 units.

Iron-Steel Sector Results

- GDP and demand multiplier corresponding to the iron-steel sector shows that one unit decrease in the exogenous demand (i.e. exports) will lead to GDP decrease by 0.76 unit and to decrease in demand for all commodities by 2.59 units.
- The output multiplier shows that a decrease by one unit of exogenous demand in iron-steel will cause 1.88-unit decrease in the output of producing activities. This multiplier effect reflects that decrease in iron-steel exports

leads to almost 2 times overall decrease in national output once all linkages are accounted for.

- As stated above, 1 unit decrease in cement exports decreases GDP by 1.16 unit, while the same amount of decrease in iron-steel exports decreases GDP by 0.76 unit. These difference in GDP multipliers shows that cement sector has stronger linkages to the rest of the economy than iron-steel.

5.6.3 Decrease in Sectoral Exports by the Amount of Respective Carbon Cost

Decrease in sectoral exports by the amount of respective carbon cost is given as an exogenous shock and SAM multiplier analysis is carried out to examine the effects of this shock on GDP, sectoral outputs, and demand for each sector.

Multiplier effects of carbon cost shock for all carbon prices is presented for each sector. However, effects are examined in detail for iron-steel and cement sectors.

5.6.3.1 Carbon Price_1 Simulation

Under the minimum carbon price (CP_1), €45/tCO_2e, respective carbon cost of each sector is given in Figure 5.10.

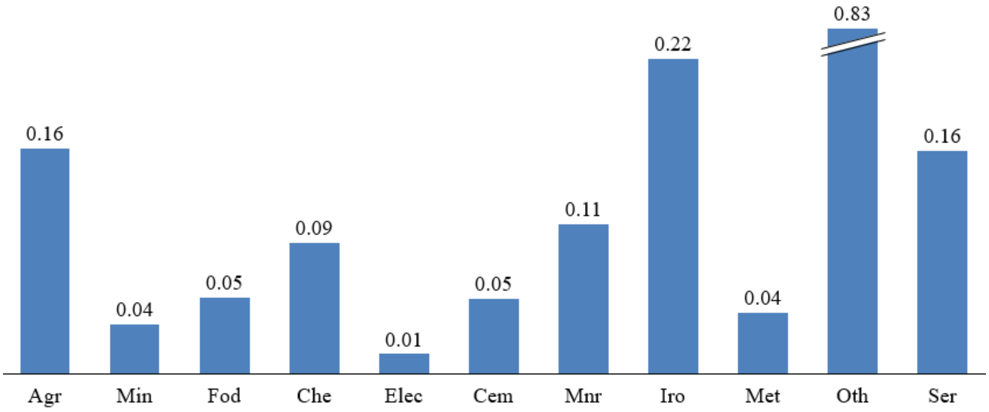

Figure 5.10 Carbon Costs (€ billion) of Sectors under CP_1

Carbon cost of each sector is given as exogenous shock of that sector and multiplier effects are obtained. Consolidated output, demand and GDP multipliers are given in Figure 5.11. Disaggregated results are presented in Appendix F.

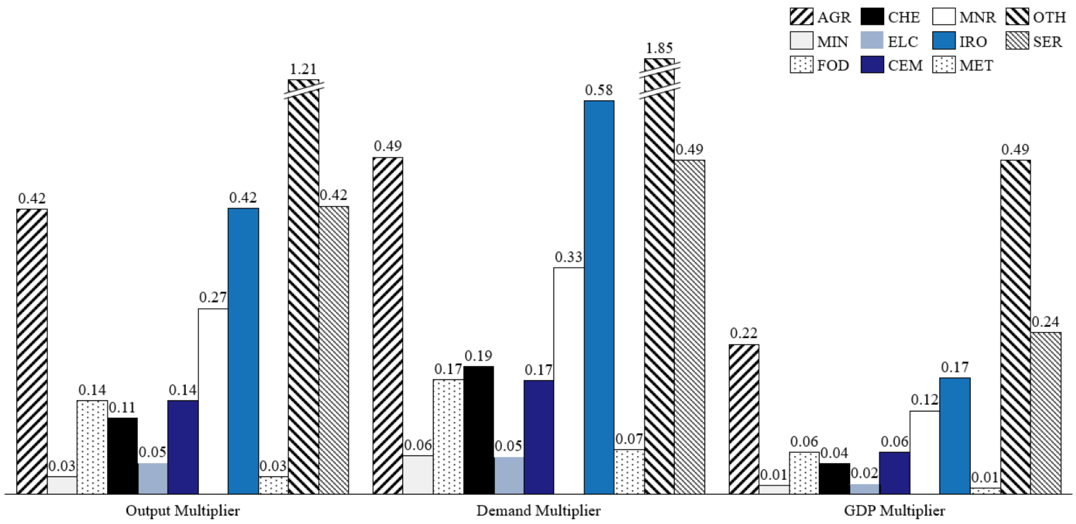

Figure 5.11 Multiplier Effects of a CP_1 Simulation of All Sectors

Figure 5.2 shows that Oth sector in the SAM (quite aggregated SAM sector) has an important export volume to EU compared to other SAM sectors. Results of the first carbon price scenario shows that a direct decrease in exogenous sector demand by €0.83 billion in Oth sector leads to a total decrease in output by €1.21 billion once all linkages and round-by-round effects are considered. Following aggregated Oth sector, Iro has the second largest demand multiplier and Iro, Agr and Ser (another aggregated SAM sector) have quite high GDP, output and income multipliers compared to others. Respective carbon costs' effects on the whole economy for these sectors will be higher than others. While Mnr has higher multipliers than Cem, For and Che, these three sectors exhibit quite close effects on output, demand, and GDP.

Cem Sector Results

€0.05 billion decrease in exports of Cem is applied as the exogenous shock in the unconstrained multiplier model. Effects of this shock, results of the unconstrained model are presented in Table 5.5. Additionally, output and demand multipliers are shown in Figure 5.12 and Figure 5.13.

Table 5.5 Unconstrained Multipliers under CP_1 Simulation of Cem Sector Shock

Given exogenous shock in unconstrained model:		€0.05 billion decrease in cement exports due to CBAM	
		Unconstrained Multipliers	Total
Activities	Agr	0.005	Output Multipliers (Total: 0.14)
	Min	0.003	
	Fod	0.006	
	Che	0.003	
	Tra	0.011	
	Elec	0.009	
	Cem	0.050	
	Mnr	0.005	
	Iro	0.001	
	Met	0.0002	
	Con	0.001	
	Oth	0.008	
	Was	0.001	
	Ser	0.035	
Commodities	Agr	0.006	Demand Multipliers (Total: 0.17)
	Min	0.011	
	Fod	0.007	
	Che	0.006	
	Tra	0.011	
	Elec	0.009	
	Cem	0.055	
	Mnr	0.005	
	Iro	0.001	
	Met	0.001	
	Con	0.001	
	Oth	0.015	
	Was	0.001	
	Ser	0.037	
Labor		0.021	GDP Multipliers (Total: 0.06)
Capital		0.041	
Household		0.061	
Government		0.010	
Saving/Investment		0.020	
Rest of World		0.023	

Decrease in Cem exports by €0.05 billion leads to a €0.06 billion decrease in economywide GDP. Additionally, the GDP multiplier is higher for capital than for labor for Cem which reflect the higher capital-intensity nature of the sector.

A direct decrease in exogenous Cem demand by €0.05 billion leads to a total decrease in output by €0.14 billion once all linkages and round-by-round effects are considered. The total output multiplier effect shows that €0.05 billion decrease in Cem exports leads to almost 2.5 times overall decrease in national output.

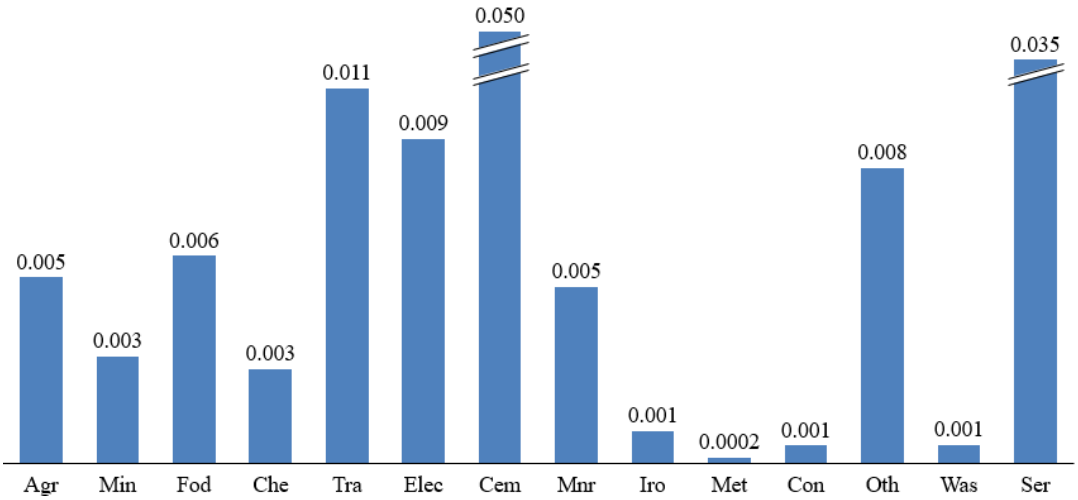

Figure 5.12 Ouput Multipliers for Cem Shock under CP_1 Simulation

The difference in multiplier effects can be seen through a closer look at the results in the activities account (IFPRI, 2010). The decomposition of Cem's multiplier effect indicates that decreasing export demand by €0.05 billion causes; mining output to decrease by €0.003 billion, chemicals by €0.003 billion, electricity by €0.009 billion, transportation by €0.011 billion and cement by €0.05 billion.

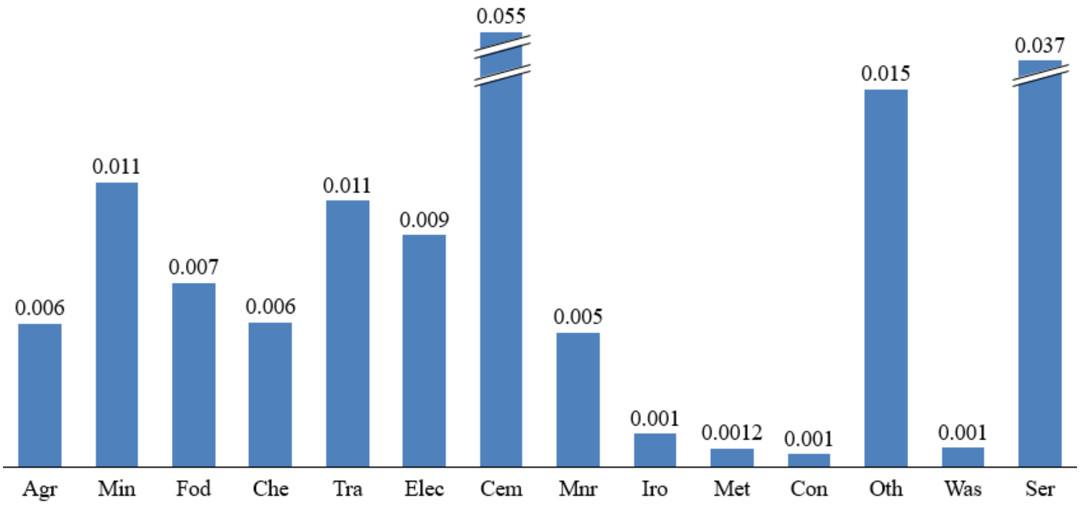

Figure 5.13 Demand Multipliers for Cem Shock under CP_1 Simulation

For cement sector's export decrease, Ser demand decreases by €0.037 billion, Oth by €0.015 billion, Che demand by €0.006 billion, electricity by €0.009 billion, mining by €0.011 billion.

Iro Sector Results

€0.22 billion decrease in exports of Iro is applied as the exogenous shock in the unconstrained multiplier model. Unconstrained multipliers generated under this shock are presented in Table 5.6. Additionally, output and demand multipliers are visualized in the Figure 5.14 and Figure 5.15.

Table 5.6 Unconstrained Multipliers under CP_1 Simulation of Iro Sector Shock

Given exogenous shock in unconstrained model:		€0.22 billion decrease in iron-steel exports due to CBAM	
		Unconstrained Multipliers	Total
Activities	Agr	0.014	Output Multipliers (Total: 0.42)
	Min	0.005	
	Fod	0.016	
	Che	0.006	
	Tra	0.032	
	Elec	0.024	
	Cem	0.000	
	Mnr	0.002	
	Iro	0.176	
	Met	0.0043	
	Con	0.003	
	Oth	0.019	
	Was	0.022	
	Ser	0.094	
Commodities	Agr	0.016	Demand Multipliers (Total: 0.58)
	Min	0.019	
	Fod	0.020	
	Che	0.014	
	Tra	0.033	
	Elec	0.025	
	Cem	0.001	
	Mnr	0.002	
	Iro	0.256	
	Met	0.020	
	Con	0.003	
	Oth	0.034	
	Was	0.033	
	Ser	0.101	
Labor		0.057	GDP Multipliers (Total: 0.17)
Capital		0.113	
Household		0.170	
Government		0.041	
Saving/Investment		0.054	
Rest of World		0.128	

Decrease in Iro exports by €0.22 billion leads to a €0.17 billion decrease in economywide GDP. GDP decreases less than the decrease in iron-steel exports (almost 0.76 times) once all linkages are accounted for. Additionally, the GDP multiplier is higher for capital than for labor which reflects the more capital-intensity nature of the sector.

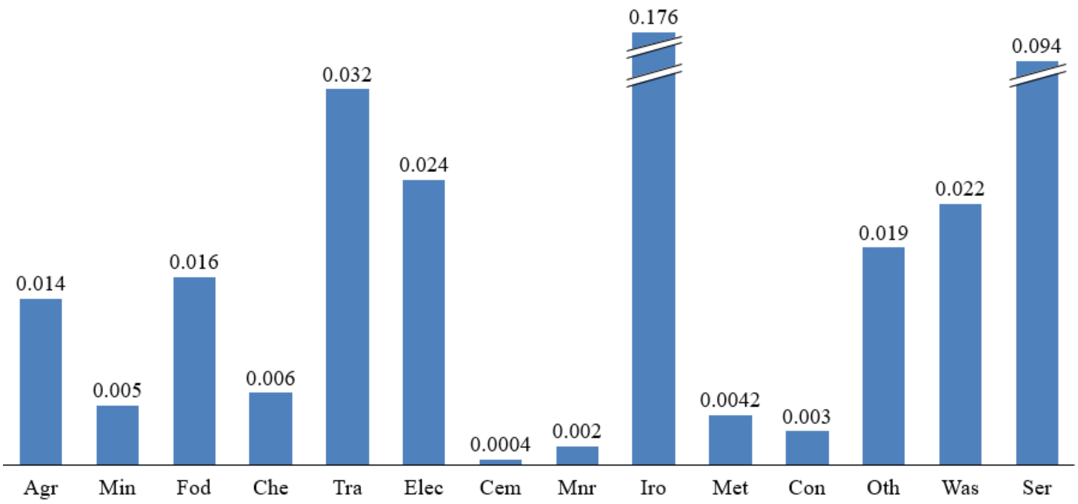

Figure 5.14 Ouput Multipliers for Iro Shock under CP_1 Simulation

The total output multiplier effect of Iro is €0.42 billion which shows that €0.22 billion decrease in exports leads to almost two times overall decrease in economy-wide output once all linkages are considered. Additionally, the decomposition of multiplier effect on activities indicates that decreasing exports by €0.22 billion causes; Tra output to decrease by €0.032 billion, Elec by €0.024 billion, Was by €0.022 billion, Iro by €0.176 billion and Ser output by €0.094 billion.

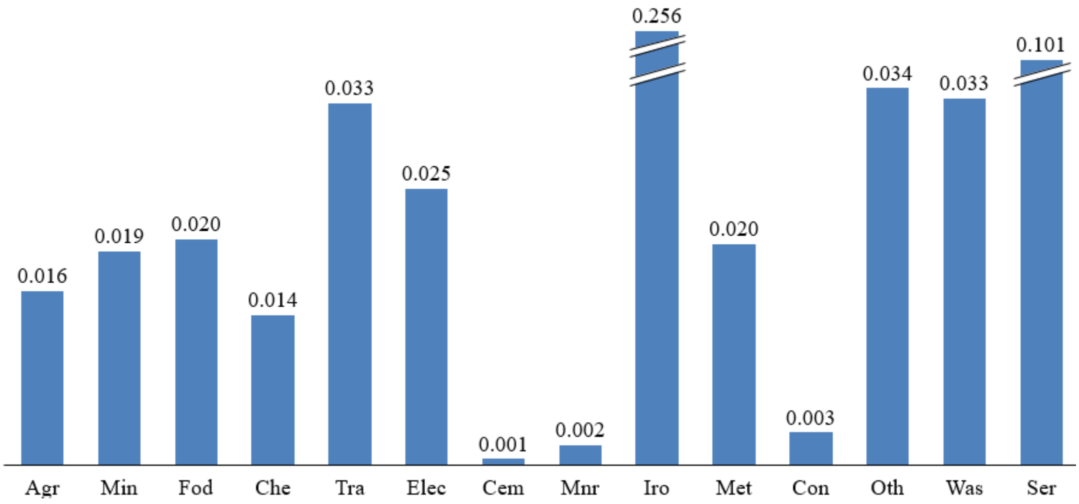

Figure 5.15 Demand Multipliers for Iro Shock under CP_1 Simulation

For Iro's sector's export decrease, Ser demand decreases by €0.101 billion, Oth by €0.034 billion, Tra demand by €0.033 billion, Was demand by €0.033 billion, electricity by €0.025 billion and mining by €0.019 billion.

5.6.3.2 Carbon Price_2 Simulation

Respective carbon cost of each sector under the moderate carbon price (CP_2), €71/tCO_2e, is given in Figure 5.16.

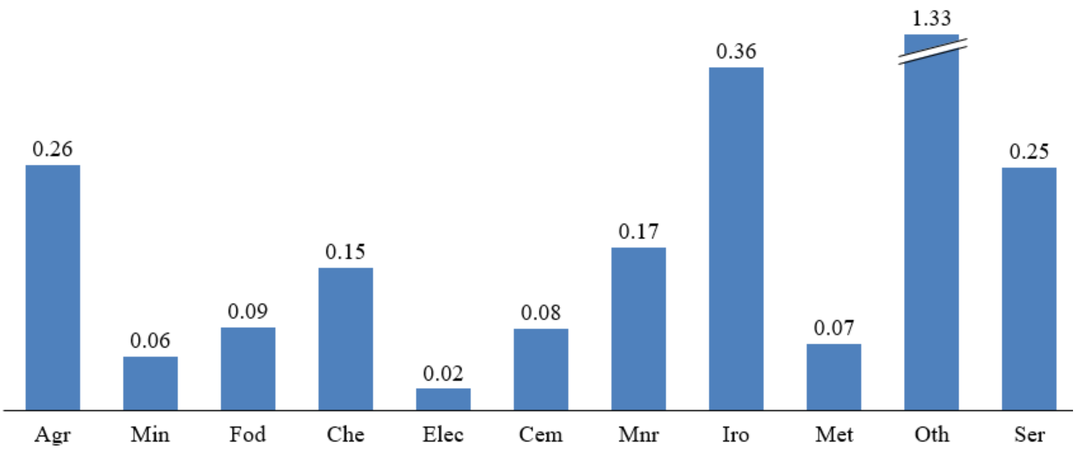

Figure 5.16 Carbon Costs (€ billion) of Sectors under CP_2

Carbon cost of each sector is given as exogenous shock of that sector and sectoral unconstrained multiplier effects are obtained. Consolidated output, demand and GDP multipliers are presented in Figure 5.17. Disaggregated results are presented in Appendix F.

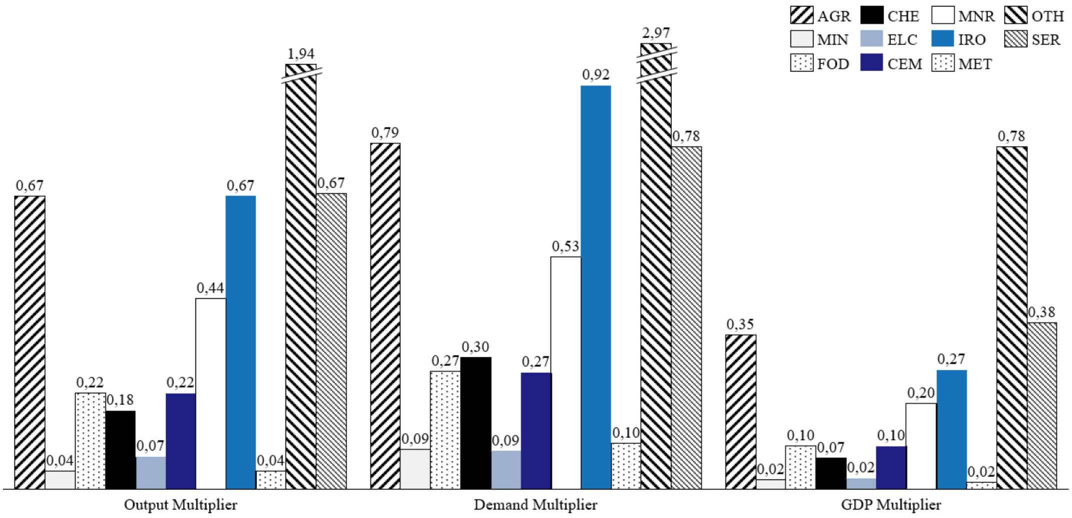

Figure 5.17 Multiplier Effects of a CP_2 Simulation of All Sectors

Oth, Iro, Ser and Agr keeps the higher multipliers as in the previous simulation. Results of the second carbon price scenario for Che shows that a direct decrease in exogenous sector demand by €0.15 billion in Che sector leads to a total decrease in demand by €0.3 billion once all linkages and round-by-round effects are considered. Decrease in agriculture and services exports by €0.26 and €0.25 billion, respectively, decrease the GDP by 0.39 and €0.38 billion.

Cem Sector Results

€0.08 billion decrease in exports of Cem is applied as the exogenous shock in the unconstrained multiplier model. Unconstrained multipliers are presented in Table 5.7. Additionally, output and demand multipliers are shown in the Figure 5.18 and Figure 5.19. It is seen that decrease in Cem exports by €0.08 billion leads to a €0.10 billion decrease in economywide GDP. Additionally, the GDP multiplier is higher for capital than for labor for Cem which reflect the higher capital-intensity nature of the sector.

Table 5.7 Unconstrained Multipliers under CP_2 Simulation of Cem Sector Shock

Given exogenous shock in unconstrained model:		€0.08 billion decrease in cement exports due to CBAM	
		Unconstrained Multipliers	Total
Activities	Agr	0.008	Output Multipliers (Total: 0.22)
	Min	0.005	
	Fod	0.009	
	Che	0.004	
	Tra	0.017	
	Elec	0.015	
	Cem	0.080	
	Mnr	0.008	
	Iro	0.001	
	Met	0.0003	
	Con	0.001	
	Oth	0.013	
	Was	0.001	
	Ser	0.055	
Commodities	Agr	0.009	Demand Multipliers (Total: 0.27)
	Min	0.018	
	Fod	0.012	
	Che	0.009	
	Tra	0.017	
	Elec	0.015	
	Cem	0.087	
	Mnr	0.009	
	Iro	0.002	
	Met	0.001	
	Con	0.001	
	Oth	0.024	
	Was	0.001	
	Ser	0.059	
Labor		0.033	GDP Multipliers (Total: 0.10)
Capital		0.065	
Household		0.098	
Government		0.016	
Saving/Investment		0.031	
Rest of World		0.037	

A direct decrease in exogenous Cem demand by €0.08 billion leads to a total decrease in gross output by €0.22 billion once all linkages and round-by-round effects are considered.

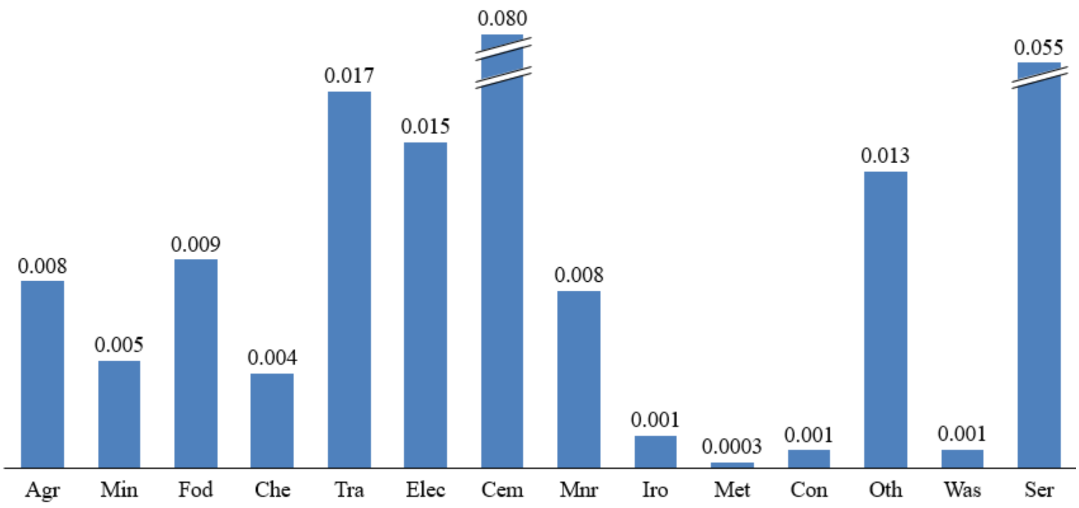

Figure 5.18 Ouput Multipliers for Cem Shock under CP_2 Simulation

The decomposition of Cem's multiplier effect under second simulation shows that decrease in export demand by €0.08 billion causes; Tra output to decrease by €0.017, Min output by €0.005 billion, Che by €0.004 billion, Elec by €0.015 billion, and Ser by €0.055 billion.

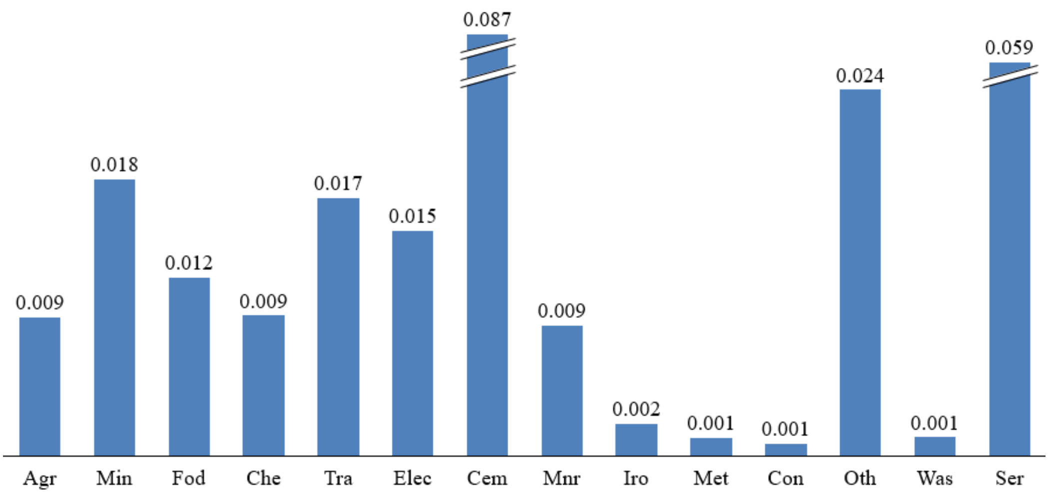

Figure 5.19 Demand Multipliers for Cem Shock under CP_2 Simulation

Decrease in cement exports affects demand of other sectors. Most affected sectors are Ser, Oth, Min, Tra and Elec. Here, Ser demand decreases by €0.059 billion, Oth demand by €0.024 billion, Che demand by €0.009 billion, Tra demand by 0.017 billion, Elec by €0.015 billion, Min by €0.018 billion.

Iro Sector Results

Figure 5.17 shows that Iro sector has the second largest demand and output multipliers. Unconstrained multipliers generated under the exogenous shock (€0.36 billion decrease in Iro exports) are presented in Table 5.8. Additionally, output and demand multipliers are visualized in the Figure 5.20 and Figure 5.21.

Table 5.8 Unconstrained Multipliers under CP_2 Simulation of Iro Sector Shock

Given exogenous shock in unconstrained model:		€0.36 billion decrease in iron-steel exports due to CBAM	
		Unconstrained Multipliers	Total
Activities	Agr	0.023	Output Multipliers (Total: 0.67)
	Min	0.008	
	Fod	0.026	
	Che	0.010	
	Tra	0.052	
	Elec	0.039	
	Cem	0.001	
	Mnr	0.003	
	Iro	0.281	
	Met	0.007	
	Con	0.005	
	Oth	0.030	
	Was	0.036	
	Ser	0.151	
Commodities	Agr	0.025	Demand Multipliers (Total: 0.92)
	Min	0.031	
	Fod	0.033	
	Che	0.022	
	Tra	0.052	
	Elec	0.040	
	Cem	0.001	
	Mnr	0.003	
	Iro	0.410	
	Met	0.032	
	Con	0.005	
	Oth	0.054	
	Was	0.053	
	Ser	0.161	
Labor		0.091	GDP Multipliers (Total: 0.27)
Capital		0.181	
Household		0.272	
Government		0.065	
Saving/Investment		0.087	
Rest of World		0.204	

Decrease in Iro exports by €0.36 billion leads to a €0.27 billion decrease in economywide GDP. Additionally, the GDP multiplier is higher for capital than for labor which reflects the more capital-intensity nature of the sector.

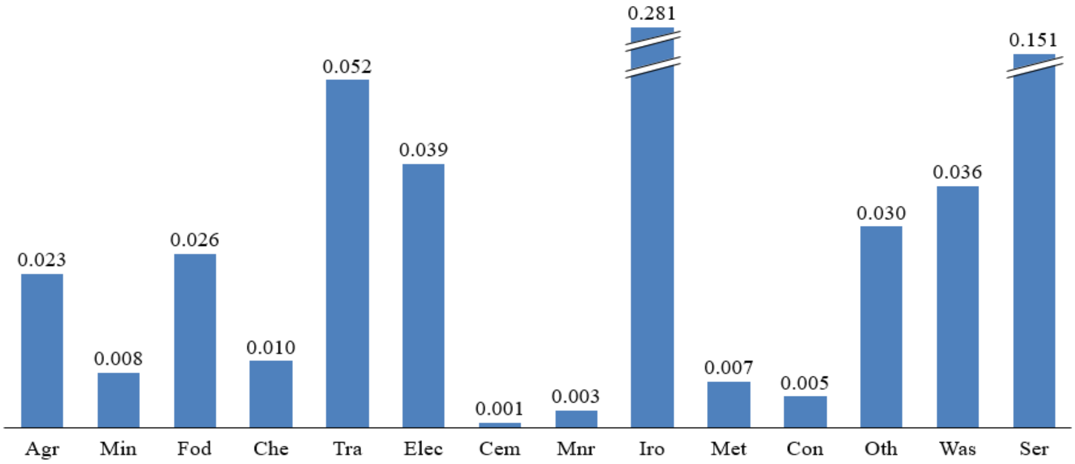

Figure 5.20 Ouput Multipliers for Iro Shock under CP_2 Simulation

The total output multiplier effect of Iro is €0.67 billion which shows that €0.36 billion decrease in exports leads to almost two times overall decrease in economywide output once all linkages are considered. Additionally, the decomposition of multiplier effect on activities indicates that decreasing exports by €0.36 billion causes; Tra output to decrease by €0.052 billion, Elec by €0.039 billion, Was by €0.036 billion, Iro by €0.281 billion and Ser output by €0.151 billion.

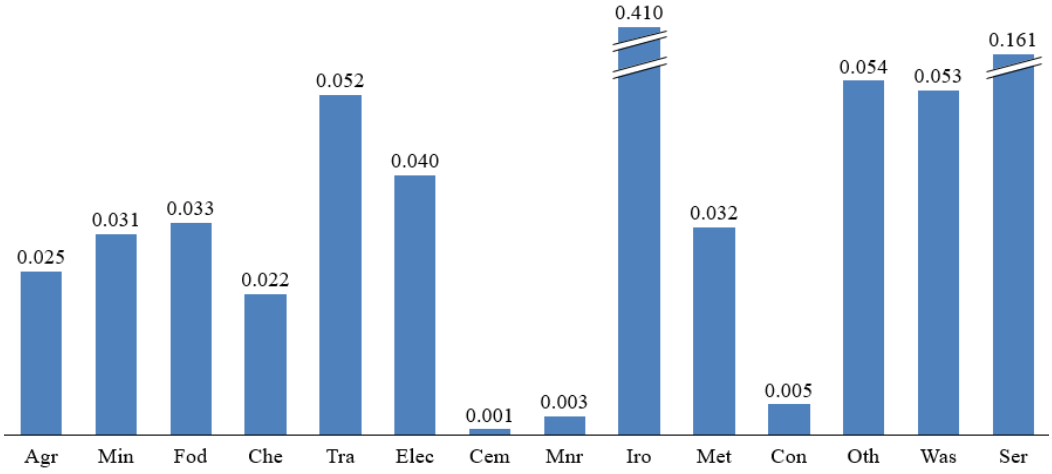

Figure 5.21 Demand Multipliers for Iro Shock under CP_2 Simulation

For Iro's sector's export decrease, Ser demand decreases by €0.161 billion, Oth by €0.054 billion, Tra demand by €0.052 billion, Was demand by €0.053 billion, electricity by €0.040 billion and mining by €0.031 billion.

5.6.3.3 Carbon Price_3 Simulation

Under the maximum carbon price (CP_3), €100/tCO_2e, respective carbon cost of each sector is presented in Figure 5.22.

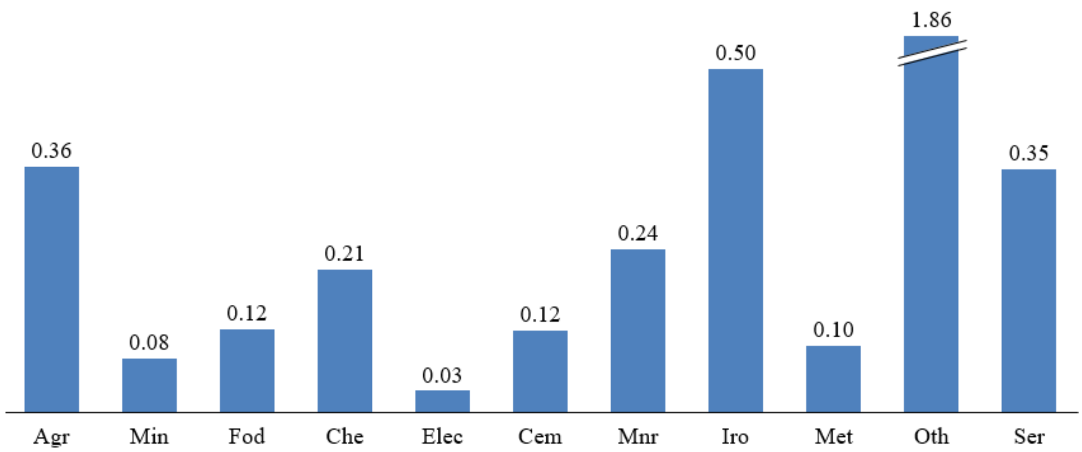

Figure 5.22 Carbon Costs of Sectors under CP_3

Carbon cost of each sector is given as exogenous shock of that sector and unconstrained multipliers are obtained for each sector. Consolidated output, demand and GDP multipliers are given in Figure 5.23. Disaggregated results are presented in Appendix F.

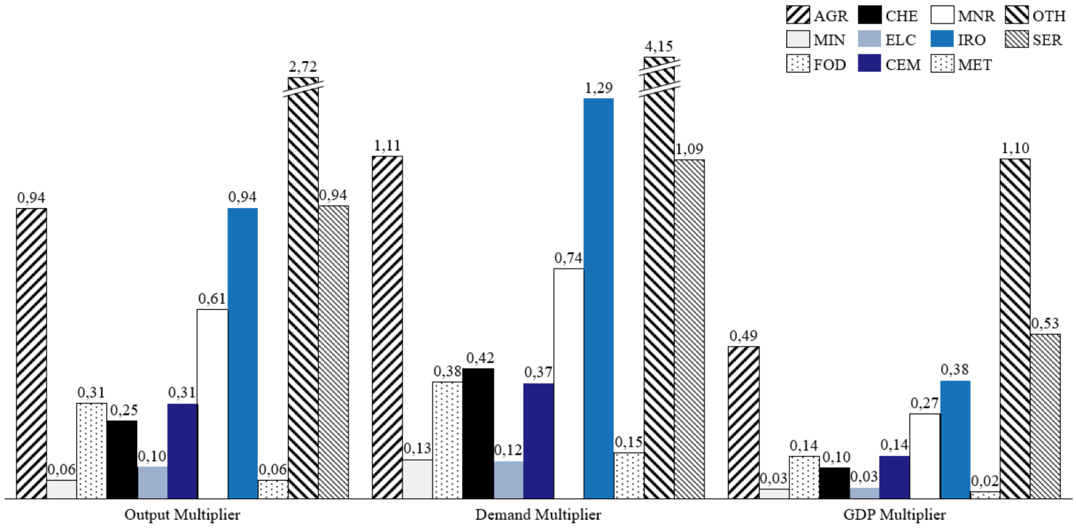

Figure 5.23 Multiplier Effects of a CP_3 Simulation of All Sectors

Oth sector in the SAM has an important export volume to EU compared to other SAM sectors. Results of the maximum carbon price scenario shows that a direct decrease in exogenous sector demand by €1.86 billion in Oth sector leads to a total decrease in output by €2.72 billion and €4.15 billion decrease in demand once all linkages and round-by-round effects are considered. Following Oth sector, Iro has the second largest demand multiplier.

<u>Cem Sector Results</u>

€0.12 billion decrease in exports of Cem is applied as the exogenous shock in the unconstrained multiplier model. Unconstrained multipliers are presented in Table 5.9. Additionally, output and demand multipliers are shown in the Figure 5.24 and Figure 5.25. The results show that decrease in Cem exports by €0.12 billion leads to €0.14 billion decrease in economywide GDP.

Table 5.9 Unconstrained Multipliers under CP_3 Simulation of Cem Sector Shock

Given exogenous shock in unconstrained model:		€0.12 billion decrease in cement exports due to CBAM	
		Unconstrained Multipliers	Total
Activities	Agr	0.012	Output Multipliers (Total: 0.31)
	Min	0.007	
	Fod	0.013	
	Che	0.006	
	Tra	0.024	
	Elec	0.021	
	Cem	0.112	
	Mnr	0.011	
	Iro	0.002	
	Met	0.0004	
	Con	0.001	
	Oth	0.019	
	Was	0.001	
	Ser	0.078	
Commodities	Agr	0.013	Demand Multipliers (Total: 0.37)
	Min	0.026	
	Fod	0.017	
	Che	0.013	
	Tra	0.024	
	Elec	0.021	
	Cem	0.122	
	Mnr	0.012	
	Iro	0.003	
	Met	0.002	
	Con	0.001	
	Oth	0.034	
	Was	0.002	
	Ser	0.083	
Labor		0.047	GDP Multipliers (Total: 0.14)
Capital		0.091	
Household		0.137	
Government		0.023	
Saving/Investment		0.044	
Rest of World		0.052	

A direct decrease in exogenous Cem demand by €0.12 billion leads to a total decrease in gross output by €0.37 billion once all linkages and round-by-round effects are considered.

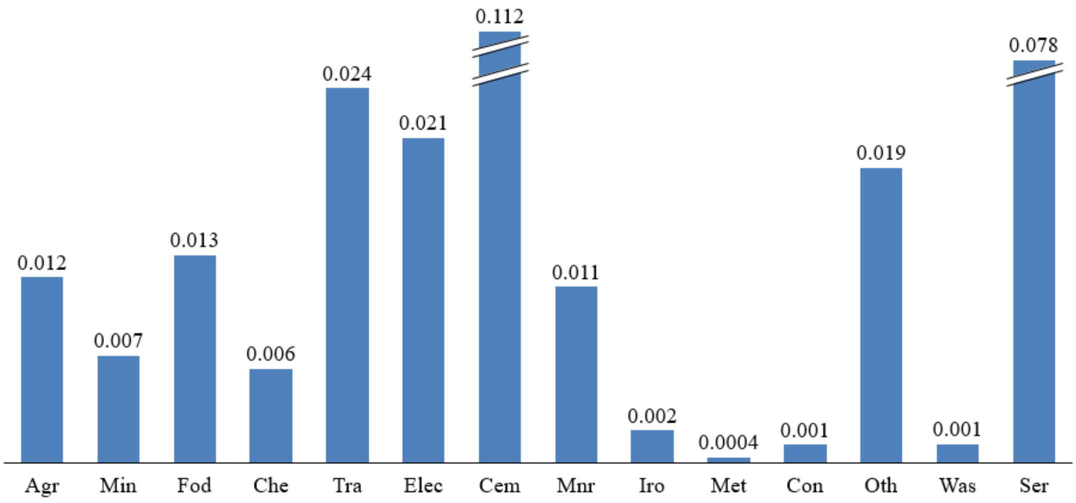

Figure 5.24 Ouput Multipliers for Cem Shock under CP_3 Simulation

Decrease in cement exports affects the output of other sectors and most affected sectors are seen as Ser, Tra, Elec and Oth. The decomposition of Cem's multiplier effect under maximum carbon price simulation shows that decrease in export by €0.12 billion causes; Tra output to decrease by €0.024, Elec by €0.021 billion, Min output by €0.007 billion, Che by €0.006 billion, and Ser by €0.078 billion.

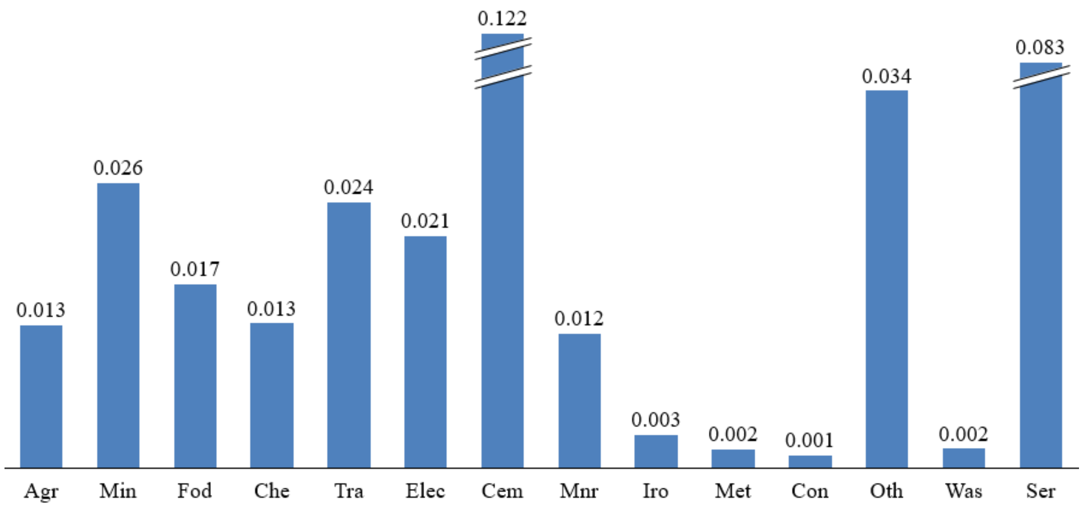

Figure 5.25 Demand Multipliers for Cem Shock under CP_3 Simulation

For cement sector's export decrease, Ser demand decreases by €0.083 billion, Oth by €0.034 billion, Che demand by €0.013 billion, Tra demand by 0.024 billion, Elec by €0.021 billion, Min by €0.026 billion.

By considering cement as an important input for construction, one would expect to see higher multipler effects. The possible reason of such an outcome can be the fixed shares based on 2012 input-output table. Here, one cannot reflect the revisions made in national income accounts and expenditures at the end of 2016 by TurkStat. These revisions have led to important changes in various macroeconomic indicators, particularly in sectoral product levels, growth rates, investment, and savings rates. Boratav et al. (2018) states that the technical coefficients of the construction sector in 2012 input-output table exhibits swings that are difficult to explain and the values was not representing the sector’s reality. With the revisions made in 2016, construction sector’s share in GDP showed an increase and almost doubled from 4.4% to 8.2%. 57% of the difference between the total sectoral revenues in the new series and the old series comes from the construction industry and the revision on the contribution of the construction sector to Turkey's economic growth was made with the aim of bringing this sector closer to its real position in the economy (Aydoğuş, 2018; Boratav et al., 2018). As a result, as there is no detailed data set for 2019 and this multiplier analysis are carried out based on 2019 data with the I-O shares based on 2012, the revisions made in construction sector could not be reflected in the analysis. This may lead to see smaller effects on the Con sector in this study as a result of the shock in Cem.

Iro Sector Results

When carbon cost of each sector applied as exogenous demand shock, we observes in Figure 5.23 that Iro sector has the second largest demand and output multipliers. By considering the first sector Oth, which is quite aggregated SAM sector, effects of a carbon cost for iron-steel sector are quite important on the rest of the economy. Unconstrained multipliers generated under the exogenous shock (€0.50 billion decrease in Iro exports) are presented in

Table 5.10. Additionally, output and demand multipliers are visualized in the Figure 5.26 and Figure 5.27.

Table 5.10 Unconstrained Multipliers under CP_3 Simulation of Iro Sector Shock

Given exogenous shock in unconstrained model:		€0.50 billion decrease in iron-steel exports due to CBAM	
		Unconstrained Multipliers	Total
Activities	Agr	0.032	Output Multipliers (Total: 0.94)
	Min	0.011	
	Fod	0.036	
	Che	0.014	
	Tra	0.072	
	Elec	0.055	
	Cem	0.001	
	Mnr	0.004	
	Iro	0.393	
	Met	0.010	
	Con	0.006	
	Oth	0.042	
	Was	0.050	
	Ser	0.211	
Commodities	Agr	0.035	Demand Multipliers (Total: 1.29)
	Min	0.043	
	Fod	0.046	
	Che	0.030	
	Tra	0.073	
	Elec	0.056	
	Cem	0.001	
	Mnr	0.004	
	Iro	0.574	
	Met	0.045	
	Con	0.007	
	Oth	0.076	
	Was	0.074	
	Ser	0.225	
Labor		0.127	GDP Multipliers (Total: 0.38)
Capital		0.253	
Household		0.380	
Government		0.091	
Saving/Investment		0.122	
Rest of World		0.286	

Decrease in Iro exports by €0.50 billion leads to a €0.38 billion decrease in economywide GDP. Additionally, the GDP multiplier is higher for capital than for labor which reflects the more capital-intensity nature of the sector.

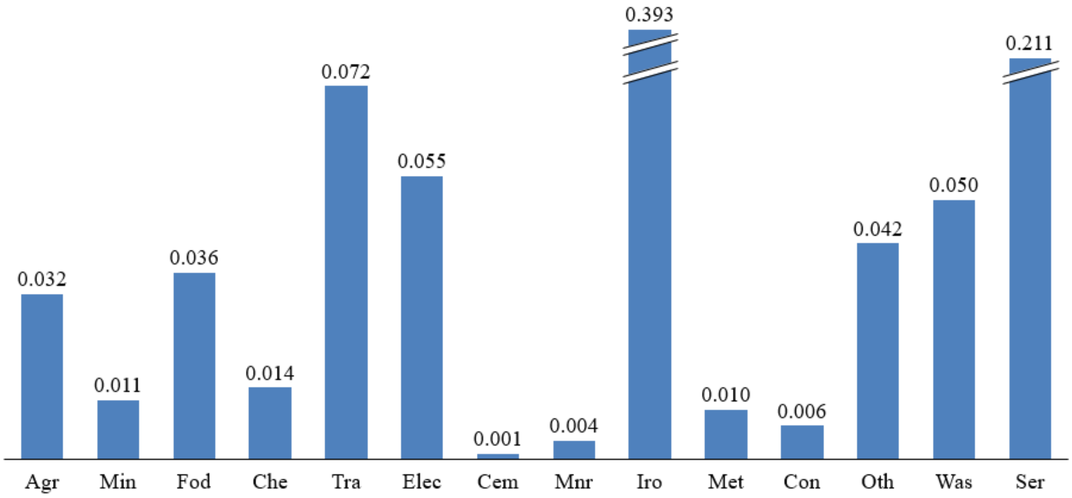

Figure 5.26 Ouput Multipliers for Iro Shock under CP_3 Simulation

The total output multiplier effect of Iro is €0.94 billion which shows that €0.50 billion decrease in exports leads to almost two times overall decrease in economywide output once all linkages are considered. Additionally, the decomposition of multiplier effect on activities indicates that decreasing exports by €0.50 billion causes; Tra output to decrease by €0.072 billion, Elec by €0.055 billion, Was by €0.05 billion and Ser output by €0.211 billion.

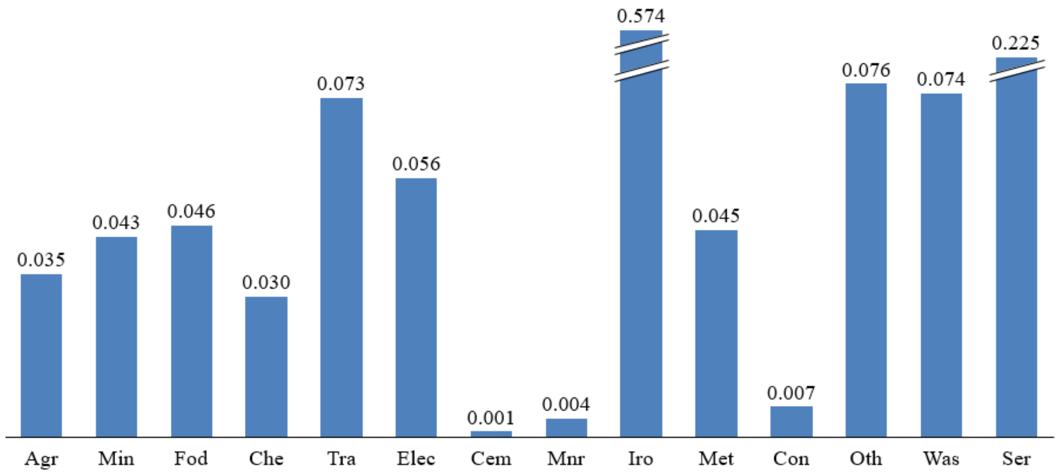

Figure 5.27 Demand Multipliers for Iro Shock under CP_3 Simulation

For Iro’s sector's export decrease, Ser demand decreases by €0.225 billion, Oth by €0.076 billion, Tra demand by €0.073 billion, Was demand by €0.074 billion, electricity by €0.056 billion and mining by €0.043 billion.

5.7 Results and Discussion with Different Demand Ranges Based on Free Allocation of Allowances

Within the EU ETS cap, there are tradable emissions allowances that can be bought or received by the companies. To achieve emissions reductions in total within the EU ETS coverage, cap is reduced annually. As a result, EU achieved 35% reduction in stationary sources’ emissions between 2005 and 2019. But while decreasing the emissions, EU ETS had to address carbon leakage also, therefore an important part of the allowances is allocated for free to the installations with carbon leakage risk (European Commission, 2021j). Iron-steel and cement production are seen as sectors at carbon leakage risk (Table 5.11) and treated accordingly.

Table 5.11 NACE Codes of Iron-Steel and Cement Sectors Deemed to be at Carbon Leakage Risk in EU ETS for the period between 2021 and 2030

NACE Code	**Description**
2351	Manufacture of cement
2410	Manufacture of basic iron and steel and ferro-alloys
2420	Manufacture of tubes, pipes, hollow profiles and related fittings, of steel
2431	Cold drawing of bars
2451	Casting of iron

Source: (European Commission, 2019a)

Since 2013 (beginning of EU ETS phase three), free allocation of allowances is determined according to benchmark values representing the 10% most efficient installations (European Commission, 2021j). Principal idea behind this is if an installation meets the benchmark value, it means they would receive enough allowances to cover their emissions. But if they cannot achieve benchmarks, they would receive less allowances and need to either reduce their emissions or buy additional allowances or both (European Commission, 2021a).

As explained in detail in the previous chapters, CBAM and free allocation of allowances are planned to be applied concurrently (and also equally for EU and non-EU producers) until free allowances totally phased out (Council of the European Union, 2022). Therefore, the CBAM will be applied only to the proportion of emissions that does not benefit from free allowances under the EU ETS until the complete phase in of CBAM and complete phase out of free allowances (European Commission, 2021b). This means that whole carbon cost and corresponding effects on the economy presented in the previous section will not be the real burden for Turkish exporters. The real cost and effect will be for the part of their emissions above benchmarks, but up to some point Turkish exporters will also receive free allocations as EU producers. As CBAM sectors are chosen based on their potential on carbon leakage risk and all sectors at carbon leakage risk take free allowances in EU ETS, all the exporters under CBAM will receive free allowances as well. Therefore, this study generates ten different demand response ranges (starting from 10% to 100%) and interpretes the results considering the free allocation of allowances for the cement and iron-steel sectors in detail. Carbon costs of sectors are calculated for ten different responses for three carbon price simulations. Decrease in sectoral exports by the amount of respective carbon cost by taking into account the differences in demand response is given as the exogenous shock and multiplier analyses are carried out. Detailed results for all sectors with all ranges under three carbon price simulations are given in Appendix G.

In order to be able to assess the possible coverage of freely allocated emissions under CBAM, share of freely allocated emissions and also benchmark coverages of iron-steel and cement sectors are compiled and presented in the following sub-sections.

It is expected to have the same benchmarks values for non-EU producers as it is mentioned in Aşıcı (2021) and therefore to see similar allocation of emissions under

CBAM for free (Aşıcı, 2021b). Possible free allocation shares for iron-steel and cement sectors are calculated and the rest, which is considered as the real carbon burden on sectors (i.e. if free allocation covers 60% to 80% of the sector's total emissions, it means that carbon cost burden on this sector would be between 20% to 40% demand response range), is represented with the difference in demand response based on free allocation. Results are presented and discussed in the following sub-sections.

Top 20 exporters to European Union for CBAM covered goods are shown in the Figure 5.28. China, Russian Federation, United Kingdom, Norway and Turkey accounts for almost half (49.4%) of the total trade. Current situation in those countries are summarized below:

- As Norway is currently under EU ETS, it is exempted from CBAM.
- After Brexit and leaving EU ETS, UK has launched its own ETS in 2021. It is not linked to the EU ETS, so it is not exempted from CBAM for the time being. Prices in UK ETS are getting closer to EU ETS and continue to increase.
- As one of the biggest exporters of EU, Russia, in light of EU's proposed mechanism, approved to build a pilot ETS (starting in mid-2022) at the beginning of 2021 for Sakhalin region which depends on fossil fuel extraction. Effects of this pilot trading system will be examined to further apply the system for the whole country (ICAP, 2021; Kardish et al., 2021).
- National ETS of China, world's largest carbon market, has been launched in 2021 (The World Bank, 2021b).
- Turkey does not have any carbon pricing mechanism yet but as it is stated in the Section 2.2.4, studies regarding the national ETS have been accelerated and it is aimed to complete studies for the implementation of the ETS in 2024, and to start the pilot process, which will take at least one year, in 2024, considering the EU CBAM calendar.

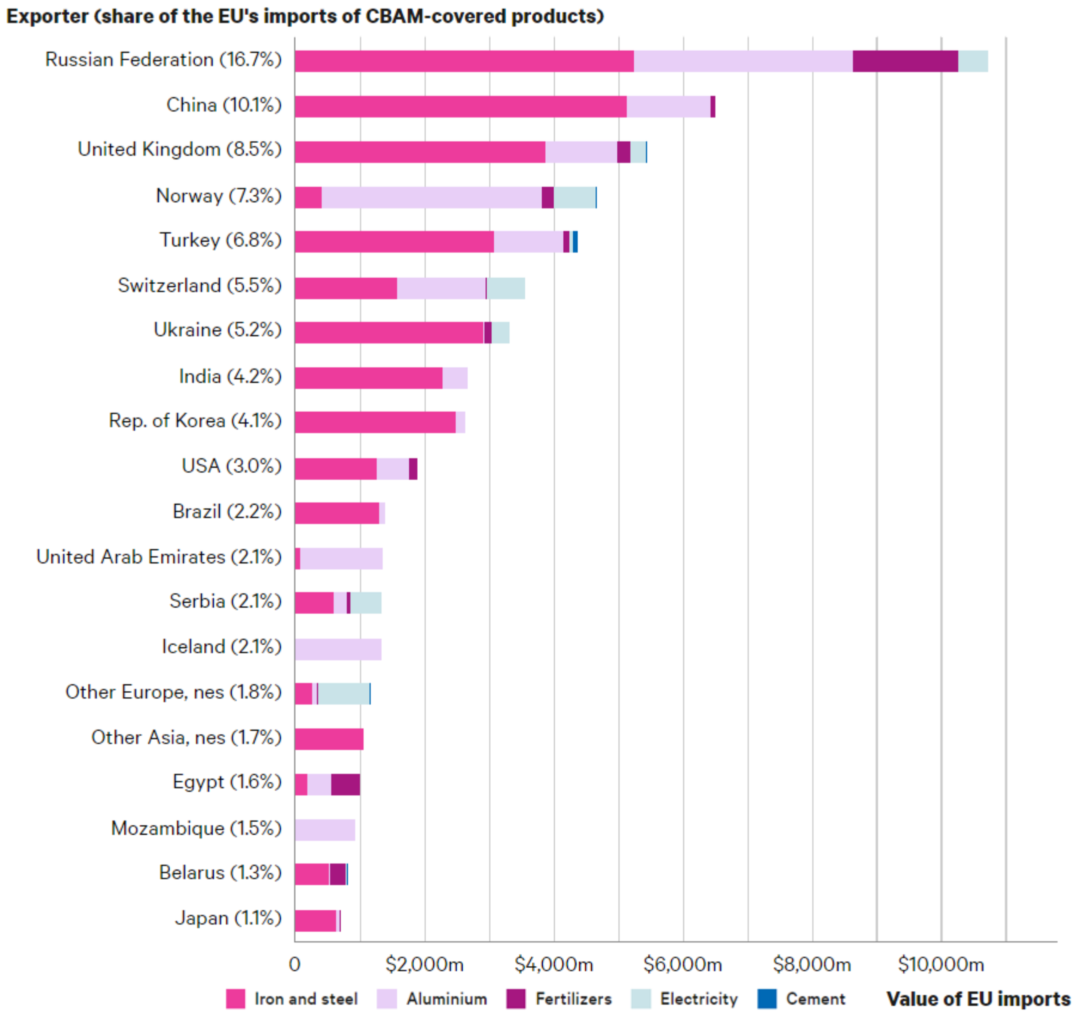

Figure 5.28 Top 20 Exporters of EU (annual average of 2015-2019) (Kardish et al., 2021)

Emission intensities of iron-steel and cement sectors considering the production processes among counties are evaluated in the following sub-sections. Apart from sectoral differences, emission intensity of electricity sector is an important parameter for both sectors. As seen in Figure 5.29, Turkey's average is worse than EU and also than some of the important exporters to the EU such as Ukraine, Russia and USA while India, China and South Korea have higher intensities than Turkey. Decarbonization of electricity sector in Turkey would be critical and needs to be fastened.

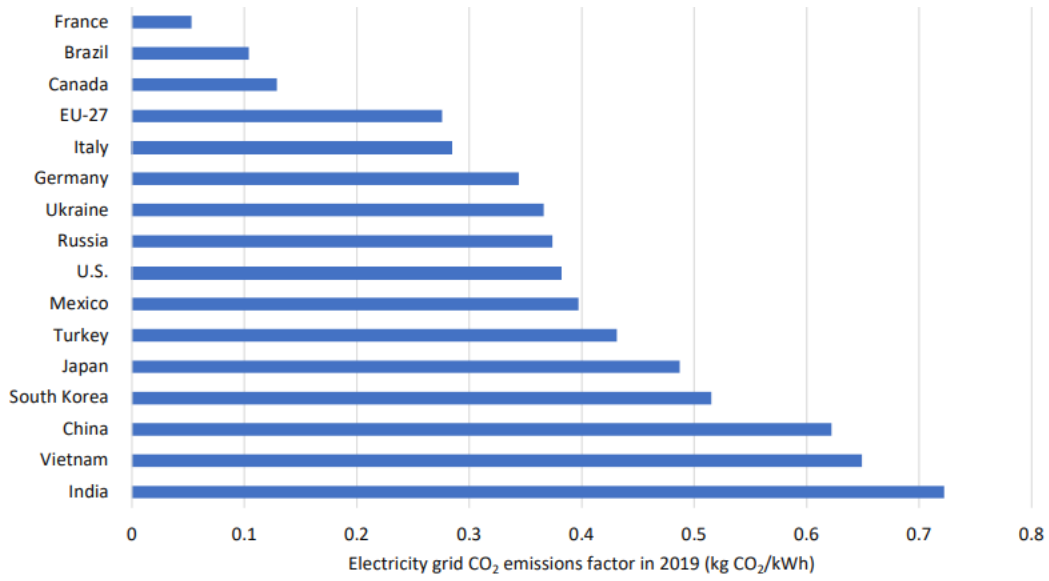

Figure 5.29 Emission Intensity of Electricity Grid in Various Counties in 2019 (Hasanbeigi, 2022)

5.7.1 Iron-Steel Sector-Specific Discussion

Steel production is made mainly through two routes: Blast furnace (BF) – Basic Oxygen Furnace (BOF) and Electric Arc Funace (EAF). Under EU ETS, there are five benchmarked products which are coke, sintered ore, hot metal, EAF carbon steel and EAF high-alloy steel for steel industry. Benchmark values for the period between 2021 and 2025 are determined based on the average value of 10% best performing installations in 2016 and 2017. Moreover, for the processes that are not covered by those products, there exists fuel and heat bechmarks (Table 5.12).

Annual direct emissions of EU steel industry in the 2021-2025 will be around ± 185 Mt/year CO_2e. 76% of this emissions (± 142 Mt/year CO_2e) will be covered by free allocation during this period annually, according to 2021-2025 benchmark values (EUROFER, 2021). Therefore, 24% of the emissions needs to be completed from the market. Hovewer, it should be noted that emission intensity of Turkish iron-steel sector per process (EAF and BF-BOF) is higher as compared to EU average. Therefore, it can be expected that approximately 76% or less of the emissions of

Turkish exporters will also be covered by free allocation in CBAM. The rest, 24% or more, will be the real carbon cost burden that exporters will face with. Therefore, the effects that are expected to be seen when CBAM applied in iron-steel sector are considered in 20 to 30% demand range. It means that, 20% to 30% of carbon costs would be expected to be the burden on Turkish iron-steel exporters which corresponds to €0.045 billion (CP_1, 20%) to €0.15 billion (CP_3, 30%) carbon cost range.

Table 5.12 Benchmark Values under EU ETS for Steel Industry

<table>
<tr><th>Process</th><th>Product</th><th>2021-2025 Benchmark Value</th><th>Unit</th></tr>
<tr><td rowspan="3">BF-BOF</td><td>Coke</td><td>0.217</td><td rowspan="5">tCO_2e/t product</td></tr>
<tr><td>Sintered ore</td><td>0.157</td></tr>
<tr><td>Hot metal</td><td>1.288</td></tr>
<tr><td rowspan="2">EAF</td><td>Carbon steel</td><td>0.215</td></tr>
<tr><td>High alloy steel</td><td>0.268</td></tr>
<tr><td colspan="2">Fuel benchmark</td><td>42.6</td><td rowspan="2">tCO_2e/TJ</td></tr>
<tr><td colspan="2">Heat benchmark</td><td>47.3</td></tr>
</table>

Source: Compiled by the author (European Commission, 2021g, 2021c)

Under all price scenarios (CP_1, CP_2 and CP_3) for 20% to 30% range, respective carbon cost of each sector is applied as the exogenous shock in the unconstrained multiplier model. Corresponding results of multiplier analysis are given in Table 5.13 and consolidated output, demand and GDP multipliers are given in Figure 5.30.

Carbon cost for iron-steel sector within the range of €0.045 billion (CP_1, 20%) and €0.15 billion (CP_3, 30%) will lead to decrease in economywide GDP by between €0.034 billion and €0.114 billion. National output will face with decrease between €0.084 billion and €0.281 billion once all linkages and round-by-round effects are considered and there will be €0.115 billion and €0.387 billion decrease in total demand.

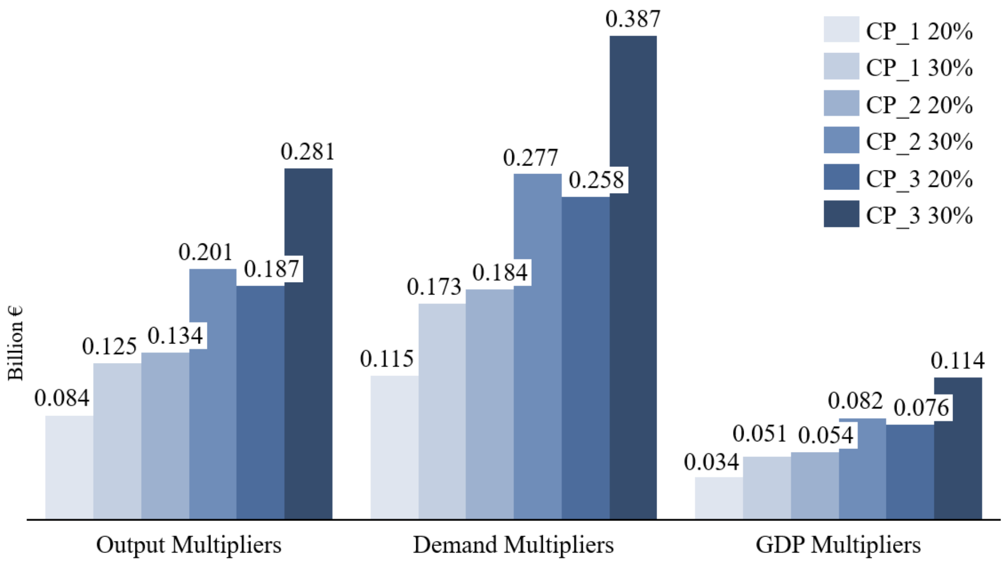

Figure 5.30 Output, Demand and GDP Multipliers for 20% to 30% Difference in Demand Response Based on Free Allocation of Allowances under CP_1, CP_2 and CP_3 for Iron-Steel Sector

In order to reflect the risk of decrease in sectoral revenues, shadow tax rates (carbon cost/export revenue) are calculated one more when free allocation is concurrently applied with CBAM. As illustrated in Figure 5.31, Iro exporters should pay back between €0.7 and €2.5 per €100 of the earned revenues to EU under stated 20% and 30% response ranges of the study for free allowances.

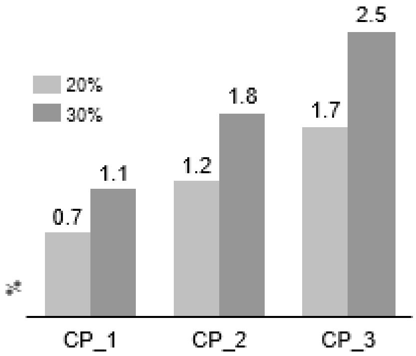

Figure 5.31 Shadow Tax Rates of Iro Sector with Free Allocation

Table 5.13 Multiplier Analysis Results for Iron-Steel Sector for 20% and 30% Difference in Demand Response Based on Free Allocation of Allowances CP_1, CP_2 and CP_3

		CP_1		CP_2		CP_3	
		20%	30%	20%	30%	20%	30%
Given exogenous shock in model (decrease in exports by):		€0.045 billion	€0.067 billion	€0.071 billion	€0.107 billion	€0.100 billion	€0.150 billion
		Unconstrained Multipliers		Unconstrained Multipliers		Unconstrained Multipliers	
Activities	Agr	0.0029	0.0043	0.0046	0.0068	0.0064	0.0096
	Min	0.0010	0.0015	0.0016	0.0024	0.0023	0.0034
	Fod	0.0032	0.0048	0.0052	0.0077	0.0072	0.0108
	Che	0.0012	0.0019	0.0020	0.0030	0.0028	0.0041
	Tra	0.0064	0.0097	0.0103	0.0155	0.0144	0.0216
	Elec	0.0049	0.0073	0.0078	0.0117	0.0110	0.0164
	Cem	0.0001	0.0001	0.0002	0.0002	0.0002	0.0003
	Mnr	0.0003	0.0005	0.0005	0.0008	0.0007	0.0011
	Iro	0.0351	0.0527	0.0562	0.0843	0.0787	0.1180
	Met	0.0009	0.0013	0.0014	0.0021	0.0019	0.0029
	Con	0.0006	0.0009	0.0009	0.0014	0.0013	0.0019
	Oth	0.0037	0.0056	0.0060	0.0089	0.0083	0.0125
	Was	0.0045	0.0067	0.0072	0.0107	0.0100	0.0150
	Ser	0.0188	0.0282	0.0301	0.0452	0.0421	0.0632
Commodities	Agr	0.0031	0.0047	0.0050	0.0075	0.0070	0.0106
	Min	0.0039	0.0058	0.0062	0.0093	0.0086	0.0130
	Fod	0.0041	0.0061	0.0065	0.0098	0.0092	0.0137
	Che	0.0027	0.0041	0.0043	0.0065	0.0061	0.0091
	Tra	0.0065	0.0098	0.0105	0.0157	0.0146	0.0219
	Elec	0.0050	0.0075	0.0080	0.0120	0.0112	0.0168
	Cem	0.0001	0.0002	0.0002	0.0003	0.0002	0.0004
	Mnr	0.0004	0.0005	0.0006	0.0008	0.0008	0.0012
	Iro	0.0513	0.0769	0.0821	0.1231	0.1149	0.1723
	Met	0.0040	0.0060	0.0064	0.0096	0.0089	0.0134
	Con	0.0006	0.0009	0.0009	0.0014	0.0013	0.0020
	Oth	0.0068	0.0102	0.0109	0.0163	0.0152	0.0229
	Was	0.0066	0.0099	0.0106	0.0159	0.0148	0.0223
	Ser	0.0201	0.0302	0.0322	0.0483	0.0451	0.0676
Labor		0.0114	0.0171	0.0182	0.0273	0.0255	0.0382
Capital		0.0226	0.0339	0.0361	0.0542	0.0506	0.0759
Household		0.0340	0.0510	0.0544	0.0815	0.0761	0.1141
Government		0.0081	0.0122	0.0130	0.0195	0.0182	0.0273
Saving/Investment		0.0109	0.0163	0.0174	0.0261	0.0243	0.0365
Rest of World		0.0255	0.0383	0.0408	0.0612	0.0571	0.0857

China was the largest steel producer (1 billion ton) in the world in 2019, followed by EU with 0.15 billion ton. China, India, Japan, United States and South Korea are among the largest steel producing countries and all of them are among the 20 exporters of EU. Although EU ranks high in steel production in the world, its imports (0.041 billion ton) are more than its exports (0.03 billion ton). As it observed in Figure 5.28, Turkey is among the top 5 steel exporters to the EU (Climate Transparency, 2020; European Commission, 2021i; Kardish et al., 2021; Marcu et al., 2021).

Under CBAM, trade shares of the EU and of the exporting countries may be affected (Aşıcı, 2021c) and emission intensity of countries shown in Figure 5.32 would be important and would serve as a determinant on these effects.

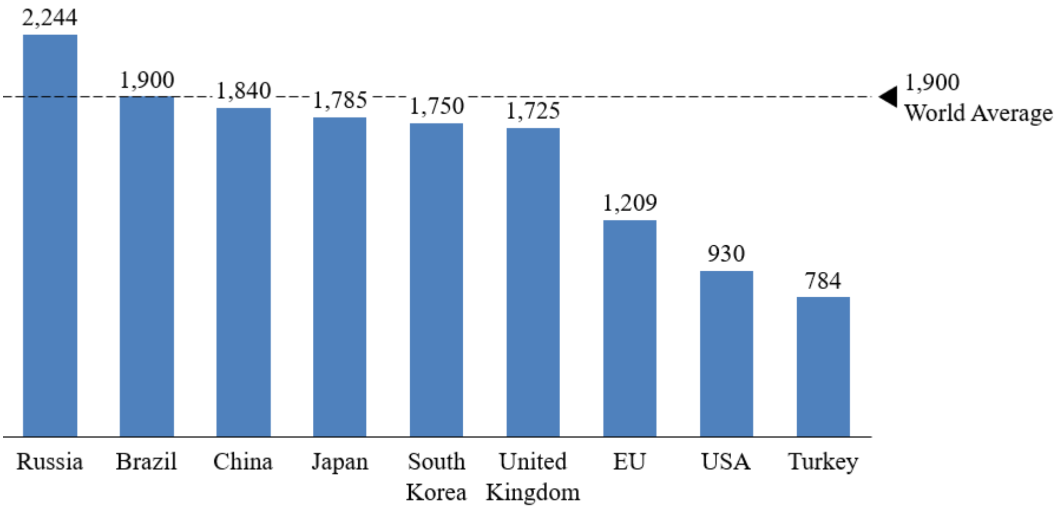

Figure 5.32 Emission Intensity of Steel Sector in Various Countries Compared with World Average in 2016 (kg CO_2/ton product)

Source: Compiled by the author from (Climate Transparency, 2017, 2021e, 2021a, 2021b, 2021d, 2021f, 2021h, 2021g, 2021c)

Differences in emission intensities among countries mainly arise from the differences in the predominant steelmaking routes. BF-BOF route is predominant in China, UK, Russia, and EU while Turkey and USA have more EAF share (Figure 5.33).

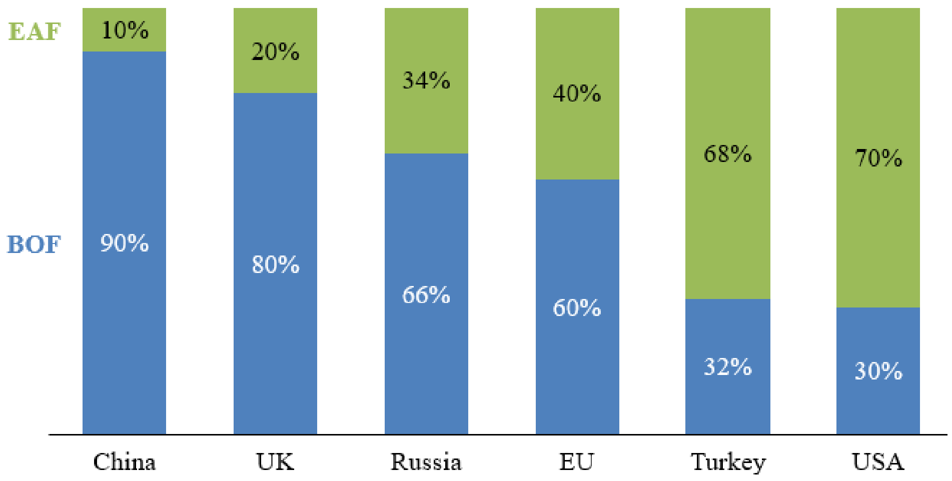

Figure 5.33 Share of Steel Production Routes (EAF and BF-BOF) in China, UK, Russia, EU and Turkey in 2019

Source: Compiled by the author (European Commission, 2021i; Hites, 2020; Ministry of Industry and Technology, 2020; Statista, 2021b; Tolomeo et al., 2019)

Blast oxygen furnaces in EU are among the most efficient ones and emission intensity (including three of scopes) of them are less than 2,000 kgCO_2/ton steel. As decarbonization in EU is accelerated, emission intensity of EAF route (around 500 kg CO_2/ton steel) is also smaller compared to others and EU steel industry has had emission reduction about 25% since 1990 (European Commission, 2021i; Fraunhofer & IMWS, 2020). Therefore, trade volume of steel within EU may increase after CBAM (Aşıcı, 2021c).

Although EU is more efficient in both production routes, as a result of higher share in BF-BOF, general emission intensity of steel industry in EU is higher than Turkey (European Commission, 2021i; Ministry of Industry and Technology, 2020). On the other hand, both Turkey and EU have lower emission intensities than the world average and emission intensity of iron-steel sector in Turkey is smaller than most of the other exporters to the EU (Climate Transparency, 2021g, 2021c) (Figure 5.32).

For more accurate emission intensity comparison among countries, differences in production routes needs to be considered. Figure 5.34 and Figure 5.35 show the emission intensities[12] of BF-BOF and EAF routes separately for different countries. As seen, after Brazil and Canada, emission intensities of both routes in EU has the lower intensities as compared to other countries. Turkey is performing better in both routes than Russia, China, Ukraine and South Korea, which are important steel exporters to the EU. Therefore, under CBAM, Turkey does not expect to lose market in steel exports to other countries exporting to EU. One may expect that Turkey may keep and even increase the steel exports to the EU because other top steel exporters of EU such as Russia and China would possibly have higher burden as a result of their higher emission intensities and high coal reserves.

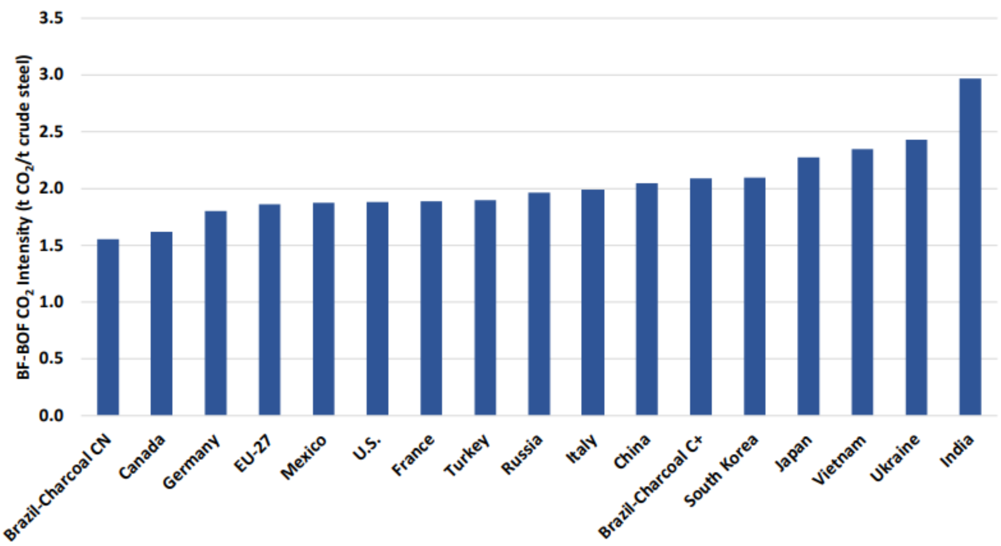

Figure 5.34 Emission Intensity of BF-BOF Route in Various Countries in 2019 (Hasanbeigi, 2022)

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[12] Emissions in these figures does not cover the emissions embodied in scrap and in consumed products such as refractories used in steel industry.

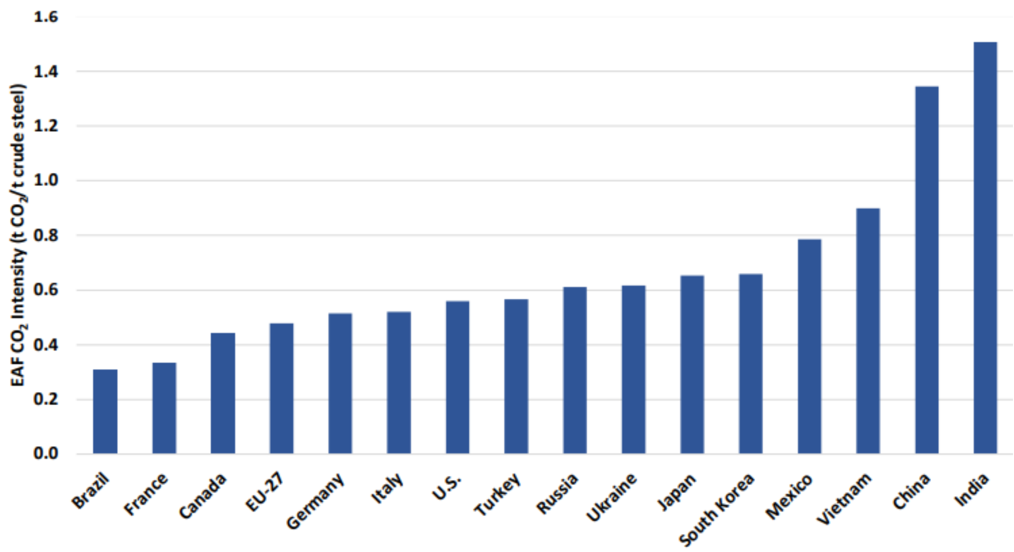

Figure 5.35 Emission Intensity of EAF Route in Various Countries in 2019 (Hasanbeigi, 2022)

It should be noted that EU producers would meet with higher carbon costs with CBAM as compared the first three phases of EU ETS without CBAM as free allocation amount would be decreasing gradually. The European Steel Association carried out a study regarding the possible impact of CBAM by considering the concurrent application and gradual phase out of free allocation with CBAM for the period of 2026-2030. The study finds that, due to upcoming reductions in benchmark values and gradual phase out of free allocation, EU steel producers would face higher free allocation shortages and higher carbon costs after CBAM; even if they invest heavily in low-carbon technologies (EUROFER, 2021).

Tang et al. (2013) finds that exports of China to EU will decrease around 1.3% in 2020 under border tax of EU, 60 USD/tCO_2 and exports will shift to Japan and to other countries with no border adjustments (Tang et al., 2013). However, as it is stated above, studies regarding carbon pricing mechanism in these countries have already begun and if emission reduction and decarbonization would be faster than Turkey’s steel sector, then outcomes may change. When one considers that both China and Russia depend on coal and high coal reserves, one may not expect to exit from BF-BOF process faster than Turkey. Also, Turkey is aiming to establish its

ETS by considering the CBAM schedule, therefore, if correct steps are taken on time, sectoral transformation through decarbonization can be supported, and Turkey's steel exports to EU can be maintained, even increased.

Hovewer, another situation that can arise is, if carbon price in Turkey's national ETS is not ambitious enough. Turkish steel producers may then choose not to export to EU but to other countries with less or no carbon pricing policies. If carbon price in Turkey's possible ETS are not high enough to drive emission reduction, producer behavior may focus on to continue producing with high emission intensities and pay for the price in Turkey and increase their market in countries with less stringent carbon policies. It should be considered by the policymakers that if price signal of the national ETS would not be strong enough, this would not lead to emission reduction and not serve to net zero emission target. Therefore, it is important to have an ETS with a strong price signal to achieve expected outcomes regarding emission reduction.

5.7.2 Cement Sector-Spesific Discussion

In the first three phases of EU ETS (2005-2020), production of cement clinker sector received more free allocation than their verified emissions (see Figure 5.36).

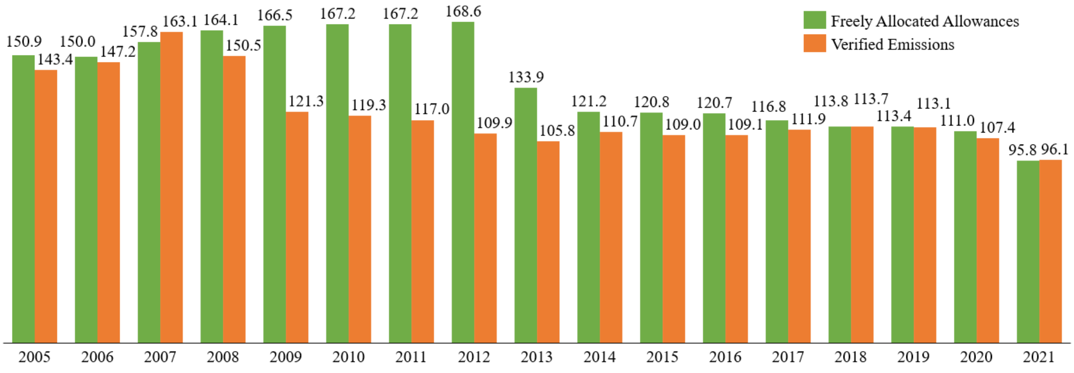

Figure 5.36 Freely Allocated Allowances and Verified Emissions of Cement Clinker Production Sector in EU-27 under EU ETS from 2005 to 2021

Source: Compiled by the author (European Environment Agency, 2022)

With the fourth phase of EU ETS covering 2021 to 2030, benchmark values are updated and decreased as compared to previous phase. This leads to lower levels of freely allocated allowances (95.8 MT CO_2e) than the sector's verified emissions (96.1 MT CO_2e) in the first year of the fourth phase. 99.7% of verified emissions are given freely while the rest have to be completed from the market.

Benchmark values for the period between 2021 and 2025 are determined based on the average value of 10% best performing installations in 2016 and 2017. Benchmarks for grey and white clinkers are given for cement sector. Share of freely allocated emissions and benchmark coverages for these products change between 85 to 87% (Table 5.14).

Table 5.14 Average GHG Intensities, Benchmark Values and Coverages under EU ETS for Grey and White Cement Clinker

Product	Average GHG Intensity in 2016 and 2017 (tCO_2e/t)		Benchmark Value (tCO_2e/t)		Current Benchmark Coverage Percantage
	All Installations	10% Most Efficiecnt Installations	2013-2020	2021-2025	
Grey cement clinker	0.818	0.722	0.766	0.693	85%
White cement clinker	1.097	0.973	0.987	0.957	87%

Source: Compiled by the author (European Commission, 2021g, 2021c)

By considering both free allocation coverage of cement clinkers production sector and benchmark value coverages, one can deduce that approximately 85% to 99.7% of carbon costs for the cement sector will be met with free allocation in order not to favor EU producers but to treat equally non-EU and EU producers. The rest (0.3% to 15%) can be considered as the cost burden share that producers would face. Hovewer, considering the higher emission intensity performance of Turkish cement producers as compared to EU average (see Figure 5.37), Turkey's emissions above the benchmark values would be higher than EU. Therefore, free allocation coverage for Turkey is expected to be lower than that of the EU. Considering all those aspects, the effect that is expected to be seen when the CBAM is applied in cement sector, is considered among 10 to 20% difference in demand response range which corresponds to of €0.005 billion (CP_1, 10%) to €0.024 billion (CP_3, 20%) carbon cost range.

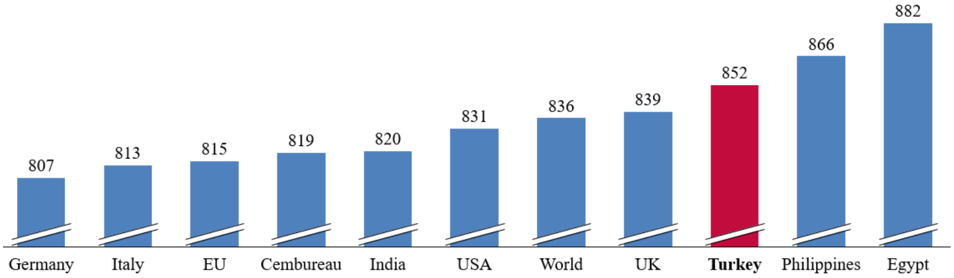

Figure 5.37 Emission Intensity of Cement Clinker Production Sector in Various Countries Compared with World and EU Average in 2018 (kg CO_2/ton clinker) (Sılkım et al., 2021)

Under all price scenarios (CP_1, CP_2 and CP_3) for 10% and 20% range, respective carbon cost of each sector is applied as the exogenous shock in the unconstrained multiplier model. Corresponding detailed results of multiplier analysis are given in Table 5.15 and consolidated output, demand and GDP multipliers are visualized in Figure 5.38.

Carbon cost for cement sector within the range of €0.005 billion (CP_1, 10%) and €0.024 billion (CP_3, 20%) will lead to decrease in economywide GDP by between €0.006 billion and €0.027 billion. Total gross output will face with decrease between €0.014 billion and €0.061 billion once all linkages and round-by-round effects are considered. There will be more decrease in demand than output and between €0.017 billion and €0.075 billion decrease in demand is expected to be seen.

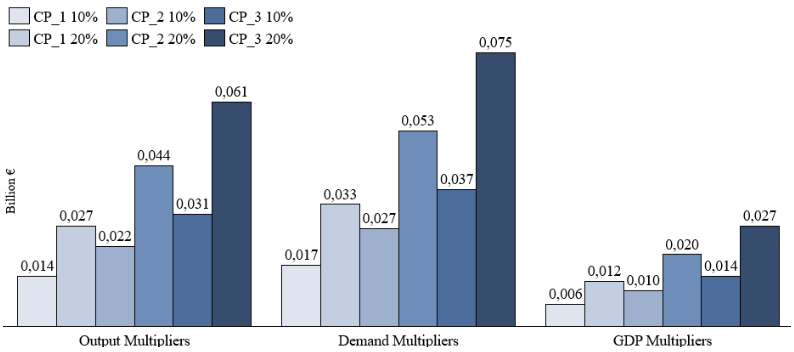

Figure 5.38 Output, Demand and GDP Multipliers for 10% and 20% Difference in Demand Response Based on Free Allocation of Allowances under CP_1, CP_2 and CP_3 for Cement Sector

EU’s cement imports (2.6% of EU’s domestic cement consumption) are less than its exports which corresponds to 7% of EU’s cement production (185 Mt in 2019). However, import volume of EU has increased more than 130% since 2016 while export volume of it decreased considerably. Carbon pricing in the EU and increasing trends in the prices of allowances are among the reasons of this increase in imports, as most of the imported countries does not have any carbon pricing mechanism and/or lower carbon prices. This leads to importing cheaper cement and putting the emission reduction efforts of EU at risk. If no CBAM was proposed, one would expect to see higher imports of cement than exports in the near term. However, in order to decrease carbon leakage risk and support EU producers’ competitiveness, CBAM is proposed. Therefore, with CBAM, it can be expected that trade within EU may increase, and EU may continue to export more than it imports. This will affect the trade shares of countries exporting high volume of cement to EU (Marcu et al., 2021).

As seen in Figure 5.39, Turkey was the largest cement exporter to EU, with 34% share in 2019. In terms of emission intensity of cement production, EU’s intensity (815 kg CO_2/t clinker) is lower than most of the other countries and below the world average of 836 kg CO_2/t clinker. Turkey’s emission performance on cement production (852 kg CO_2/t clinker) is worse than both the global and EU averages (Marcu et al., 2021; Sılkım et al., 2021; ZKG Cement Lime Gypsum, 2020). Therefore, Turkish cement exporters to EU will not be in a favorable position due to their higher emission intensity and it is expected to be negatively affected unless they do not take actions to reduce their emission intensity.

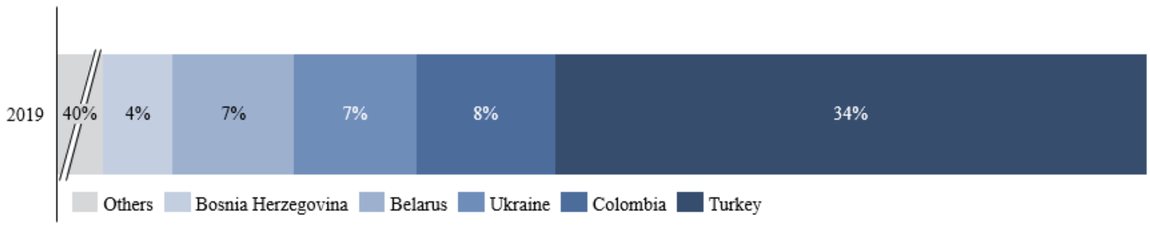

Figure 5.39 Main Countries of Cement Imports of EU (% of total imports) in 2019 (Marcu et al., 2021)

As illustrated in Figure 5.40, Cem exporters should pay back between €4.4 and €19.7 per €100 of the earned revenues to EU under stated 10% and 20% response ranges of the study when free allocation is concurrently applied with CBAM.

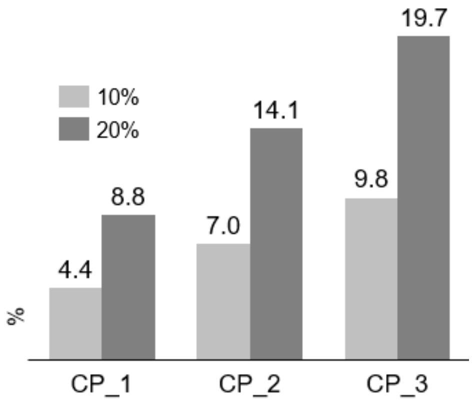

Figure 5.40 Shadow Tax Rates of Cem Sector with Free Allocation

Aşıcı (2021) carried out a CBAM cost analysis for the emission values above 2021-2025 grey cement clinker benchmark values using real emissions data of three cement facilities in Turkey. In the scenario of €50 carbon price, which is close to our CP_1 scenario, €5.44-€7.88 per ton of clinker is found as the cost burden for producers (Aşıcı, 2021a).

Table 5.15 Multiplier Analysis Results for Cement Sector for 10% and 20% Difference in Demand Response Based on Free Allocation of Allowances under CP_1, CP_2 and CP_3

		CP 1				CP 2				CP 3			
		10%		20%		10%		20%		10%		20%	
Given exogenous shock in unconstrained model:		€0.005 billion decrease in cement exports due to CBAM		€0.011 billion decrease in cement exports due to CBAM		€0.008 billion decrease in cement exports due to CBAM		€0.017 billion decrease in cement exports due to CBAM		€0.012 billion decrease in cement exports due to CBAM		€0.024 billion decrease in cement exports due to CBAM	
		Unconstrained Multipliers	Total	Unconstrained Multipliers	Total	Unconstrained Multipliers	Total	Unconstrained Multipliers	Total	Unconstrained Multipliers	Total	Unconstrained Multipliers	Total
Activities	Agr	0.0005		0.0010		0.0008		0.0017		0.0012		0.0024	
	Min	0.0003		0.0006		0.0005		0.0010		0.0007		0.0014	
	Fod	0.0006		0.0012		0.0009		0.0019		0.0013		0.0026	
	Che	0.0003		0.0005		0.0004		0.0009		0.0006		0.0012	
	Tra	0.0011		0.0021		0.0017		0.0034		0.0024		0.0047	
	Elec	0.0009		0.0018		0.0015		0.0029		0.0021		0.0041	
	Cem	0.0050	Output Multipliers (Total: 0.014)	0.0100	Output Multipliers (Total: 0.027)	0.0080	Output Multipliers (Total: 0.022)	0.0160	Output Multipliers (Total: 0.044)	0.0112	Output Multipliers (Total: 0.031)	0.0225	Output Multipliers (Total: 0.061)
	Mnr	0.0005		0.0010		0.0008		0.0016		0.0011		0.0022	
	Iro	0.0001		0.0002		0.0001		0.0003		0.0002		0.0004	
	Met	0.00002		0.00003		0.00003		0.0001		0.0000		0.0001	
	Con	0.0001		0.0001		0.0001		0.0002		0.0001		0.0002	
	Oth	0.0008		0.0017		0.0013		0.0027		0.0019		0.0037	
	Was	0.0001		0.0001		0.0001		0.0002		0.0001		0.0002	
	Ser	0.0035		0.0069		0.0055		0.0111		0.0078		0.0155	
Commodities	Agr	0.0006		0.0012		0.0009		0.0019		0.0013		0.0026	
	Min	0.0011		0.0023		0.0018		0.0037		0.0026		0.0051	
	Fod	0.0007		0.0015		0.0012		0.0024		0.0017		0.0033	
	Che	0.0006		0.0012		0.0009		0.0019		0.0013		0.0026	
	Tra	0.0011		0.0021		0.0017		0.0034		0.0024		0.0048	
	Elec	0.0009		0.0019		0.0015		0.0030		0.0021		0.0042	
	Cem	0.0055	Demand Multipliers (Total: 0.017)	0.0109	Demand Multipliers (Total: 0.033)	0.0087	Demand Multipliers (Total: 0.027)	0.0175	Demand Multipliers (Total: 0.053)	0.0122	Demand Multipliers (Total: 0.037)	0.0245	Demand Multipliers (Total: 0.075)
	Mnr	0.0005		0.0011		0.0009		0.0017		0.0012		0.0024	
	Iro	0.0001		0.0003		0.0002		0.0004		0.0003		0.0006	
	Met	0.0001		0.0002		0.0001		0.0002		0.0002		0.0003	
	Con	0.0001		0.0001		0.0001		0.0002		0.0001		0.0002	
	Oth	0.0015		0.0030		0.0024		0.0049		0.0034		0.0068	
	Was	0.0001		0.0002		0.0001		0.0003		0.0002		0.0004	
	Ser	0.0037		0.0074		0.0059		0.0119		0.0083		0.0166	
Labor		0.0021	GDP Multipliers (Total: 0.006)	0.0042	GDP Multipliers (Total: 0.012)	0.0033	GDP Multipliers (Total: 0.01)	0.0067	GDP Multipliers (Total: 0.02)	0.0047	GDP Multipliers (Total: 0.014)	0.0093	GDP Multipliers (Total: 0.027)
Capital		0.0041		0.0081		0.0065		0.0130		0.0091		0.0181	
Household		0.0061		0.0123		0.0098		0.0196		0.0137		0.0275	
Government		0.0010		0.0020		0.0016		0.0033		0.0023		0.0046	
Saving/Investment		0.0020		0.0039		0.0031		0.0063		0.0044		0.0088	
Rest of World		0.0023		0.0046		0.0037		0.0074		0.0052		0.0104	

CHAPTER 6

CONCLUSION

6.1 Summary of Findings

This thesis analyzes possible effects of the CBAM proposed by EU on the Turkish economy. Here, specifically the effects on iron-steel and cement sectors are assessed using SAM multiplier analysis. 2012 input-output table of Turkey constitutes the basis of this study and firstly by collecting additional data, Turkey's 2012 SAM for 14 sectors is constructed. By considering the latest developments and changes in the Turkish economy and GHG emissions inventory, SAM is updated to 2019 and a non-linear optimization mathematical programming model developed in GAMS is used to balance the updated SAM. Additionally, GHG emissions according to SAM sectors are compiled from the officially submitted and published documents. Key statistics obtained from SAM and GHG emissions are summarized below.

- GDP at factor in 2019 is equal to 3.9 trillion TRY. Contributions of capital-intensive iron-steel and cement sectors to total GDP are 2.4% and 0.3% respectively.
- The sum of imports and exports share of GDP is 59%, indicating that Turkey is quite an open economy since total trade accounts more than half of its GDP. Turkey imported more goods and services than it exported in 2019. Trade deficit in 2019 is 118.8 billion TRY.
- In 2019, 506 Mt CO_2e emissions are emitted to the atmosphere in Turkey. When both fuel consumption and process emissions are considered, GHG emissions from Cem (51.4 Mt CO_2e) constitutes 10.2% and Iro (15.1 Mt CO_2e) constitutes 3% of total GHG emissions in 2019. When the process emissions are separately examined, it is seen that the most important emission sources of the industrial processes and product use (IPPU) are Iro and Cem

sectors and nearly three quarters, 73%, of IPPU's total emissions are coming from Cem and Iro processes.

- Turkey exports more iron-steel and cement products than it imports.
- Imported cement accounts for 7% of total cement demand while imported iron-steel accounts for 25% of total iron-steel demand.
- Turkey's total goods and services exports are worth €190.9 billion in 2019 and EU is the biggest export partner of Turkey with the share of 43.3%.
- 18% of cement output, and 35% of iron-steel output is exported. 43% of cement exports, worth of €1.8 billion and 35% of iron-steel exports, worth of €5.9 billion are sold to EU.

The input-output analyses conducted in this thesis indicate that Turkish exports to the EU in 2019 embody 39.6 Mt CO_2e emissions; 15 Mt CO_2e scope 1 emissions, 10.9 Mt CO_2e scope 2 emissions and 13.7 Mt CO_2e scope 3 emissions. Three carbon price scenarios, i.e., 45, 71 and 100€/tCO_2e, for CBAM are based on different carbon price estimations, suggestions, and European Union allowance prices. With the assumption that CBAM will affect all three scopes of emissions, carbon cost of CBAM on the Turkish exporters is found to range between €1.8-€2.8-€4 billion annually, without considering the free allocation application. Total revenue of exports to EU in 2019 is €82.8 billion and calculated carbon costs constitute 2.1%, 3.4% and 4.8% of total export revenues, respectively.

Carbon cost of cement sector is found as €53-€85-€119 million and of iron-steel sector as €223-€356-€498 million. According to calculated shadow tax rates, cement sector is found to be more vulnerable to CBAM than iron-steel sector and decrease in revenue would be higher. This is due to difference in the unit value (€ per ton product) of iron-steel and cement products, higher economic emission intensity (kg CO_2e/€) of cement than steel and Turkey's cement sector's higher emission intensity (kg CO_2e/ton clinker) compared to that of the EU.

SAM multiplier analysis with a unitary exogenous demand shock for all sectors is carried out to examine an equal shock's sectoral effects on GDP and sectoral outputs. Given that the electricity is an important input for almost all sectors in an integrated position, and it is consumed directly by end users, larger multiplier effects of the electricity sector compared to other sectors are observed. The negligible amount of international trade in power sector, on the other hand, may seem to alleviate the potential negative impacts of this large multiplier. Hovewer, it is quite possible to include indirect emissions on CBAM and by considering Turkey's higher emission intensity of electricity sector as compared to EU, this would pose a risk for Turkish exporters. Following electricity, second larger multiplier effect is seen on transportation sector. Considering those sectors' highly integrated position among others and important multiplier effects on the rest of the economy, decarbonizing the electricity and transportation sectors should be one of the priorities of national net zero strategy. Their decarbonization will fasten the decarbonization of other sectors as well. If indirect emissions would take part in CBAM, decarbonization of electricity sector would help other CBAM sectors to be less negatively affected or to be in a more positive condition as compared to other countries.

Change in total demand as a result of the unitary shock is larger than the change in output for all sectors. This shows that sectors in Turkey are highly dependent on imports (such as intermediate goods, natural gas etc.). It also means that if there is an increase in exogenous demand, not all the additional demand generated by this increase would be met by domestic production. Results generated for unitary shock in iron-steel and cement sectors are summarized below:

- One unit decrease in cement exports decreases GDP by 1.16-unit, while the same amount of decrease in iron-steel exports decreases GDP by 0.76-unit. These difference in GDP multipliers shows that cement sector has stronger linkages with the rest of the economy than iron-steel.

- The total output multiplier effect reflects that decrease in cement and iron-steel exports leads to almost 2.5 times and 2 times than the overall decrease in national output, respectively.
- The shock in cement and iron-steel will lead to decrease in demand for all commodities by 3.14-units and by 2.59-units, respectively.

Decrease in sectoral exports by the amount of respective carbon cost (with the assumption of no free allocation) is given as an exogenous shock. Then, SAM multiplier analysis for carbon price simulations is carried out to examine the effects of this shock on GDP, sectoral outputs, and demand for each sector. The results of multiplier analysis in each sector under every carbon price simulation indicate that following the aggregated “other sector”, iron-steel has the second largest demand multiplier and iron-steel, agriculture, and services (another aggregated SAM sector) have quite high GDP, output and income multipliers compared to others. This means that effects of carbon costs of these sectors on the whole economy will be higher than other sectors. Results generated for iron-steel and cement sectors are presented below:

- Decrease in iron-steel exports by €0.22-€0.36-€0.50 billion leads to €0.17-€0.27-€0.38 billion decrease in economywide GDP which leads to a total decrease in output by €0.42-€0.67-€0.94 billion once all linkages and round-by-round effects are considered.
- The decomposition of iron-steel’s multiplier effect indicates that decreasing export demand by €0.22-€0.36-€0.50 billion causes the transportation output to decrease by €0.032-€0.052-€0.072 billion, electricity by €0.024-€0.039-€0.055 billion, waste by €0.022-€0.036-€0.050 billion and services by €0.094-€0.151-€0.211 billion.
- For iron-steel sector's export decrease, services demand decreases by €0.101-€0.161-€0.225 billion, other sector demand by €0.034-€0.054-€0.076 billion, transportation demand by €0.033-€0.052-€0.003 billion, waste by €0.033-€0.053-€0.074 billion, electricity by €0.025-€0.040-€0.056 billion.

- Decrease in Cem exports by €0.05-€0.08-€0.12 billion leads to €0.06-€0.10-€0.14 billion decrease in economywide GDP; leads to total decrease in output by €0.14-€0.22-€0.37 billion once all linkages and round-by-round effects are considered.
- The decomposition of Cem’s multiplier effect indicates that decreasing export demand by €0.05-€0.08-€0.12 billion causes; mining output to decrease by €0.003-€0.005-€0.007 billion, chemicals by €0.003-€0.004-€0.006 billion, electricity by €0.009-€0.015-€0.021 billion, transportation by €0.011-€0.017-€0.024 billion and services by €0.035-€0.055-€0.078 billion.
- For cement sector's export decrease, services demand decreases by €0.037-€0.059-€0.083 billion, Oth by €0.015-€0.024-€0.034 billion, Che demand by €0.006-€0.009-€0.013 billion, electricity by €0.009-€0.015-€0.021 billion, mining by €0.011-€0.018-€0.026 billion.

As the documents published by EU regarding the CBAM proposal state that CBAM and free allocation of allowances are planned to be applied concurrently until free allowances are totally phased out and CBAM totally phased in, the cost generated due to CBAM will be only for the proportion of emissions that are above benchmark values and does not benefit from free allowances. Possible coverage of freely allocated emissions and benchmark coverages under CBAM for iron-steel and cement sectors is evaluated. Here, under the CBAM, approximately 76% of carbon costs for the iron-steel sector, and 85% to 99.7% of carbon costs for the cement sector will be met by the free allocation in order to provide the same playing field for non-EU and EU producers. Therefore, the effects that are expected to be seen when CBAM is applied in iron-steel sector fall within 20% to 30% demand response range and in cement sector within 10% to 20% range. Decreases in sectoral exports by the amount of respective carbon cost under those ranges are applied as exogenous shocks and multiplier analyses are carried out. Results of shocks under these ranges for iron-steel and cement sectors are summarized below:

- Carbon cost for iron-steel sector within the range of €0.045 billion (CP_1, 20%) and €0.150 billion (CP_3, 30%) will lead to decrease in economywide GDP by between €0.034 billion and €0.114 billion. Output will decrease between €0.084 billion and €0.281 billion and there will be 0.115 billion and €0.387 billion decrease in total demand.
- Carbon cost for cement sector within the range of €0.005 billion (CP_1, 10%) and €0.024 billion (CP_3, 20%) will lead to decrease in economywide GDP by between €0.006 billion and €0.027 billion. Total gross output will face with decrease between €0.014 billion and €0.061 billion once all linkages and round-by-round effects are considered. There will be more decrease in demand (between €0.017 billion and €0.075 billion) than output.

In order to reflect the risk of decrease in sectoral revenues, shadow tax rates (carbon cost/export revenue) are calculated for Iro and Cem sector once more by considering that free allocation is concurrently applied with CBAM. Iro exporters should pay back between €0.7 and €2.5 per €100 of the earned revenues and Cem exporters should pay back between €4.4 and €19.7 per €100 of the earned revenues to EU under when free allowances are applied with CBAM.

When CBAM is evaluated from the perspective of trade shares among countries, one deduces that there will be changes in trade shares of countries due to CBAM and also changes in trade routes. Countries with sectors having higher emission intensities as compared to that of EU or global averages will be affected more negatively than others. Additionally, one may expect to see higher trade volumes within the EU after CBAM. For Turkey, if firms in these sectors are performing better than EU producers in terms of emission intensity, one may expect to see increases in market shares, but if otherwise, some markets of Turkish exporters may be lost to EU producers or other countries' producers. Moreover, if Turkey can establish a well-working ETS with a strong price signal, and if decarbonization transformation of sectors can be supported and revenues to be generated can finance the decarbonization efforts, then Turkey can be in a more positive condition as compared to other countries with less stringent climate policies.

Electricity is an important factor for almost all sectors and Turkey's emission intensity of electricity grid is higher than that of the EU and than that of most of the countries exporting to the EU. Therefore, decarbonization of the electricity sector would be key to be in a advantageous position in CBAM as compared to other counties. As it is found in the results of the unitary shock multiplier effect of this study, decarbonization priority should be given to the electicity sector in Turkey considering the highly integrated position of the sector.

Due to high share of EAF route in Turkey and Turkey steel industry's lower emission intensity as compared to other countries exporting to EU, it is expected that Turkey will not be in an unfavorable condition as compared to other countries exporting to EU with higher emission intensity. But it should be considered that EU's iron-steel installations are more efficient than Turkey's and when EAF and BF-BOF routes are seperately examined, Turkey's performance are worse than EU. EU has already created the road map for net zero 2050 target, has utilized strategies such as hydrogen strategy and also has created sectoral road maps for decarbonization. Therefore, Turkey needs more solid steps in terms of climate policy and sectoral decarbonization. It also needs to increase the efficiency and achieve better emission intensities to get closer to EU averages soon.

Due to higher emission intensity of cement production in Turkey as compared to that of the EU, and of the countries exporting cement to EU, Turkish cement exporters will not be in a favorable position. The exporters may be negatively affected unless they take actions to reduce their emission intensity.

CBAM proposal has certainly triggerred Turkey and accelerated climate related efforts. Although the main reason behind movement is to keep resources within Turkey and not to pay or pay less to EU, it is still positive to see steps started to be taken to contribute to global net zero target and global warming objectives.

6.2 Policy Recommendations

Below policy and steps are recommended for Turkey to obtain more opportunities than the threats and negative effects from the CBAM, EGD and/or similar ambitious policies of trade partners:

- Turkey needs to accelerate climate ambition and set the future development projection on the basis of decarbonization and tackling climate change so as to achieve a sustainable development. If an ambitious and well-designed policy package can be set and initiated, it would ease to reach to international climate finance and may facilitate the sectoral transformation.
- International cooperation efforts of Turkey regarding climate change should be increased.
- The prospective NDC (which is being prepared) of Turkey should include viable projections and actions and milestones should be well set in a way to really reach to the stated target.
- Turkey needs to transform the production processes and decarbonize the industry in order to meet the climate targets. Today's carbon-intensive installations such as iron-steel, cement need to be low-carbon soon to achieve pledges (Climate Transparency, 2020).
- Carbon pricing mechanism of Turkey, ETS, should be established soon and efficient working of it should be ensured by considering the lessons learned from EU ETS process.
- Scope of the ETS should not only cover the CBAM sectors, but all MRV sectors at the beginning and the scope should be widened after some time. During transition, obligations regarding sectors out of the MRV begin. It should be noted that even though ETS would start for MRV sectors, its effects will be seen on the whole value chain through the signal created (Marcu et al., 2021). Therefore, behavioral change in all sectors and efforts to reduce

emissions are expected to be seen after ETS under the assumption of a well generated carbon price.

- Revenues to be obtained from the ETS should be used to finance the decarbonization efforts, especially on industry.
- In order to ensure the effective operability of the ETS, all parties and installations that will take part should be educated about the working principles of the system. Infrastructure regarding ETS has been worked through PMR Turkey project but in order to assess the operation and make sure that responsible parties learn well enough how it works, a pilot phase is needed. But it should not be more than the start of operational phase of CBAM.
- Linking national ETS with the EU ETS needs to be considered to optimize the economic effects of CBAM (Acar et al., 2021).
- High carbon-intensive sectors should focus on their efforts to reduce their emissions, to increase energy efficiency, to follow closely the global technological developments in their sector and to set their emission reduction targets and road maps to achieve them.
- Unfortunately, some technologies that are needed to decarbonize carbon-intensive sectors such iron-steel are not mature enough and require research and development, improvement, pilot scales etc. to become available to the sectoral players. Cooperation among firms, public institutions, global institutions, universities, etc. would be the key to develop those technologies faster.
- Soon enough, it would be needed to have and disclose or share when needed the whole life cycle of products. Therefore, especially exporter companies would start to make life cycle analyses for all their exported products.
- Turkey’s emission intensity of electricity is quite higher than of the EU average. Unitary shock experiments’ result indicates that electricity is the most interlinked sector in Turkey, and it is the input for carbon-intensive

sectors and constitutes their scope 2 emissions. Therefore decarbonization of the electricity sector of Turkey is crucial, because this will lead to improvements in most of the sectors emission intensity and will positively contribute to competitiveness of exporters (Aşıcı, 2021c). Following electricity sector, second highest multiplier effects are seen on transportation sector, therefore decarbonization efforts should also be focused on transportation sector as well.

6.3 Further Studies

This study examined the effects of CBAM, but as in line with the CBAM calendar, Turkey would have its own ETS. Therefore, it is recommended to analyze the effects of CBAM and national ETS while they are working concurrently. Also, to study projections reflecting the gradual phase out of free allocation is recommended. Turkey will submit its NDC soon and it is expected to have an intermediate target also in addition to 2053 net zero target. Therefore, those targets can be modelled and contribution of CBAM and national ETS to these targets can be studied. Additionally, reallocation of revenues generated from the national ETS can be studied.

SAM multiplier model used in this study has below given assumptions and limitations.

- Prices does not change, price level fixed: Any changes in demand result in change in outputs, not in prices (IFPRI, 2010).
- Factor resources of the economy are unconstrained (unlimited): Any increase in demand will be met by corresponding increase in supply (IFPRI, 2010).
- It is a static model and not dynamic. Coefficients and current structure and interrelations of the economy will remain same and will not change after the exogenous demand shock: There will be no change in behavior and there are linear linkage effects (IFPRI, 2010; International Labor Organization, 2017).

- It reflects the given period (2019 in this study) and projection for the upcoming years are not possible (International Labor Organization, 2017; Erik Thorbecke, 2000).

To reflect the possible price changes or behavior changes that may occur after the shock, more complicated models such as computable general equilibrium (CGE) model are recommended to be used while carrying out above mentioned studies (Erik Thorbecke, 2000). CGE model using SAM created in this study as one of the databases would allow simulate not only the Turkish economy but also to simulate the changes in trade routes, to project emissions and development, to consider the changes in prices (European Parliament, 2020).

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APPENDICES

A. 2012 and 2019 SAM Turkey Creation Procedures

A.1 Social Accounting Matrix of Turkey for 2012

To create the disaggregated social accounting matrix of Turkey, following steps are taken:

- Sectoral categories are determined by examining input-output table, national GHG inventory report and expected outcomes of this thesis study,
- According to sectors identified, aggregation and disaggregation studies are carried out,
- Aggregated input-output table for identified 14 sectors is created,
- Aggregated social accounting matrix of Turkey is created,
- Disaggregated social accounting matrix of Turkey is created.

Those steps given in detail in the following sub-sections.

A.1.1 Sectoral Categories for Disaggregated SAM and Aggregated Input-Output Table

There is no standard way of how to disaggregate the data in a SAM. It depends on the objectives of the study, focus point of the examined policy and unique characteristics of the country (Thorbecke, 2000).

TurkStat 2012 input-output table consists of 64 sectors (TurkStat, 2016). To achieve the most efficient sectoral classification that fits to the purpose of this thesis study, aggregation and disaggregation studies carried out and 64 sectors are reclassified into 14 sectors to create the SAM (Table A.1).

In order to be able to evaluate the cement and iron-steel sector in detail, “Other non-metallic mineral products” and “Basic metals” sectors in input-output table are disaggregated, while other sectors in I-O table is kept as they are (SAM sectors: mining and quarrying; electricity, gas, steam and air conditioning) and/or aggregated (SAM sectors: agriculture; food; chemistry; transportation and storage; other industrial processes and products; waste; services) in order to make the structure suitable for the main intention of the thesis. Additionally, to obtain the cement sector as disaggregated from its general group in NIR, share of cement sector CO_2 emissions from mineral production is calculated. Disaggregation in input-output table and NIR is given in detail in the following two sub-sections.

Table A.1 Sectoral Disaggregation of the SAM

Abbreviation	SAM Sectors	**Input-Output Table (NACE Rev.2)** (TurkStat, 2016)	
		Codes	**Economic Activity Definitions**
Agr	Agriculture	A01	Crop and animal production, hunting and related service activities
		A02	Forestry and logging
		A03	Fishing and aquaculture
Min	Mining and Quarrying	B	Mining and quarrying
Fod	Food, Beverages, and Tobacco Products	C10-C12	Manufacture of food products; beverages and tobacco products
Che	Chemicals	C20	Manufacture of chemicals and chemical products
		C21	Manufacture of basic pharmaceutical products and preparations
		C22	Manufacture of rubber and plastic products
Tra	Transportation and Storage	H49	Land transport and transport via pipelines
		H50	Water transport
		H51	Air transport
		H52	Warehousing and support activities for transportation
		H53	Postal and courier activities
Elc	Electricity, Gas, Steam and Air Conditioning	D35	Electricity, gas, steam and air conditioning supply
Cem	Cement Production	C23	Manufacture of other non-metallic mineral products
Mnr	Production of Other than Cement Non-Metallic Mineral Products		

Table A.1 Sectoral Disaggregation of the SAM (continued)

Abbreviation	SAM Sectors	Input-Output Table (NACE Rev.2) (TurkStat, 2016)	
		Codes	**Economic Activity Definitions**
Iro	Iron and Steel Production	C24	Manufacture of basic metals
Met	Production of Other Basic Metals		
Con	Construction	F	Constructions and construction works
Oth	Other Industrial Processes and Products	C13-C15	Manufacture of textiles, wearing apparel, leather and related products
		C16	Manufacture of wood and of products of wood and cork, except furniture;
		C17	manufacture of articles of straw and plaiting materials
		C18	Manufacture of paper and paper products
		C19	Printing and reproduction of recorded media
		C25	Manufacture of coke and refined petroleum products
		C26	Manufacture of computer, electronic and optical products
		C27	Manufacture of electrical equipment
		C28	Manufacture of machinery and equipment n.e.c.
		C29	Manufacture of motor vehicles, trailers, and semi-trailers
		C30	Manufacture of other transport equipment
		C31-C32	Manufacture of furniture; other manufacturing
		C33	Repair and installation of machinery and equipment

Table A.1 Sectoral Disaggregation of the SAM (continued)

Abbreviation	SAM Sectors	**Input-Output Table (NACE Rev.2)** (TurkStat, 2016)	
		Codes	**Economic Activity Definitions**
Was	Waste and Water Management	E36	Water collection, treatment, and supply
		E37-E39	Sewerage, waste management, remediation activities
Ser	Services	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
		G46	Wholesale trade, except of motor vehicles and motorcycles
		G47	Retail trade, except of motor vehicles and motorcycles
		I	Accommodation and food service activities
		J58	Publishing activities
		J59-J60	Motion picture, video, TV program production; programming and broadcasting activities
		J61	Telecommunications
		J62-J63	Computer programming, consultancy, and information service activities
		K64	Financial service activities, except insurance and pension funding
		K65	Insurance, reinsurance and pension funding, except compulsory social security
		K66	Activities auxiliary to financial services and insurance activities
		L68B	Real estate activities excluding imputed rents
		L68A	Imputed rents of owner-occupied dwellings

Table A.1 Sectoral Disaggregation of the SAM (continued)

Abbreviation	SAM Sectors	**Input-Output Table (NACE Rev.2)** (TurkStat, 2016)	
		Codes	**Economic Activity Definitions**
Was	Waste and Water Management	E36	Water collection, treatment, and supply
		E37-E39	Sewerage, waste management, remediation activities
Ser	Services	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
		G46	Wholesale trade, except of motor vehicles and motorcycles
		G47	Retail trade, except of motor vehicles and motorcycles
		I	Accommodation and food service activities
		J58	Publishing activities
		J59-J60	Motion picture, video, TV program production; programming and broadcasting activities
		J61	Telecommunications
		J62-J63	Computer programming, consultancy, and information service activities
		K64	Financial service activities, except insurance and pension funding
		K65	Insurance, reinsurance and pension funding, except compulsory social security
		K66	Activities auxiliary to financial services and insurance activities
		L68B	Real estate activities excluding imputed rents
		L68A	Imputed rents of owner-occupied dwellings
		M69-M70	Legal and accounting activities; activities of head offices; management consultancy activities

Table A.1 Sectoral Disaggregation of the SAM (continued)

Abbreviation	SAM Sectors	Input-Output Table (NACE Rev.2) (TurkStat, 2016)	
		Codes	**Economic Activity Definitions**
Ser	Services		Architectural and engineering activities; technical testing and analysis
		M71	Scientific research and development, Advertising and market research
		M72, M73	Other professional, scientific and technical activities; veterinary activities
		M74-M75	Rental and leasing activities, Employment activities
		N77, N78	Travel agency, tour operator reservation service and related activities
		N79	Security and investigation, service and landscape, office administrative and support activities
		N80-N82	Public administration and defense; compulsory social security
		O84	Education, Human health activities
		P85, Q86	Residential care activities and social work activities without accommodation
		Q87-Q88	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities;
		R90-R92	gambling and betting activities
		R93, S94	Sports activities and amusement and recreation activities, Activities of membership organizations
		S95	Repair of computers and personal and household goods
		S96	Other personal service activities
		T	Activities of households as employers; undifferentiated goods- and services-producing activities of
			households for own use

A.1.1.1 Disaggregation in Input-Output Table

Cement sector is given within the other non-metallic mineral products sector (NACE Rev.2 Code Division 23). Other non-metallic mineral products sector in input-output table is disaggregated into "Cement production" and "Production of other than cement non-metallic mineral products" (TurkStat, 2016).

Iron-steel sector is given within the basic metals sectors and fabricated metal products (except machinery and equipment) sectors (NACE Rev.2 Code Division 24 and Division 25) in input-output table. These sectors in I-O table are disaggregated into "Iron and steel production" and "Production of other basic metals" (TurkStat, 2016).

In order to disaggregate the data for cement and iron-steel sectors in input-output table;

- TurkStat production values by economic activity data (TurkStat, 2021a) are evaluated according to statistical classification of economic activities,
- Groups and classes of cement sector are identified:
  According to NACE Rev.2:
  - 23.51: Manufacture of cement
  - 23.61: Manufacture of concrete products for construction purposes
  - 23.65: Manufacture of fibre cement

  According to HS:
  - 252310: Cement clinkers (whether or not colored)
  - 252321: Cement; portland, white, whether or not artificially colored
  - 252329: Cement; portland, other than white, whether or not artificially colored
  - 252330: Cement; aluminous (cement fondu), whether or not colored or in the form of clinkers
  - 252390: Cement; hydraulic kinds n.e.c. in heading no. 2523

- 6810: Articles of cement, of concrete or of artificial stone, whether or not reinforced tiles, flagstones, bricks, and similar articles
- 6811: Articles of asbestos-cement, of cellulose fibre-cement or the like

- Groups and classes of iron-steel sector are identified:

  According to NACE Rev.2:
  - 24.1: Manufacture of basic iron-steel and of ferro-alloys
  - 24.2: Manufacture of tubes, pipers, hollow profiles, and related fittings, of steel
  - 24.3: Manufacture of other products of first processing of steel
  - 25.51: Casting of iron
  - 24.52: Casting of steel

  According to NACE Rev.2:
  - 72: Iron and steel
  - 73: Iron and steel articles

- Share of cement and iron-steel sectors within their general divisions are calculated by using production value by economic activity (see Appendix B) data published by TurkStat.
  - Share of cement sector in NACE Rev.2 Code Division 23: 21.0%
  - Share of iron-steel sector in NACE Rev.2 Code Division 24: 86.8%

A.1.1.2 Sectoral Mapping

Input-output table have the classification according to NACE Rev.2 codes, national inventory report gives the GHG emissions for the categories stated in UNFCCC common reporting format and the trade data published by the United Nations is given in the Harmonized System (HS) codes.

Sectoral mapping (NIR CRF categories, NACE Rev.2 codes of sectors and corresponding HS codes of the 14 sectors of the SAM) used in this study are given in Table A.2.

Table A.2 Sectoral Mapping between SAM, CRF, NIR, I-O Table and HS Codes

SAM Sector	**CRF and NIR Categories**	**I-O Table NACE Rev.2 Codes**	**HS Codes**
Agr	Category 3 Category 1.A.4.c	A01 A02 A03	1-…-14
Min	Category 1.B.1 Category 1.B.2.a.1-2-3 Category 1.B.2.b.1-2-3 Category 1.B.2.c	B	26-27
Fod	Category 1.A.2.e	C10-C12	15-…-24
Che	Category 2.B Category 1.A.2.c	C20 C21 C22	28-…-40
Tra	Category 1.A.3	H49 H52 H50 H53 H51	-
Elc	Category 1.A.1.a Category 1.B.2.b.4-5	D35	27.16
Cem	Category 2.A.1 Category 1.A.2.f share	C23.51-61-65	25.23.10-21-29-30-90 68.10-68.11
Mnr	Category 2.A.2 Category 2.A.3 Category 2.A.4 Category 1.A.2.f share	Rest of C23	Rest of 25 Rest of 68 69-70
Iro	Category 2.C.1 Category 1.A.2.a	C24.1-2-3-51-52 C25	72-73
Met	Category 2.C.2 Category 2.C.3 Category 2.C.5 Category 1.A.2.b	C24.4-53-54 C25	74-…-83

Table A.2 Sectoral Mapping between SAM, NIR and I-O Table (continued)

SAM Sector	CRF Categories	NACE Rev.2 Codes	HS Codes
Con	Category 1.A.2.g	F	-
Oth	Category 1.A.1.b Category 1.A.1.c Category 1.A.2.d Category 1.A.2.g Category 1.B.2.a.4 Category 2.D-E-F.6	C13 C19 C30 C15 C26 C31 C16 C27 C32C33 C17 C28 C18 C29	41-…-67 71 84-…-96
Was	Category 5	E36 E37-E39	-
Ser	Category 1.A.4.a Category 2.F.3	G45 K Q G46 L R G47 M S I O T J P	-

A.1.2 Aggregated 2012 Input-Output Table of Turkey

Input-output table including 64 sectors is aggregated into 14 SAM sectors. Aggregated input-output table and taxes less subsidies on products values aggregated for all sectors are given in Table A.3 and Table A.4.

Table A.3 Aggregated 2012 Input-Output Table of Turkey

Billion TL	Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr	Iro	Met	Con	Oth	Was	Ser	Total
Agr	29.44	0.13	56.67	0.63	0.02	0.00	0.01	0.02	0.00	0.00	0.11	7.78	0.01	5.50	100.32
Min	0.45	1.95	0.84	2.47	0.42	28.16	2.31	5.90	8.65	1.32	4.90	33.77	0.09	3.51	94.74
Fod	6.37	0.04	23.84	0.16	0.22	0.02	0.01	0.03	0.04	0.01	0.11	0.85	0.04	22.08	53.81
Che	8.94	0.67	5.65	39.93	2.60	0.07	0.60	1.54	2.92	0.45	9.01	27.01	0.79	13.76	113.94
Tra	2.66	1.97	7.75	4.15	58.16	0.54	0.56	1.43	5.82	0.89	6.09	13.26	0.71	34.66	138.66
Elec	0.90	0.98	1.84	2.03	0.76	60.46	0.72	1.83	4.40	0.67	0.43	5.80	1.59	15.96	98.37
Cem	0.04	0.06	0.16	0.18	0.25	0.04	0.55	1.40	0.18	0.03	7.42	0.46	0.02	1.62	12.37
Mnr	0.09	0.15	0.40	0.46	0.63	0.09	1.40	3.56	0.45	0.07	18.93	1.16	0.05	4.12	31.55
Iro	0.06	0.45	0.68	1.12	1.12	0.07	0.12	0.30	31.35	4.78	31.98	31.55	0.19	4.30	108.06
Met	0.01	0.07	0.10	0.17	0.17	0.01	0.02	0.05	4.78	0.73	4.88	4.81	0.03	0.66	16.48
Con	0.36	0.09	0.35	0.23	0.45	0.41	0.02	0.06	0.37	0.06	47.24	0.77	2.18	14.15	66.74
Oth	5.54	2.96	4.44	3.50	32.15	1.02	1.01	2.58	2.42	0.37	19.83	122.25	0.84	50.20	249.11
Was	0.55	0.01	0.17	0.42	0.08	0.01	0.03	0.08	22.39	3.42	0.15	1.63	4.57	3.51	37.01
Ser	6.48	2.98	18.45	9.87	29.20	4.73	1.43	3.65	8.45	1.29	29.45	46.23	3.24	204.22	369.68
Total	61.90	12.50	121.33	65.33	126.21	95.63	8.79	22.42	92.22	14.07	180.54	297.33	14.36	378.24	**1,490.85**
Net Taxes on Production	2.38	1.34	1.54	4.04	17.39	5.35	0.51	1.31	4.97	0.76	6.03	15.82	0.67	18.37	80.50
Compensation of Employees	3.19	5.28	13.41	9.42	23.58	3.49	1.69	4.32	10.07	1.54	28.44	47.25	4.28	282.62	438.58
Operating Surplus	111.27	13.61	37.00	17.32	105.81	17.36	3.40	8.67	19.65	3.00	82.83	76.75	12.89	408.08	917.65
Consumption of Fixed Capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.70	28.46	29.19
Value Added at Basic Prices	114.46	18.90	50.41	26.74	129.40	20.85	5.10	12.99	29.72	4.53	111.27	124.01	17.87	719.17	1,385.41
Imports, fob	14.03	76.13	11.04	66.30	4.96	0.46	0.88	2.25	48.79	7.44	0.62	186.76	17.79	10.87	448.32
Supply at Basic Prices	192.78	108.87	184.32	162.41	277.95	122.29	15.28	38.97	175.70	26.80	298.46	623.92	50.68	1,126.65	**3,405.09**

Billion TL	Private Consumption	Government Consumption	Final Consumption Expenditure	Gross Fixed Capital Formation	Changes in Inventories	Total Gross Capital formation	Exports, fob	Final Uses at Basic Prices	Total Use at Basic Prices
Agr	67.99	0	67.99	10.35	4.63	14.98	9.49	92.45	192.78
Min	5.91	0	5.91	0.49	2.47	2.96	5.27	14.13	108.87
Fod	111.98	0	111.98	0	0.64	0.64	17.89	130.51	184.32
Che	15.09	9.10	24.19	1.17	-0.91	0.26	24.02	48.47	162.41
Tra	97.80	0.57	98.37	6.32	0	6.32	34.61	139.30	277.95
Elec	23.58	0	23.58	0	0	0	0.34	23.92	122.29
Cem	0.77	0	0.77	0.32	-0.10	0.21	1.93	2.91	15.28
Mnr	1.96	0	1.96	0.81	-0.27	0.54	4.91	7.42	38.97
Iro	2.45	0	2.45	13.63	0.84	14.47	50.72	67.64	175.70
Met	0.37	0	0.37	2.08	0.13	2.21	7.74	10.32	26.80
Con	1.97	0.01	1.98	219.08	8.19	227.27	2.47	231.71	298.46
Oth	121.86	0.07	121.93	109.39	-4.11	105.28	147.60	374.81	623.92
Was	6.40	6.86	13.26	0	-0.28	-0.28	0.69	13.67	50.68
Ser	484.99	206.34	691.32	48.55	2.14	50.69	14.96	756.97	1,126.65
Total	943.12	222.94	1,166.06	412.18	13.37	425.55	322.63	1,914.24	**3,405.09**

Source: (TurkStat, 2016) and Author's calculations

Table A.4 Aggregated 2012 Taxes Less Subsidies on Products Table of Turkey

Billion TL	Private Consumption	Government Consumption	Final Consumption Expenditure	Gross Fixed Capital Formation (Investment)	Changes in Inventories and Valuables	Total gross capital formation	Exports, fob	Final Uses at Basic Prices	Total Use at Basic Prices
Agr	-1.22	0	-1.22	-0.12	-0.11	-0.23	-0.20	-1.65	-3.54
Min	0.85	0	0.85	0.002	0.35	0.35	0.05	1.26	12.51
Fod	27.59	0	27.59	0	0.65	0.65	0.00	28.24	31.79
Che	1.91	0.31	2.22	0.03	0.12	0.16	0.10	2.47	8.87
Tra	3.42	0	3.42	0	0	0	0	3.42	3.83
Elec	1.72	0	1.72	0	0	0	0	1.72	2.98
Cem	0.04	0	0.04	0.002	0.001	0.003	0.002	0.04	0.21
Mnr	0.09	0	0.09	0.01	0.001	0.01	0.005	0.10	0.55
Iro	0.17	0	0.17	0.30	0.11	0.42	1.95	2.54	7.72
Met	0.03	0	0.03	0.05	0.02	0.06	0.30	0.39	1.18
Con	0.05	0	0.05	5.44	0.04	5.48	0	5.53	5.76
Oth	25.79	0	25.79	10.76	0.93	11.70	0.36	37.85	79.88
Was	0.37	0	0.37	0	-0.00001	-0.00001	0.0005	0.37	2.41
Ser	21.17	0.15	21.32	0.17	-0.02	0.15	0.001	21.47	30.11
Total	**81.98**	**0.46**	**82.44**	**16.65**	**2.08**	**18.74**	**2.58**	**103.76**	**184.26**

A.1.3 Turkey 2012 Aggregated Social Accounting Matrix

There is no unique way of building a SAM. Mostly, an aggregated SAM is constructed as a first step and then disaggregated version is generated (Erik Thorbecke, 2000).

Aggregated SAM of Turkey is created by using and utilizing data from TurkStat, Central Bank of the Republic of Turkey (CBRT), Republic of Turkey Ministry of Treasury and Finance (MTF), Presidency of Republic of Turkey-Presidency of Strategy and Budget (PSB), Republic of Turkey Social Security Institution (SSI) and it is given in Table A.5. Values and descriptions of each cell in the aggregated SAM are given below. Later, data resources of each entry are described.

Intermediate Demand

(A2: 1,490,848,056)

Goods and services used in the production process reflects the intermediate demand (IFPRI, 2010). Data for intermediate demand is taken from input-output table.

Supply for Domestic Demand

(B1: 2,631,547,809)

Supply for domestic market is calculated by subtracting export values of each sector from total use values (basic prices converted into producer's prices by using taxes less subsidies table). Data for the calculation of domestic supply is taken from domestic use table, input output table and taxes less subsidies table.

Value Added

(A3: 438,577,769 & A4: 946,835,000)

Labor and capital are taken as the factors of production in the SAM. Wages of labor and profits of capital which are the income of factors of production are the total value added. This is also called as “GDP at factor cost”(IFPRI, 2010). Data for value added is obtained from input-output table.

Factor Income Distribution

(C5: 438,577,769 & D5: 946,835,000)

Factor income is paid to household.

Private Consumption

(E2: 1,025,098,746)

Important part of the income of households is used to buy commodities to consume. Private consumption data is obtained from input-output and taxes less subsidies on products table.

Government Recurrent Spending and Investment Demand

(F2: 223,401,702 & G2: 444,282,344)

Government consumption and investment data is obtained from input-output and taxes less subsidies on products table.

Foreign Trade

(B8: 448,324,963 & H1: 325,214,286)

Data for exports and imports are taken from input-output and taxes less subsidies on products table.

Government Revenues

(A6: 80,501,271 & B6: 103,758,076 & E6: 86,679,267)

Data for indirect taxes on inputs and tariffs are taken from input-output table and taxes less subsidies on products table. Direct taxes and non-tax payments are obtained from the general government budget statistics of Ministry of Treasury and Finance, Turkish Presidency-Presidency of Strategy and Budget.

Social Transfers and Remittances

(F5: 57,996,220 & H5: 1,761,825)

Households have transfers from rest of the world as remittances and from government as social transfers. Data for social funds is taken from Republic of Turkey Social Security Institution (SSI), data for interest payment on domestic borrowing is taken from MTF and workers remittances data is obtained from the CBRT.

Public and Private Savings

(E7: 333,392,801 & F7: 110,889,543)

Private and public savings are computed as residual (difference between income and expenditure) and inserted into SAM as a transfer to household and government investment account.

Foreign Saving

(H6: 128,625,628)

Foreign saving, computed from the account of ROW, is taken as a transfer to government from ROW.

Interest Payments

(F8: 7,276,776)

Interest payment on foreign borrowing data is derived from MTF statistics.

Table A.5 2012 Aggregated Social Accounting Matrix of Turkey (Thousand TRY)

	Activities (A)	Commodities (B)	Factors of Production		Household (E)	Government (F)	Saving Investment (G)	Rest of World (H)	TOTAL (I)
			Labor (C)	Capital (D)					
1		2,631,547,809						325,214,286	**2,956,762,095**
2	2,631,547,809				1,025,098,746	223,401,702	444,282,344		**3,183,630,848**
3	438,577,769								**438,577,769**
4	946,835,000								**946,835,000**
5			438,577,769	946,835,000		57,996,220		1,761,825	**1,445,170,813**
6	80,501,271	103,758,076			86,679,267			128,625,628	**399,564,242**
7					333,392,801	110,889,543			**444,282,344**
8		448,324,963				7,276,776			**455,601,739**
9	**2,956,762,095**	**3,183,630,848**	**438,577,769**	**946,835,000**	**1,445,170,813**	**399,564,242**	**444,282,344**	**455,601,739**	

Source: Author's calculations from TurkStat, MTF, PSB, SSI, CBRT.

Data resources of values in each cell of the aggregated SAM are summarized below:

- A2: Intermediate input demand, A3: Wages, A4: Profits, A6: Indirect Taxes on Inputs, B8: Imports, C5: Labor income, D5: Profit income [(TurkStat, 2016) Input-Output Table 2012]
- B1: Domestic supply [(TurkStat, 2016) Domestic Use Table, Input-Output Table and Taxes Less Subsidies on Products Table 2012]
- E2: Private Consumption, F2: Government Consumption, G2: Investment, H1: Exports [(TurkStat, 2016) Input-Output Table 2012 and Taxes Less Subsidies on Products Table 2012]
- B6: Tariffs [(TurkStat, 2016) Taxes Less Subsidies on Products Table 2012]
- E6: Direct taxes and non-tax payments [(Ministry of Treasury and Finance, 2013; Turkish Presidency Presidency of Strategy and Budget, 2021) General Government Revenues and Expenditures 2012 and General Government Budget Revenues]
- E7: Private savings (I5-E2-E6), F7: Public savings (I6-F2-F5-F8)
- F5: Social transfers [(Ministry of Treasury and Finance, 2021; Republic of Turkey Social Security Institution, 2013) Interest Payment on Domestic Borrowing 2012 and Social Funds 2012]
- F8: Interest payments [(Ministry of Treasury and Finance, 2021) Interest Payments on Foreign Borrowing 2012]
- H5: Transfers from abroad [(The Central Bank of the Republic of Turkey, 2013) Workers Remittances 2012]
- H6: Foreign saving (I8-(H1+H5))
- I1: Gross production, I2: Aggregate demand, I3: Labor income, I4: Capital income, I5: Private income, I6: Public income, I7: Total savings, I8: Foreign exchange expenditures
- A9: Production expenditure, B9: Total absorption, C9: Total wages, D9: Total profits, E9: Total private expenditure, F9: Total public expenditure, G9: Total savings, H9: Foreign exchange earnings

A.1.4 Turkey 2012 Disaggregated SAM

By using the data mentioned in the previous sections, applying aggregation and disaggregation, and making calculations, disaggregated SAM for 14 sectors is created for 2012 Turkish economy and given in Table A.6.

Table A.6 Turkey 2012 Disaggregated SAM

	Billion TL	ACTIVITIES														COMMODITIES																				
		AGR	MIN	FOD	CHE	TRA	ELEC	CEM	MNR	IRO	MET	CON	OTH	WAS	SER	AGR	MIN	FOD	CHE	TRA	ELEC	CEM	MNR	IRO	MET	CON	OTH	WAS	SER	LAB (3)	CAP (4)	HH (5)	GOV (6)	S-I (7)	RoW (8)	TOTAL
	AGR															169.46																			9.29	178.74
	MIN																27.42																		5.32	32.74
	FOD																	155.39																	17.89	173.28
	CHE																		71.99																24.12	96.11
	TRA																			238.38															34.61	272.99
	ELEC																				121.49														0.34	121.83
1	CEM																					12.47													1.93	14.40
	MNR																						31.80												4.92	36.72
	IRO																							74.23											52.68	126.91
	MET																								11.32										8.04	19.36
	CON																									295.37									2.47	297.84
	OTH																										289.19								147.97	437.16
	WAS																											32.21							0.69	32.89
	SER																												1,100.82						14.96	1,115.78
	AGR	29.44	0.13	56.67	0.63	0.02	0.00	0.01	0.02	0.00	0.00	0.11	7.78	0.01	5.50																	66.77	0.00	14.75		181.84
	MIN	0.45	1.95	0.84	2.47	0.42	28.16	2.31	5.90	8.65	1.32	4.90	33.77	0.09	3.51																	6.76	0.00	3.31		104.80
	FOD	6.37	0.04	23.84	0.16	0.22	0.02	0.01	0.03	0.04	0.01	0.11	0.85	0.04	22.08																	139.57	0.00	1.29		194.67
	CHE	8.94	0.67	5.65	39.93	2.60	0.07	0.60	1.54	2.92	0.45	9.01	27.01	0.79	13.76																	17.00	9.41	0.42		140.77
	TRA	2.66	1.97	7.75	4.15	58.16	0.54	0.56	1.43	5.82	0.89	6.09	13.26	0.71	34.66																	101.23	0.57	6.32		246.77
	ELEC	0.90	0.98	1.84	2.03	0.76	60.46	0.72	1.83	4.40	0.67	0.43	5.80	1.59	15.96																	25.30	0.00	0.00		123.67
2	CEM	0.04	0.06	0.16	0.18	0.25	0.04	0.55	1.40	0.18	0.03	7.42	0.46	0.02	1.62																	0.81	0.00	0.22		13.40
	MNR	0.09	0.15	0.40	0.46	0.63	0.09	1.40	3.56	0.45	0.07	18.93	1.16	0.05	4.12																	2.06	0.00	0.55		34.15
	IRO	0.06	0.45	0.68	1.12	1.12	0.07	0.12	0.30	31.35	4.78	31.98	31.55	0.19	4.30																	2.62	0.00	14.89		125.57
	MET	0.01	0.07	0.10	0.17	0.17	0.01	0.02	0.05	4.78	0.73	4.88	4.81	0.03	0.66																	0.40	0.00	2.27		19.15
	CON	0.36	0.09	0.35	0.23	0.45	0.41	0.02	0.06	0.37	0.06	47.24	0.77	2.18	14.15																	2.03	0.01	232.75		301.52
	OTH	5.54	2.96	4.44	3.50	32.15	1.02	1.01	2.58	2.42	0.37	19.83	122.25	0.84	50.20																	147.65	0.07	116.97		513.81
	WAS	0.55	0.01	0.17	0.42	0.08	0.01	0.03	0.08	22.39	3.42	0.15	1.63	4.57	3.51																	6.77	6.86	-0.28		50.36
	SER	6.48	2.98	18.45	9.87	29.20	4.73	1.43	3.65	8.45	1.29	29.45	46.23	3.24	204.22																	506.16	206.49	50.84		1,133.16
	3	3.19	5.28	13.41	9.42	23.58	3.49	1.69	4.32	10.07	1.54	28.44	47.25	4.28	282.62																					438.58
	4	111.27	13.62	37.00	17.32	105.81	17.36	3.40	8.67	19.65	3.00	82.83	76.76	13.59	436.55																					946.83
	5																													438.58	946.83		58.00		1.76	1,445.17
	6	2.38	1.34	1.54	4.04	17.39	5.35	0.51	1.31	4.97	0.76	6.03	15.82	0.67	18.37	-1.65	1.26	28.24	2.47	3.42	1.72	0.04	0.10	2.54	0.39	5.53	37.85	0.37	21.47			86.68			128.63	399.57
	7																															333.39	110.90			444.28
	8															14.03	76.13	11.04	66.30	4.96	0.46	0.88	2.25	48.79	7.44	0.62	186.76	17.79	10.87				7.28			455.60
	TOTAL	178.74	32.74	173.28	96.11	272.99	121.83	14.40	36.72	126.91	19.36	297.84	437.16	32.89	1,115.78	181.84	104.80	194.67	140.77	246.77	123.67	13.40	34.15	125.57	19.15	301.52	513.81	50.36	1,133.16	438.58	946.83	1,445.17	399.57	444.28	455.60	

A.2 Social Accounting Matrix of Turkey for 2019

National aggregate accounts, survey data, goverment revenues and expenditures, trade data etc. are collected for 2019 and aggrageted SAM is created at first. Later, following a top-down approach, disaggregation is made. As it is stated in the previous section, there does not exist a published input-output table for 2019. Therefore, the shares between or among sectors are distributed based on 2012 SAM shares. 2019 aggregated intermediate demand, domestic supply, nex taxes on products, compensation of employees, operating surplus, consumption expenditure and gross capital formation data are disaggragated based on 2012 percentages. Imports and exports data in a sectoral disaggregated from is available for 2019, therefore 2012 shares have not been used for the trade data.

Incorporating data from different sources and distributing an important amount of aggregated data based on 2012 shares lead to inconsistencies between expenditure and income of accounts after consolidation and need to be balanced. Balance of the SAM is achieved by developing a non-linear mathematical model in GAMS. All the steps of creating the SAM for 2019 and balancing it is presented in detail in the following sub-sections.

A.2.1 Turkey 2019 Aggregated Social Accounting Matrix

Aggregated SAM of Turkey for 2019 is created by using and utilizing data from TurkStat, Central Bank of the Republic of Turkey (CBRT), Republic of Turkey Ministry of Treasury and Finance (MTF), Presidency of Republic of Turkey-Presidency of Strategy and Budget (PSB), Republic of Turkey Social Security Institution (SSI), United Nations Comtrade Database and is given in Table A.7.

Table A.7 2019 Aggregated Social Accounting Matrix of Turkey (Million TRY)

	Activities (A)	Commodities (B)	Factors of Production		Household (E)	Governme nt (F)	Saving Investment (G)	Rest of World (H)	TOTAL (I)
			Labor (C)	Capital (D)					
1								1,215,104	**8,405,237**
2	4,517,312				2,456,123	668,572	1,311,886		**8,953,894**
3	1,354,321								**1,354,321**
4	2,533,603								**2,533,603**
5			1,354,321	2,533,603		81,294		961	**3,970,179**
6		429,863			243,691			142,049	**815,603**
7					1,270,366	41,521			**1,311,886**
8		1,333,899				24,216			**1,358,115**
9	**8,405,237**	**8,953,894**	**1,354,321**	**2,533,603**	**3,970,179**	**815,603**	**1,311,886**	**1,358,115**	

Source: Author's calculations from TurkStat, MTF, PSB, SSI, CBRT, UN Comtrade.

A.2.2 Turkey 2019 Disaggregated Social Accounting Matrix

Cement and iron-steel sector are not examined in detail in similar studies and NACE division 23 as total is taken as cement sector, and NACE division 24 as iron-steel sector (Acar et al., 2021; Aşıcı, 2021c; Yeldan et al., 2016). But these general classes include lime, plaster, glass etc. in division 23, and aluminum, lead, zinc, non-ferrous metals etc. in division 24. In this study it is aimed to isolate cement and iron-steel sector specifically and generate results reflecting these sectors. Therefore, shares of cement and iron-steel in 2019 are calculated and used while constructing the SAM.

Share of cement and iron-steel sectors within their general divisions are calculated by using 2019 production value by economic activity data (Appendix B) published by TurkStat. Production value of stated NACE classes for SAM sectors (C23.51, C23.61, C23.65 for Cem; C24.1, C24.2, C24.3, C24.51, C24.52 and part of C25) is divided by total production value of the respective divisions. 23.2% is found as the share to distribute NACE division 23 values, which will be used to create SAM, to Cem sector and remaining part, 76.8%, is taken as the share of Mnr sector. For the Iro sector, on the other hand, the share to distribute NACE divisions 24&25 values is calculated as 86% and remaining 14% is taken as the share of Met sector.

Cem ve Iro shares' calculations are shown below.

- Share of cement sector in NACE division 23

$$\frac{15{,}589{,}845{,}701\ +\ 6{,}931{,}348{,}652 + 164{,}556{,}878}{97{,}955{,}569{,}223} = \mathbf{23.2}\%$$

- Share of iron-steel sector in NACE divisions 24 and 25

$$\frac{152{,}050{,}392{,}775 +\ 20{,}045\ 732\ 344 + 14{,}654{,}064{,}885 + 6{,}606{,}370{,}701 + 3{,}277{,}042{,}097 + 144{,}960{,}042{,}482}{252{,}011{,}271{,}551}$$
$$= \mathbf{86.0}\%$$

In the following part of this section, how disaggregation is made for 2019 by using aggregate 2019 data and calculated shares of 2012 SAM as a basis will be presented.

Disaggregation of Intermediate Demand Data

In the 2019 Institutional Sector Accounts data published by TurkStat, intermediate demand data is given as 4,517,312,474 kTRY. Since, its sectoral coverage and disaggregation for 2019 are not provided, first based on 2012 disaggregated SAM, shares are calculated. Then, according to these shares, 2019 aggregated data is distributed. An example about the disaggregation is given below:

2012 intermediate demand data 1,490,848,056 and existing disaggregation

Commoditiy Agr row sum =	100,324,264
Percentage of row sum =	100,324,264 / 1,490,848,056
=	*6.7%* (Table A.9)
Commodity Agr to Activity Fod in 2012 =	**56,673,948** (Table A.8)
Percentage of C_Agr to A_fod data in 2012 =	56,673,948 / 100,324,264
=	*56.5%* (Table A.9)

2019 intermediate demand data 4,517,312,474 and applied disaggregation

Commodity Agr to Activity Fod in 2019 = *2019 intermediate demand data * Row sum percentage in 2012 * Percentage of C_Agr to A_Fod data in 2012*

= *4,517,312,474 * 6.7% * 56.5%*

= **171,723,692** (Table A.10)

For Cem, Mnr, Iro and Met sectors additional disaggregation is applied according to the 2019 sectoral shares calculated. Therefore, firstly 2012 demand data percentages are calculated for NACE division 23 and NACE divisions 24&25 and then disaggregated according to calculated 2019 shares of these sectors (23.2% and 86%). An example related to this disaggregation is shown below:

2012 intermediate demand data 1,490,848,056 and existing disaggregation

Commoditiy Min row sum = 94,735,469

Percentage of row sum = 94,735,469/ 1,490,848,056

= *6.4%* (Table A.9)

Commodity Min to Activity Cem in 2012 = 2,312,769 (Table A.8)

Commodity Min to Activity Mnr in 2012 = 5,896,635 (Table A.8)

C_Min to Activity NACE division 23 = 2,312,769 + 5,896,635 **= 8,209,404**

Percentage of C_Min to A_ NACE 23 data in 2012

= 8,209,404/ 94,735,469 = *8.7%* (Table A.9)

2019 intermediate demand data 4,517,312,474 and applied disaggregation

Commodity Min to Activity Cem in 2019 = *2019 intermediate demand data * Row sum percentage in 2012 * Percentage of C_Min to A_ NACE 23 data in 2012 * Share of cement sector in NACE division 23 in 2019*

= *4,517,312,474 * 6.4% * 8.7% * 23.2%*

= **5,760,795** (Table A.10)

Disaggregated intermediate demand data calculated for 2019 is given in Table A.10.

Table A.8 2012 Disaggregated Intermediate Demand Data (kTRY)

		Activities														
		Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr	Iro	Met	Con	Oth	Was	Ser	Total
Commodities	Agr	29,438,082	133,291	56,673,948	627,218	15,683	218	8,292	21,140	1,513	231	114,145	7,783,866	8,728	5,497,909	100,324,264
	Min	452,063	1,946,322	839,462	2,473,300	419,526	28,156,572	2,312,769	5,896,635	8,647,765	1,319,147	4,902,443	33,770,217	86,582	3,512,665	94,735,469
	Fod	6,367,557	37,176	23,837,174	163,604	215,823	20,740	9,938	25,338	42,016	6,409	112,565	848,912	44,139	22,075,536	53,806,928
	Che	8,943,774	667,798	5,654,674	39,930,012	2,603,118	74,998	602,401	1,535,882	2,922,571	445,815	9,011,344	27,006,397	788,103	13,756,088	113,942,974
	Tra	2,657,744	1,974,488	7,746,312	4,151,020	58,160,752	541,558	562,364	1,433,803	5,820,878	887,928	6,088,677	13,256,320	714,123	34,661,590	138,657,557
	Elec	902,509	979,825	1,835,289	2,034,290	759,052	60,459,561	719,652	1,834,824	4,397,635	670,824	428,258	5,801,389	1,590,774	15,955,868	98,369,748
	Cem	36,957	58,251	155,411	179,813	246,130	36,739	547,587	1,396,127	175,096	26,709	7,424,703	455,034	19,175	1,616,634	12,374,365
	Mnr	94,224	148,518	396,235	458,451	627,534	93,669	1,396,127	3,559,565	446,424	68,098	18,930,024	1,160,154	48,888	4,121,770	31,549,682
	Iro	60,674	449,588	676,764	1,122,930	1,115,346	67,243	118,645	302,497	31,349,853	4,782,167	31,979,599	31,548,210	192,577	4,295,687	108,061,778
	Met	9,255	68,581	103,235	171,294	170,137	10,257	18,098	46,143	4,782,167	729,481	4,878,230	4,812,425	29,376	655,272	16,483,952
	Con	364,064	93,241	350,386	226,323	445,099	409,542	23,956	61,077	368,581	56,224	47,242,346	770,766	2,178,252	14,153,658	66,743,517
	Oth	5,539,983	2,960,866	4,441,542	3,496,543	32,149,736	1,017,722	1,011,234	2,578,243	2,423,232	369,644	19,829,830	122,253,374	841,762	50,199,362	249,113,072
	Was	548,992	5,767	169,768	420,031	75,475	13,882	30,098	76,738	22,390,532	3,415,495	149,759	1,627,109	4,569,849	3,514,434	37,007,929
	Ser	6,484,510	2,979,612	18,449,593	9,870,309	29,203,033	4,725,441	1,431,121	3,648,787	8,449,061	1,288,836	29,447,160	46,234,076	3,243,366	204,221,916	369,676,822

Table A.9 2012 Shares of Disaggregated Intermediate Demand Data

		Activities												
		Agr	Min	Fod	Che	Tra	Elec	Cem & Mnr	Iro & Met	Con	Oth	Was	Ser	Total
Commodities	Agr	29.3%	0.1%	56.5%	0.6%	0.02%	0.0002%	0.03%	0.002%	0.1%	7.8%	0.01%	5.5%	7%
	Min	0.5%	2.1%	0.9%	2.6%	0.4%	29.7%	8.7%	10.5%	5.2%	35.6%	0.1%	3.7%	6%
	Fod	11.8%	0.1%	44.3%	0.3%	0.4%	0.04%	0.1%	0.1%	0.2%	1.6%	0.1%	41.0%	4%
	Che	7.8%	0.6%	5.0%	35.0%	2.3%	0.1%	1.9%	3.0%	7.9%	23.7%	0.7%	12.1%	8%
	Tra	1.9%	1.4%	5.6%	3.0%	41.9%	0.4%	1.4%	4.8%	4.4%	9.6%	0.5%	25.0%	9%
	Elec	0.9%	1.0%	1.9%	2.1%	0.8%	61.5%	2.6%	5.2%	0.4%	5.9%	1.6%	16.2%	7%
	Cem	0.3%	0.5%	1.3%	1.5%	2.0%	0.3%	15.7%	1.6%	60.0%	3.7%	0.2%	13.1%	1%
	Mnr	0.3%	0.5%	1.3%	1.5%	2.0%	0.3%	15.7%	1.6%	60.0%	3.7%	0.2%	13.1%	2%
	Iro	0.1%	0.4%	0.6%	1.0%	1.0%	0.1%	0.4%	33.4%	29.6%	29.2%	0.2%	4.0%	7%
	Met	0.1%	0.4%	0.6%	1.0%	1.0%	0.1%	0.4%	33.4%	29.6%	29.2%	0.2%	4.0%	1%
	Con	0.5%	0.1%	0.5%	0.3%	0.7%	0.6%	0.1%	0.6%	70.8%	1.2%	3.3%	21.2%	4%
	Oth	2.2%	1.2%	1.8%	1.4%	12.9%	0.4%	1.4%	1.1%	8.0%	49.1%	0.3%	20.2%	17%
	Was	1.5%	0.0%	0.5%	1.1%	0.2%	0.04%	0.3%	69.7%	0.4%	4.4%	12.3%	9.5%	2%
	Ser	1.8%	0.8%	5.0%	2.7%	7.9%	1.3%	1.4%	2.6%	8.0%	12.5%	0.9%	55.2%	25%

Table A.10 2019 Disaggregated Intermediate Demand Data (Unbalanced) (kTRY)

		Activities														
		Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr	Iro	Met	Con	Oth	Was	Ser	Total
Commodities	Agr	89,198,233	403,875	171,723,692	1,900,490	47,520	661	20,653	68,527	4,547	737	345,863	23,585,337	26,447	16,658,823	303,985,403
	Min	1,369,765	5,897,410	2,543,595	7,494,171	1,271,176	85,315,223	5,760,795	19,113,935	25,987,113	4,212,917	14,854,544	102,324,728	262,347	10,643,477	287,051,195
	Fod	19,293,882	112,645	72,227,322	495,723	653,951	62,844	24,754	82,133	126,260	20,469	341,074	2,572,229	133,743	66,889,510	163,036,538
	Che	27,099,891	2,023,448	17,133,825	120,989,083	7,887,522	227,246	1,500,500	4,978,561	8,782,521	1,423,784	27,304,631	81,830,159	2,387,974	41,681,343	345,250,488
	Tra	8,053,041	5,982,756	23,471,549	12,577,709	176,228,750	1,640,936	1,400,773	4,647,671	17,492,128	2,835,747	18,448,867	40,167,029	2,163,814	105,025,615	420,136,386
	Elec	2,734,629	2,968,898	5,560,978	6,163,956	2,299,950	183,194,209	1,792,555	5,947,579	13,215,186	2,142,388	1,297,633	17,578,374	4,820,090	48,346,739	298,063,164
	Cem	111,979	176,503	470,899	544,839	745,782	111,319	1,363,964	4,525,543	526,174	85,301	22,497,064	1,378,765	58,101	4,898,447	37,494,681
	Mnr	285,503	450,013	1,200,604	1,389,121	1,901,447	283,820	3,477,563	11,538,324	1,341,533	217,484	57,358,518	3,515,299	148,133	12,489,081	95,596,444
	Iro	183,843	1,362,266	2,050,613	3,402,511	3,379,532	203,748	295,528	980,544	94,208,403	15,272,655	96,899,103	95,591,982	583,513	13,016,054	327,430,295
	Met	28,044	207,803	312,804	519,026	515,520	31,080	45,080	149,574	14,370,731	2,329,720	14,781,176	14,581,785	89,010	1,985,494	49,946,848
	Con	1,103,125	282,524	1,061,680	685,766	1,348,663	1,240,925	59,670	197,981	1,107,612	179,561	143,145,666	2,335,444	6,600,166	42,885,992	202,234,775
	Oth	16,786,307	8,971,509	13,458,001	10,594,625	97,414,623	3,083,727	2,518,848	8,357,371	7,281,974	1,180,522	60,084,954	370,431,237	2,550,562	152,105,510	754,819,769
	Was	1,663,463	17,473	514,401	1,272,705	228,691	42,064	74,970	248,747	67,285,047	10,907,958	453,773	4,930,189	13,846,773	10,648,836	112,135,089
	Ser	19,648,253	9,028,311	55,902,797	29,907,322	88,486,030	14,318,223	3,564,730	11,827,537	25,389,992	4,116,114	89,225,741	140,090,579	9,827,493	618,798,277	1,120,131,399
	Total	187,559,958	37,885,435	367,632,760	197,937,047	382,409,157	289,756,024	21,900,385	72,664,025	277,119,222	44,925,357	547,038,608	900,913,135	43,498,165	1,146,073,197	

Disaggregation of Supply for Domestic Market Data

Supply for domestic market data is the difference between total output and exports.

2012 aggregated data

Total output = 2,956,762,095

Export = 325,214,286

Supply for domestic market = 2,956,762,095 - 325,214,286 = **2,631,547,809**

2019 aggregated data

Total output = 8,405,236,512

Export = 1,215,104,204

Supply for domestic market = 8,405,236,512 - 1,215,104,204 = **7,190,132,308**

As sectoral coverage and disaggregation is not available for 2019, based on 2012 disaggregated SAM, shares are calculated and according to these shares, 2019 aggregated data is distributed. An example about the disaggregation is given below:

2012 supply for domestic market data and existing disaggregation

Agr domestic supply = 169,455,597 (Table A.11)

Percentage = 169,455,597 / 2,631,547,809 = *6.4%* (Table A.12)

2019 supply for domestic market data and applied disaggregation

Agr domestic supply in 2019 = *2019 supply for domestic market data * Percentage of Agr domestic supply data in 2012*

= *7,190,132,308 * 6.4%*

= **463,000,581** (Table A.13)

As in intermediate demand data disaggregation, for Cem, Mnr, Iro and Met sectors additional disaggregation is applied according to the 2019 sectoral shares calculated. Therefore, firstly 2012 demand data percentages are calculated for NACE division 23 and NACE divisions 24&25 and then disaggregated according to calculated 2019 shares of these sectors (23.2% and 86%). An example related to this disaggregation is shown below:

<u>2012 supply for domestic market data and existing disaggregation</u>

Iro domestic supply = 201,157,628

Met domestic supply = 32,610,795

NACE 24&25 domestic supply = 74,234,109 + 11,323,814**= 85,557,923**

Percentage, *NACE 24&25 data* = 85,557,923 / 2,631,547,809=*3.3%* (Table A.11)

<u>2019 supply for domestic market data and applied disaggregation</u>

Iro domestic supply in 2019 = *2019 supply for domestic market data * Percentage of NACE 24&25 domestic supply data in 2012 * Share of Iro sector in 2019*

*= 7,190,132,308 * 3.3% * 86.0%*

= **201,157,628** (Table A.13)

Disaggregated supply for domestic market data calculated for 2019 is given in Table A.13.

Table A.11 2012 Disaggregated Supply for Domestic Market Data (kTRY)

		Commodities													
		Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr	Iro	Met	Con	Oth	Was	Ser
Activities	Agr	169,455,597													
	Min		27,419,411												
	Fod			155,387,587											
	Che				71,991,430										
	Tra					238,384,716									
	Elec						121,486,887								
	Cem							9,315,957							
	Mnr								34,956,548						
	Iro									74,234,109					
	Met										11,323,814				
	Con											295,370,096			
	Oth												289,194,449		
	Was													32,205,533	
	Ser														1,100,821,676

Table A.12 2012 Shares of Disaggregated Supply for Domestic Market Data

		Commodities													
		Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr	Iro	Met	Con	Oth	Was	Ser
Activities	Agr	6.4%													
	Min		1.0%												
	Fod			5.9%											
	Che				2.7%										
	Tra					9.1%									
	Elec						4.6%								
	Cem							1.7%							
	Mnr														
	Iro									3.3%					
	Met														
	Con											11.2%			
	Oth												11.0%		
	Was													1.2%	
	Ser														41.8%

Table A.13 2019 Disaggregated Supply for Domestic Market Data (kTRY)

		Commodities													
		Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr	Iro	Met	Con	Oth	Was	Ser
Activities	Agr	463,000,581													
	Min		74,917,580												
	Fod			424,562,800											
	Che				196,700,932										
	Tra					651,334,413									
	Elec						331,936,508								
	Cem							28,014,556							
	Mnr								92,950,439						
	Iro									201,157,628					
	Met										32,610,795				
	Con											807,034,576			
	Oth												790,160,964		
	Was													87,994,616	
	Ser														3,007,755,920

Disaggregation of Labor and Capital Data

Compared to intermediate demand and domestic supply data, for labor and capital data of 2019, disaggragated data for NACE sections (GDP by kind of economic activity data) required for labor and to calculate capital exists in Turkstat. NACE sections corresponding to SAMS sectors of this study is given in Table A.14, detailed sectoral mapping can be seen in Table A.2.

Table A.14 NACE Sections Corresponding to SAM Sectors

<table>
<tr><th>SAM Sector</th><th>NACE Section</th></tr>
<tr><td>Agr</td><td>A</td></tr>
<tr><td>Min</td><td>B</td></tr>
<tr><td>Fod</td><td>C10-C12</td></tr>
<tr><td>Che</td><td>C20, C21, C22</td></tr>
<tr><td>Tra</td><td>H</td></tr>
<tr><td>Elc</td><td>D</td></tr>
<tr><td>Cem</td><td rowspan="2">C23</td></tr>
<tr><td>Mnr</td></tr>
<tr><td>Iro</td><td rowspan="2">C24, C25</td></tr>
<tr><td>Met</td></tr>
<tr><td>Con</td><td>F</td></tr>
<tr><td>Oth</td><td>Rest of C</td></tr>
<tr><td>Was</td><td>E</td></tr>
<tr><td>Ser</td><td>G, I-…-T</td></tr>
</table>

As it is stated, available 2019 data are not in NACE division and NACE group detail, but only in NACE sections. Therefore additional disaggragation is applied to disaggragate the NACE section C-Manufacturing to obtain data for SAM sectors. Based on 2012 disaggregated SAM, shares are calculated and according to these shares, 2019 aggregated data for Section C is distributed. An example about the disaggregation is given below:

2012 aggregated labor data for NACE section C (87,692,343) and disaggregation

Compensation of employees for Fod = 13,409,074 (Table A.15)

Percentage = 13,409,074 / 87,692,343 = *15.3%* (Table A.16)

Labor and capital data in 2012 and calculated shares of NACE divisions under Section C is given in Table A.15 and Table A.16.

Table A.15 NACE Section C (Manufacturing) Labor and Capital Data in 2012 (kTRY)

NACE Rev.2	Nace Section C Manufacturing	SAM Sectors C10-C12 Fod	C20-C22 Che	C23 Cem	C23 Mnr	C24 C25 Iro	C24 C25 Met	OTHER C Oth
Compensation of Employees	**87,692,343**	13,409,074	9,417,064	1,694,397	4,320,034	10,067,584	1,535,729	47,248,463
Operating Surplus	**165,786,740**	36,999,041	17,321,100	3,401,886	8,673,449	19,647,976	2,997,140	76,746,149

Table A.16 2012 Shares of NACE Section C for Labor and Capital Data

NACE Rev.2	Nace Section C Manufacturing	SAM Sectors C10-C12 Fod	C20-C22 Che	C23 Cem	C23 Mnr	C24 C25 Iro	C24 C25 Met	OTHER C Oth
Compensation of Employees	**100%**	15.3%	10.7%	6.9%		13.2%		53.9%
Operating Surplus	**100%**	22.3%	10.4%	7.3%		13.7%		46.3%

2019 aggregated labor data for NACE section C (290,198,223) and applied disaggregation

Fod labor data in 2019 = *2019 labor data for for NACE section C * Percentage of Fod labor in 2012 among NACE section C*

= *290,198,223 * 15.3%*

= **44,374,334** (Table A.18)

Capital is calculated with the formula below for NACE sections. As it is stated above, disaggregation is applied for manufacturing industry.

Capital = Gross operating surplus/mixed income + Taxes on production – Subsidies on production

2019 capital data for NACE Section A (Agriculture)

Gross operating surplus / mixed income = 270,117,532 (Table A.17)

Taxes on production = 18,720 (Table A.17)

Subsidies on production = 7,683,336 (Table A.17)

Capital for NACE Section A in 2019 = 270,117,532 + 18,720 – 7,683,336

= **262,452,916**

Table A.17 2019 Data Used to Calculate Capital in NACE Sections (kTRY)

	Nace Section									TOTAL
	A	B	C	D	E	F	G	H	I-...-T	
Gross operating surplus/mixed income	270,117,532	36,026,092	531,512,917	60,627,536	29,669,869	154,342,581	352,382,297	296,452,938	839,937,947	2,571,069,708
Taxes on production	18,720	164,781	3,686,939	547,009	114,999	1,857,115	2,669,077	2,049,270	15,608,677	26,716,587
Subsidies on production	7,683,336	1,162,445	36,064,471	0	3,721,297	0	0	5,519,040	10,032,339	64,182,929

As in intermediate demand and domestic supply data disaggregation, for Cem, Mnr, Iro and Met sectors additional disaggregation is applied according to the 2019 sectoral shares calculated. Therefore, firstly 2012 labor and capital data percentages are calculated for NACE division 23 and NACE divisions 24&25 and then disaggregated according to calculated 2019 shares of these sectors (23.2% and 86%). An example related to this disaggregation is shown below:

2012 data and existing disaggregation

Cem labor = 1,694,397

Mnr labor = 4,320,034

NACE C23 labor = 1,694,397+ 4,320,034= 6,014,431

NACE Section C total labor: 87,692,343

Percentage, NACE 23 data = 6,014,431/ 87,692,343= 6.9% (Table A.16)

2019 data and applied disaggregation

NACE Section C total labor: 290,198,223

Cem labor in 2019 = *2019 section C labor data * Percentage of NACE 23 labor data in 2012 * Share of Cem sector in 2019*

= 290,198,223* 6.9% * 23.2%

= **4,609,477** (Calculated and disaggregated labor and capital data for 2019 is given in Table A.18)

Table A.18 2019 Labor and Capital Data (kTRY)

NACE Code	**A**	**B**	**C10-C12**	**C20-C22**	**H**	**D**	**C23**	**C23**
SAM Sectors	**Agr**	**Min**	**Fod**	**Che**	**Tra**	**Elec**	**Cem**	**Mnr**
Labor	13,918,906	13,191,306	44,374,334	31,163,669	77,528,372	10,173,119	4,609,477	15,293,938
Capital	262,452,916	35,028,428	111,393,289	52,148,766	292,983,167	61,174,545	8,419,606	27,935,695

NACE Code	**C24 C25**	**C24 C25**	**F**	**OTHER C**	**E**	**G-I-...-T**	**TOTAL**
SAM Sectors	**Iro**	**Met**	**Con**	**Oth**	**Was**	**Ser**	
Labor	33,041,953	5,356,617	77,113,285	156,358,235	7,712,819	864,484,642	**1,354,320,671**
Capital	58,666,985	9,510,835	156,199,695	231,060,207	26,063,571	1,200,565,659	**2,533,603,366**

Disaggregation of Net Taxes on Products Data

In the 2019 Institutional Sector Accounts data and GDP by kind of economic activity data published by TurkStat, taxes less subsidies on products data are given as 429,862,871 kTRY. Since, its sectoral coverage and disaggregation are not provided, based on 2012 disaggregated SAM, percentages are calculated and according to these shares, 2019 aggregated data is distributed. An example about the disaggregation is given below:

<u>2012 taxes less subsidies on products data and existing disaggregation</u>

Total net taxes on products = 184,259,347

Min net taxes on products = 12,510,732

Percentage = 12,510,732 / 184,259,347

= *6.8%* (Table A.19)

2019 taxes less subsidies on products data and applied disaggregation

Total net taxes on products = 429,862,871

Min net taxes on products in 2019 = *2019 net taxes on products data * Percentage in 2012*

= *429,862,871* 6.8%*

= **29,186,574** (Table A.20)

For Cem, Mnr, Iro and Met sectors additional disaggregation is applied according to the 2019 sectoral shares calculated. Therefore, firstly 2012 demand data percentages are calculated for NACE division 23 and NACE divisions 24&25 and then disaggregated according to calculated 2019 shares of these sectors (23.2% and 86%). An example related to this disaggregation is shown below:

2012 taxes less subsidies on products data and existing disaggregation

NACE C23 taxes less subsidies on products = 760,525

Percentage, NACE 23 data = 760,525 / 184,259,347 = 0.4% (Table A.19)

2019 taxes less subsidies on products data and applied disaggregation

Cem net taxes on products in 2019 = *2019 C23 net taxes on products data * Percentage in 2012 * Share of cement sector in NACE division 23 in 2019*

= *760,525 * 0.4% * 23.2%*

= **410,902** (Table A.20)

Disaggregated taxes less subsidies on products data calculated for 2019 is given in Table A.20.

Table A.19 2012 Net Taxes on Products Data (kTRY) and Percentages

SAM Sectors	Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr
Net Taxes on Products	-3,537,434	12,510,732	31,788,227	8,870,334	3,832,767	2,983,692	760,525	
Percentages	-1.9%	6.8%	17.3%	4.8%	2.1%	1.6%	0.4%	

SAM Sectors	Iro	Met	Con	Oth	Was	Ser	TOTAL
Net Taxes on Products	8,899,186		5,755,774	79,881,696	2,407,497	30,106,353	184,259,347
Percentages	4.8%		3.1%	43.4%	1.3%	16.3%	

Table A.20 2019 Net Taxes on Products Data (kTRY)

SAM Sectors	Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr
Net Taxes on Products	-8,252,561	29,186,574	74,159,487	20,693,805	8,941,550	6,960,723	410,902	1,363,344

SAM Sectors	Iro	Met	Con	Oth	Was	Ser	TOTAL
Net Taxes on Products	17,864,931	2,896,185	13,427,778	186,357,847	5,616,505	70,235,803	429,862,871

Disaggregation of Consumption Expenditure Data

In the 2019 Institutional Sector Accounts data published by TurkStat, private consumption data and government consumption data are given as 2,456,122,508 and 668,572,403 kTRY, respectively. Since, its sectoral coverage and disaggregation are not provided, based on 2012 disaggregated SAM, percentages are calculated for both and according to these shares, 2019 aggregated data is distributed. An example about the disaggregation is given below:

<u>2012 consumption expenditure data and existing disaggregation</u>

Total private consumption = 1,025,098,746

Che private consumption = 16,998,175

Percentage = 16,998,175 / 1,025,098,746 = *1.7%*

<u>2019 consumption expenditure data and applied disaggregation</u>

Total private consumption = 2,456,122,508

Che private consumption in 2019 = *2019 private consumption data * Percentage in 2012*

*=2,456,122,508 * 1.7%*

= **40,727,395** (Table A.21)

Disaggregated private consumption and government consumption data for 2019 are given in Table A.21.

Table A.21 2012 and 2019 Consumption Expenditure Data (kTRY) and Percentages

2012 Data and Percentages

SAM Sectors	Total in SAM		Percentages	
	Private Consumption	Government Consumption	Private Consumption	Government Consumption
Agr	66,766,221	0	6.5%	0%
Min	6,758,489	0	0.7%	0%
Fod	139,568,875	0	13.6%	0%
Che	16,998,175	9,407,335	1.7%	4.2%
Tra	101,228,013	567,328	9.9%	0.3%
Elec	25,295,549	0	2.5%	0%
Cem	806,310	0	0.1%	0%
Mnr	2,055,769	0	0.2%	0%
Iro	2,621,333	0	0.3%	0%
Met	399,863	0	0.0%	0%
Con	2,026,304	5,403	0.2%	0.002%
Oth	147,648,533	74,683	14.4%	0.03%
Was	6,769,052	6,859,340	0.7%	3.1%
Ser	506,156,260	206,487,615	49.4%	92.4%
TOTAL	**1,025,098,746**	**223,401,702**	**100%**	**100%**

2019 Data

SAM Sectors	Private Consumption	Government Consumption
Agr	159,970,948	0
Min	16,193,246	0
Fod	334,405,106	0
Che	40,727,395	28,153,251
Tra	242,540,928	1,697,837
Elec	60,607,787	0
Cem	1,931,909	0
Mnr	4,925,595	0
Iro	6,280,677	0
Met	958,067	0
Con	4,854,996	16,169
Oth	353,763,855	223,503
Was	16,218,557	20,527,888
Ser	1,212,743,444	617,953,754
TOTAL	**2,456,122,508**	**668,572,403**

Disaggregation of Capital Formation Data

Total gross capital formation data for 2019 is 1,311,886,326 kTRY. Since, its sectoral coverage and disaggregation are not provided, based on 2012 disaggregated SAM, percentages are calculated for both and according to these shares, 2019 aggregated data is distributed. An example about the disaggregation is given below:

2012 gross capital formation data and existing disaggregation

Total private consumption = 444,282,344

Agr private consumption = 14,747,682

Percentage = 14,747,682 / 444,282,344 = *3.3%*

2019 gross capital formation data and applied disaggregation

Total private consumption = 1,311,886,326

Agr private consumption in 2019 = *2019 total gross capital formation data * Percentage in 2012*

= *1,311,886,326 * 3.3%*

= **40,727,395** (Table A.22)

Disaggregated total gross capital formation data for 2012 (with percentages) and 2019 are given in Table A.22.

Table A.22 2012 and 2019 Total Gross Capital Formation (kTRY) and Percentages

	2012		2019
SAM Sectors	Total Gross Capital Formation	Percentages	Total Gross Capital Formation
Agr	14,747,682	3.3%	43,547,268
Min	3,310,858	0.7%	9,776,373
Fod	1,290,647	0.3%	3,811,050
Che	417,450	0.1%	1,232,654
Tra	6,315,987	1.4%	18,649,982
Elec	0	0%	0
Cem	215,219	0.05%	635,503
Mnr	548,722	0.1%	1,620,278
Iro	14,886,770	3.4%	43,957,970
Met	2,270,857	0.5%	6,705,433
Con	232,745,786	52.4%	687,256,692
Oth	116,971,909	26.3%	345,397,134
Was	-275,161	-0.1%	-812,502
Ser	50,835,618	11.4%	150,108,489
TOTAL	**444,282,344**	**100%**	**1,311,886,326**

Compilation of Imports Data

Imports of goods and services data for 2019 are obtained from ‘imports by general system’ data and ‘international trade in services by type of main services’ data published by Turkstat. Imports of goods and services had a total volume of 1,333,899 million TRY in 2019.

Most of the trade data are provided in US$, currency rates given below is used for 2019:

1 € = 1.12 $

1 $ = 5.68 TRY

1 € = 6.36 TRY

Table A.23 2019 Imports Data (kTRY)

SAM Sectors	Imports
Agr	55,851,709
Min	179,989,598
Fod	39,175,246
Che	214,030,718
Tra	63
Elec	230,596
Cem	2,108,478
Mnr	6,995,789
Iro	74,632,353
Met	116,433,160
Oth	467,377,953
Was	36,721,709
Ser	140,351,157
TOTAL	**1,333,898,530**

Compilation of Exports Data

Total exports of goods and services data for 2019 are obtained from ‘exports by general system’ and ‘international trade in services by type of main services’ data published by Turkstat and exports to European Union (EU-27) data is taken from UN Comtrade. Exports of goods and services had a total volume of 1,215,104 MTRY in 2019.

In order to evaluate the effects of CBAM on the Turkish exports to the EU, exports are disaggrated further and exports to EU-27 is compiled. It is found that 43.4% of total exports volume, 526,675 MTRY, is generated from exports to EU-27. Since Turkey does not have exports data with country or region breakdown together with NACE, HS code or a similar classification and available data published by Turkish institutions does not provide required sectoral division to create data for SAM sectors, trade statistics published by United Nations Comtrade is used for the exports of goods and European Commissions trade data published is used for exports of services (European Commission, 2022b; United Nations, 2022).

UN Comtrade database includes data with Harmonized System (HS), Standard International Trade Classification (SITC) and Broad Economic Categories (BEC) classification for all the the partners around the world. As it is given in the sectoral mapping section and Table Aelow, SAM sectors and corresponding HS codes is determined, therefore exports of goods data in HS classification is obtained from the data base.

Additionally, UN Comtrade database gives data for EU-28 as total and also data for each EU country. As EU-28 includes United Kingdom which is not a part of European Union anymore and also not in EU ETS. Proposed CBAM of European

Commission does not include UK, therefore, UK trade data is excluded from the EU-28 trade data and representing the present EU, exports to EU-27[13], is obtained.

Table A.24 HS Chapters Corresponding to the Goods of SAM Sectors

SAM Sector	**HS Chapter**
Agr	1-…-14
Min	26-27
Fod	15-…-24
Che	28-…-40
Elc	27.16
Cem	25.23.10-21-29-30-90 68.10-68.11
Mnr	Rest of 25 Rest of 68 69-70
Iro	72-73
Met	74-...-83
Oth	41-…-67 71 84-…-96

Turkey's goods export to EU was worth of €82.8 billion and services export to EU was worth of €13.9 billion. Total exports of Turkey and exports to EU is given in Table A.25. 42.7% of goods exports and 47.3% of services exports of Turkey were with EU.

[13] Acar et al. (2021) used EU-28 data while examining the effects of CBAM in Turkey and to the best of our knowledge, this is the first and most recent study which uses trade data for EU-27 while analyzing the effects of CBAM (Acar et al., 2021b).

Table A.25 2019 Exports Data (kTRY)

SAM Sectors	Total Exports	Exports to EU27
Agr	31,770,610	17,648,598
Min	18,193,378	15,334,736
Fod	81,848,094	11,316,616
Che	107,116,327	36,237,672
Elec	593,796	359,293
Cem	6,250,110	769,072
Mnr	20,737,449	10,730,670
Iro	106,858,256	37,771,542
Met	38,768,273	17,628,872
Oth	611,790,856	290,773,514
Was	3,324,929	
Ser	187,852,126	88,463,817
TOTAL	**1,215,104,204**	**527,034,401**

Disaggragated Unbalanced 2019 SAM of Turkey

By using all the data obtained, disaggregated, and yet unbalanced SAM for 14 sectors is created for 2019 Turkish economy and given in Table A.26.

Table A.26 Turkey 2019 Disaggregated SAM (unbalanced)

		ACTIVITIES (1)														COMMODITIES (2)														LAB (3)	CAP (4)	HH (5)	GOV (6)	S-I (7)	RoW (8)	TOTAL
	Billion TL	AGR	MIN	FOD	CHE	TRA	ELEC	CEM	MNR	IRO	MET	CON	OTH	WAS	SER	AGR	MIN	FOD	CHE	TRA	ELEC	CEM	MNR	IRO	MET	CON	OTH	WAS	SER							
	AGR															463.00																			31.77	494.77
	MIN																74.92																		18.19	93.11
	FOD																	424.56																	81.85	506.41
	CHE																		196.70																107.12	303.82
	TRA																			651.33																651.33
	ELEC																				331.94														0.59	332.53
1	CEM																					28.01													6.25	34.26
	MNR																						92.95												20.74	113.69
	IRO																							201.16											106.86	308.02
	MET																								32.61										38.77	71.38
	CON																									807.03										807.03
	OTH																										790.16								611.79	1,401.95
	WAS																											87.99							3.32	91.32
	SER																												3,007.76						187.85	3,195.61
	AGR	89.20	0.40	171.72	1.90	0.05	0.00	0.02	0.07	0.00	0.00	0.35	23.59	0.03	16.66																	159.97		43.55		507.50
	MIN	1.37	5.90	2.54	7.49	1.27	85.32	5.76	19.11	25.99	4.21	14.85	102.32	0.26	10.64																	16.19		9.78		313.02
	FOD	19.29	0.11	72.23	0.50	0.65	0.06	0.02	0.08	0.13	0.02	0.34	2.57	0.13	66.89																	334.41		3.81		501.25
	CHE	27.10	2.02	17.13	120.99	7.89	0.23	1.50	4.98	8.78	1.42	27.30	81.83	2.39	41.68																	40.73	28.15	1.23		415.36
	TRA	8.05	5.98	23.47	12.58	176.23	1.64	1.40	4.65	17.49	2.84	18.45	40.17	2.16	105.03																	242.54	1.70	18.65		683.03
	ELEC	2.73	2.97	5.56	6.16	2.30	183.19	1.79	5.95	13.22	2.14	1.30	17.58	4.82	48.35																	60.61		0.00		358.67
2	CEM	0.11	0.18	0.47	0.54	0.75	0.11	1.36	4.53	0.53	0.09	22.50	1.38	0.06	4.90																	1.93		0.64		40.06
	MNR	0.29	0.45	1.20	1.39	1.90	0.28	3.48	11.54	1.34	0.22	57.36	3.52	0.15	12.49																	4.93		1.62		102.14
	IRO	0.18	1.36	2.05	3.40	3.38	0.20	0.30	0.98	94.21	15.27	96.90	95.59	0.58	13.02																	6.28		43.96		377.67
	MET	0.03	0.21	0.31	0.52	0.52	0.03	0.05	0.15	14.37	2.33	14.78	14.58	0.09	1.99																	0.96		6.71		57.61
	CON	1.10	0.28	1.06	0.69	1.35	1.24	0.06	0.20	1.11	0.18	143.15	2.34	6.60	42.89																	4.85	0.02	687.26		894.36
	OTH	16.79	8.97	13.46	10.59	97.41	3.08	2.52	8.36	7.28	1.18	60.08	370.43	2.55	152.11																	353.76	0.22	345.40		1,454.20
	WAS	1.66	0.02	0.51	1.27	0.23	0.04	0.07	0.25	67.29	10.91	0.45	4.93	13.85	10.65																	16.22	20.53	-0.81		148.07
	SER	19.65	9.03	55.90	29.91	88.49	14.32	3.56	11.83	25.39	4.12	89.23	140.09	9.83	618.80																	1,212.74	617.95	150.11		3,100.94
	3	13.92	13.19	44.37	31.16	77.53	10.17	4.61	15.29	33.04	5.36	77.11	156.36	7.71	864.48																					1,354.32
	4	262.45	35.03	111.39	52.15	292.98	61.17	8.42	27.94	58.67	9.51	156.20	231.06	26.06	1,200.57																					2,533.60
	5																													1,354.32	2,533.60		81.29		0.96	3,970.18
	6															-8.25	29.19	74.16	20.69	8.94	6.96	0.41	1.36	17.86	2.90	13.43	186.36	5.62	70.24			243.69			142.05	815.60
	7																															1,270.37	41.52			1,311.89
	8															55.85	179.99	39.18	214.03	0.00	0.23	2.11	7.00	74.63	116.43		467.38	36.72	140.35				24.22			1,358.11
	TOTAL	463.93	86.11	523.40	281.25	752.92	361.10	34.93	115.89	368.83	59.79	780.35	1,288.33	77.27	3,211.12	510.60	284.09	537.90	431.43	660.28	339.13	30.53	101.31	293.65	151.94	820.46	1,443.90	130.33	3,218.34	1,354.32	2,533.60	3,970.18	815.60	1,311.89	1,358.11	

A.2.3 Balancing SAM with GAMS

It is an important need to have consistent data sets for policy analysis and economic models. To update I-O table and SAM for a recent year is challenging since it is hard to achieve disaggregated data for recent years (Robinson & El-Said, 1997).

Turkey published the latest I-O table, 2012 I-O table in 2016. The previous I-O table was for 2002 and published in 2006. Apart from I-O table, quite aggregated statistics (national accounts, trade data, institutional accounts, etc.) are provided by Turkstat annually.

Data from various sources are needed to generate a SAM and while creating a disaggregated SAM for recent year, inconsistencies may occur, i.e., row and column totals may not be equal. As Telli (2004) mentions, proposing an optimization model is one of the most flexible methods to balance an unbalanced SAM (Telli, 2005). Robinson & El-Said (1997) describes this method as a powerful method when there is inconsistent and distributed data to update SAM for recent years (Robinson & El-Said, 1997).

In this study, a non-linear optimization mathematical programming model is developed in GAMS to balance the unbalanced SAM and obtain the disaggregated 2019 SAM of Turkey. Main steps using GAMS programming language are summarized below. The model utilizes a similar approach as the RAS method (The United Nations, 1999). The proposed model aims to determine the row and column multipliers (which are defined for intermediate flows) that minimize the sum of squares of the deviations between row and column sums. In the rest of this sub-section; first, the notation is presented, and then the model is given.

- i and j are the indices defined to represent all of the headings (activities, commodities and the other headings) in the SAM for rows and columns, respectively; I and J denote the corresponding sets.

- setA and SetC denote the set of activities and commodities, respectively.
- Total of intermediate demand is set to 4,517,312,471 as retrieved in Section A.2.2.
- $vR(i)$ and $vS(j)$ represent row multipliers and column multipliers, respectively.
- $vTotR(i)$ and $vTotS(j)$ represent row and column sums, respectively.
- The difference between row and column sums are represented by $vDev(i)$.

The optimization model is given below. As seen from equation B.1, the objective is to minimize total sum of squares of $vDev$ values. Row totals and column totals are given in equations B.2 and B.3. In these equations, the first summation represents the sum of initial SAM entries while the second one is defined to capture the changes due to the row and column multipliers of the intermediate goods. The last equation keeps track of row-column deviations.

$$Minimize \sum_{i \in I} vDev(i)^2 \qquad \text{(Eq. A.1)}$$

$$s.t.$$

$$vTotR(i) = \sum_{j \in J} SAM(i,j) + \sum_{j \in setA \mid i \in setC} SAM(i,j) * [\, vR(i) * vS(j) \; - 1 \,] \qquad \forall\, i \in I \qquad \text{(Eq. A.2)}$$

$$vTotS(j) = \sum_{i \in I} SAM(i,j) + \sum_{i \in setC \mid j \in setA} SAM(i,j) * [\, vR(i) * vS(j) \; - 1 \,] \qquad \forall\, j \in J \qquad \text{(Eq. A.3)}$$

$$vDev(i) = vTotR(i) - vTotS(i) \qquad \forall\, i \in I \qquad \text{(Eq. A.4)}$$

In addition to these constraints in the model, the row-column deviations are bounded by 0.01% of the unbalanced values. GAMS codes of the study are given in Appendix E.

Using balanced results obtained after the execution of the program, balanced aggregated input-output table (Table A.27) and balanced disaggragated SAM of Turkey for 2019 (Table 4.3) is created.

Table A.27 Turkey 2019 Aggregated Input-Output Table (balanced)

Billion TL	Agr	Min	Fod	Che	Tra	Elec	Cem	Mnr	Iro	Met	Con	Oth	Was	Ser	Total	Private Consumption	Government Consumption	Total gross capital formation	Exports, fob	Final Uses at Basic Prices	Taxes Less Subsidies on Products on Total Use	Total use at basic prices
Agr	103.10	0.51	155.75	2.25	0.04	0.00	0.02	0.07	0.00	0.00	0.44	28.65	0.04	16.21	307.08	159.97	0.00	43.55	31.77	235.29	-8.25	550.62
Min	1.29	5.99	1.87	7.21	0.76	70.59	5.11	16.96	18.37	4.80	15.48	100.95	0.33	8.41	258.12	16.19	0.00	9.78	18.19	44.16	29.19	273.10
Fod	28.15	0.18	82.70	0.74	0.61	0.08	0.03	0.11	0.14	0.04	0.55	3.94	0.26	82.15	199.68	334.41	0.00	3.81	81.85	420.06	74.16	545.59
Che	28.73	2.32	14.25	131.33	5.33	0.21	1.50	4.99	7.01	1.83	32.12	91.14	3.36	37.19	361.31	40.73	28.15	1.23	107.12	177.23	20.69	517.85
Tra	9.53	7.66	21.79	15.24	132.91	1.71	1.57	5.20	15.58	4.07	24.22	49.93	3.40	104.58	397.39	242.54	1.70	18.65	0.00	262.89	8.94	651.33
Elec	2.86	3.36	4.56	6.60	1.53	168.79	1.77	5.88	10.40	2.72	1.51	19.31	6.69	42.54	278.52	60.61	0.00	0.00	0.59	61.20	6.96	332.76
Cem	0.08	0.14	0.27	0.41	0.35	0.07	0.94	3.11	0.29	0.08	18.14	1.05	0.06	3.00	27.97	1.93	0.00	0.64	6.25	8.82	0.41	36.37
Mnr	0.28	0.47	0.91	1.37	1.17	0.24	3.17	10.53	0.98	0.25	61.48	3.57	0.19	10.15	94.76	4.93	0.00	1.62	20.74	27.28	1.36	120.68
Iro	0.14	1.12	1.23	2.66	1.64	0.14	0.21	0.71	54.04	14.12	81.94	76.54	0.59	8.35	243.42	6.28	0.00	43.96	106.86	157.10	17.86	382.65
Met	0.08	0.67	0.73	1.57	0.97	0.08	0.13	0.42	32.03	8.37	48.57	45.37	0.35	4.95	144.28	0.96	0.00	6.71	38.77	46.43	2.90	187.81
Con	0.67	0.18	0.50	0.42	0.52	0.66	0.03	0.11	0.50	0.13	96.00	1.48	5.29	21.81	128.33	4.85	0.02	687.26	0.00	692.13	13.43	807.03
Oth	17.42	10.08	10.96	11.26	64.46	2.82	2.47	8.20	5.69	1.49	69.22	404.04	3.51	132.89	744.51	353.76	0.22	345.40	611.79	1,311.18	186.36	1,869.33
Was	1.56	0.02	0.38	1.22	0.14	0.03	0.07	0.22	47.44	12.39	0.47	4.85	17.21	8.40	94.40	16.22	20.53	-0.81	3.32	39.26	5.62	128.04
Ser	24.52	12.19	54.74	38.22	70.39	15.75	4.20	13.95	23.85	6.23	123.57	183.70	16.27	649.94	1,237.54	1,212.74	617.95	150.11	187.85	2,168.66	70.24	3,335.96
Total	218.40	44.89	350.64	220.50	280.82	261.18	21.24	70.46	216.31	56.51	573.72	1,014.53	57.54	1,130.56	**4,517.31**	2,456.12	668.57	1,311.89	1,215.10	5,651.69	429.86	**9,739.14**
Compensation of Employee	13.92	13.19	44.37	31.16	77.53	10.17	4.61	15.29	33.04	5.36	77.11	156.36	7.71	864.48	1,354.32							
Operating Surplus	262.45	35.03	111.39	52.15	292.98	61.17	8.42	27.94	58.67	9.51	156.20	231.06	26.06	1,200.57	2,533.60							
Value Added, Gross	276.37	48.22	155.77	83.31	370.51	71.35	13.03	43.23	91.71	14.87	233.31	387.42	33.78	2,065.05	3,887.92							
Total Output	494.77	93.11	506.41	303.82	651.33	332.53	34.26	113.69	308.02	71.38	807.03	1,401.95	91.32	3,195.61	8,405.24							
Imports, fob	55.85	179.99	39.18	214.03	0.00	0.23	2.11	7.00	74.63	116.43	0.00	467.38	36.72	140.35	1,333.90							
Total Supply	550.62	273.10	545.59	517.85	651.33	332.76	36.37	120.68	382.65	187.81	807.03	1,869.33	128.04	3,335.96	**9,739.14**							

B. Production Values by Economic Activities

B.1 2012 Values

Table B.1 Production Value by Economic Activity for NACE Code 23 in 2012

NACE Code	Production Value (TRY)
23	**42,443,316,292**
231	5,579,181,556
2312	1,636,254,731
2319	232,144,254
232	627,745,007
2320	627,745,007
233	4,383,474,670
2331	3,206,307,781
2332	1,177,166,889
234	1,974,798,453
2342	1,110,357,011
2349	7,489,678
235	9,866,355,448
2351	8,931,053,558
2352	935,301,890
236	13,382,679,717
2361	3,026,157,010

Source: (TurkStat, 2021a)

Table B.1 Production Value by Economic Activity for NACE Code 23 in 2012 (continued)

NACE Code	Production Value (TRY)
2362	538,220,037
2363	8,584,643,160
2364	635,288,197
237	4,116,829,478
2370	4,116,829,478
239	2,512,251,963
2391	288,411,775
2399	2,223,840,188

Source: (TurkStat, 2021a)

Table B.2 Production Value by Economic Activity for NACE Code 24 and 25 in 2012

NACE Code	Production Value (TRY)
24	**92,846,800,635**
241	59,473,528,350
2410	59,473,528,350
242	7,524,806,114
2420	7,524,806,114
243	4,114,547,483
2433	1,667,870,186
2434	1,008,363,784

Source: (TurkStat, 2021a)

Table B.2 Production Value by Economic Activity for NACE Code 24 and 25 in 2012 (continued)

NACE Code	Production Value (TRY)
244	17,305,293,531
2442	7,944,923,868
2444	8,058,900,243
2445	865,855,326
245	4,428,625,157
2451	2,556,758,794
2452	937,154,363
2453	803,992,307
2454	130,719,693
25	**44,966,924,512**

Source: (TurkStat, 2021a)

B.2 2019 Values

Table B.3 Production Value by Economic Activity for NACE Division 23 in 2019

NACE Code	Production Value (TRY)
23	**97,955,569,223**
231	18,549,517,205
2311	3,815,087,325
2312	6,553,046,550
2313	7,106,672,063
232	1,848,217,693
2320	1,848,217,693
233	10,003,078,891

Source: (TurkStat, 2021a)

Table B.3 Production Value by Economic Activity for NACE Division 23 in 2019 (continued)

NACE Code	**Production Value (TRY)**
2331	8,181,141,936
2332	1,821,936,955
234	5,320,633,455
2341	1,993,909,956
2342	3,182,240,392
235	18,019,248,117
2351	15,589,845,701
2352	2,429,402,416
236	26,771,219,543
2361	6,931,348,652
2362	1,384,285,208
2363	15,392,138,056
2364	1,915,630,010
2365	164,556,878
2369	983,260,739
237	10,401,238,502
2370	10,401,238,502
239	7,042,415,817
2391	942,655,288
2399	6,099,760,529

Source: (TurkStat, 2021a)

Table B.4 Production Value by Economic Activity for NACE Division 24 and 25 in 2019

NACE Code	**Production Value (TRY)**
24	**252,011,271,551**
241	152,050,392,775
2410	152,050,392,775
242	20,045,732,344
2420	20,045,732,344
243	14,654,064,885
2431	4,851,927,581
2433	5,587,737,785
244	51,810,076,832
2442	29,684,335,605
2443	1,399,499,357
2444	20,526,464,213
2445	199,777,657
245	13,451,004,715
2451	6,606,370,701
2452	3,277,042,097
2453	3,142,139,195
2454	425,452,722
25	**144,960,042,482**
251	28,410,581,817
2511	16,676,681,868
2512	11,733,899,949
252	14,550,872,989

Source: (TurkStat, 2021a)

Table B.4 Production Value by Economic Activity for NACE Division 24 and 25 in 2019 (continued)

NACE Code	**Production Value (TRY)**
2521	11,201,299,551
2529	3,349,573,438
253	1,035,032,495
2530	1,035,032,495
254	5,716,856,686
2540	5,716,856,686
255	14,636,103,243
2550	14,636,103,243
256	28,961,553,530
2561	10,840,760,251
2562	18,120,793,279
257	13,417,731,589
2571	1,636,766,492
2572	4,536,904,070
2573	7,244,061,027
259	38,231,310,133
2591	2,662,293,583
2592	6,175,884,013
2593	11,590,142,314
2594	6,515,715,265
2599	11,287,274,958

Source: (TurkStat, 2021a)

C. Disaggregated Values of 2019 GHG Emissions of SAM Sectors

Table C.1 Disaggragated Values of 2019 GHG Emissions of SAM Sectors

UNFCCC CRF Category and Table #	NIR Table #	CO_2	CH_4	N_2O	HFC	PFC	SF6	NOx	CO	NMVOC	SO_2	CO_2eq
		kt			Kt CO_2e			kt				kt
AGR	-	**11,030.4**	**1,503.7**	**101.56**				**68.02**	**521.83**	**10.45**	**13.19**	**78,885.78**
Category 3 Table3s1	Table 5.5	1,287.9	1,503.1	97.85					505.94			68,023.7
Category 1.A.4.c Table 1s2 Table1.A(a)s4	Table 3.52	9,742.4	0.57	3.71				68.02	15.89	10.45	13.19	10,862.08
MIN	-	**180.4**	**303.62**									**7,771.7**
Category 1.B.1 Table 1s2 Table1.B.1	Table 3.55		270.8									6,770.1
Category1.B.2.a.2 Table 1B2	Part of Table 3.58	0.9	12.5									313.39
Category1.B.2.a.3 Table 1B2	Part of Table 3.58	3.4	0.22									8.81
Category1.B.2.b.2 Table 1B2	Part of Table 3.58	0.04	1.11									27.81

Source: (Ministry of Energy and Natural Resources, 2020; TurkStat, 2021b, 2021c)

Table C.1 Disaggragated Values of 2019 GHG Emissions of SAM Sectors (continued)

UNFCCC CRF Category and Table #	NIR Table #	CO_2	CH_4	N_2O	HFCs	PFCs	SF6	NOx	CO	NMVOC	SO_2	CO_2eq
		kt			Kt CO_2e			kt				kt
Category1.B.2.b.3 Table 1B2	Part of Table 3.58	**0.15**	**0.5**									12.59
Category 1.B.2.c Table 1s2	Part of Table 3.58	175.88	18.49	0.00								639
FOOD Category 1.A.2.e Table 1s1 Table1.A(a)s2	**Table 3.34**	**5,156.25**	**0.36**	**0.05**				**6.45**	**17.07**	**2.51**	**37.42**	**5,180.16**
CHE	-	**7,496.96**	**0.5**	**4.07**				**14.49**	**18.09**	**3.76**	**24.92**	**8,772.97**
Category 2.B.1 Table2(I)s1	Table 4.17	545.1						0.43	0.04			2,304.7
Category 2.B.2 Table2(I)s1	Table 4.18			4				3.44				
Category 2.B.5 Table2(I)s1	Table 4.19	8.16										
Category 2.B.7 Table2(I)s1	Table 4.20	557.4										
Category 2.B.8 Table2(I)s1	Table 4.21	1.35										

Source: (Ministry of Energy and Natural Resources, 2020; TurkStat, 2021b, 2021c)

Table C.1 Disaggragated Values of 2019 GHG Emissions of SAM Sectors (continued)

UNFCCC CRF Category and Table #	NIR Table #	**CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF6**	**NOx**	**CO**	**NMVOC**	**SO_2**	**CO_2eq**
		kt			**Kt CO_2e**			**kt**				**kt**
1.A.2.c Table 1s1 Table1.A(a)s2	Table 3.32	6,384.95	0.5	0.07				10.62	18.04	4.76	24.92	6,418.27
TRA Category 1.A.3 Table 1s1 Table1.A(a)s3	**Table 3.37**	**80,745.01**	**16.04**	**4.3**				**191.13**	**306.55**	**47.5**		**82,427.48**
ELEC	-	**138,275.3**	**76.1**	**2.69**				**344.81**	**29.7**	**2.86**	**1,841.5**	**140,979.79**
Category 1.A.1.a Table 1s1 Table1.A(a)s1	Table 3.16	138,272.9	1.66	2.69				344.81	29.7	2.86	1,841.5	139,115.68
Category 1.B.2.b.4 Table1.B.2	Part of Table 3.58	0.04	22.91									573.56
Category 1.B.2.b.5 Table1.B.2	Part of Table 3.58	2.39	51.53									1,290.55
CEM	-	**51,317.1**	**1.9**	**0.28**								**51,448.61**
Category 2.A.1 Table2(I)s1	Table 4.3	30,423.12										30,423.12

Source: (Ministry of Energy and Natural Resources, 2020; TurkStat, 2021b, 2021c)

Table C.1 Disaggragated Values of 2019 GHG Emissions of SAM Sectors (continued)

UNFCCC CRF Category and Table #	NIR Table #	CO_2	CH_4	N_2O	HFCs	PFCs	SF6	NOx	CO	NMVOC	SO_2	CO_2eq
		kt			Kt CO_2e			kt				kt
Part of Category 1.A.2.f Table2(I)s1 Table 1s1 Table1.A(a)s	Part of Table 3.35	20,893.98	1.89	0.28				32.03	142.38	14.7	143.84	21,025.48
MNR	-	**10,801.5**	**0.4**	**0.1**				**6.7**	**30**	**3.1**	**30.3**	**10,829.21**
Category 2.A.2 Table2(I)s1	Table 4.5	2,786.84										2,786.84
Category 2.A.3 Table2(I)s1	Table 4.8	717.17										717.17
Category 2.A.4 Table2(I)s1	Table 4.13	2,899.63										2,899.63
Part of Category 1.A.2.f Table 1s1 Table1.A(a)s2	Part of Table 3.35	4,397.89	0.4	0.06				6.74	29.97	3.09	30.28	4,425.57
IRO	-	**15,132.1**	**0.72**	**0.01**								**15,153.02**
Category 2.C.1 Table2(I)s1	Tble 4.23	10,557.51	**0.64**							5.06		10,573.44

Source: (Ministry of Energy and Natural Resources, 2020; TurkStat, 2021b, 2021c)

Table C.1 Disaggragated Values of 2019 GHG Emissions of SAM Sectors (continued)

UNFCCC CRF Category and Table #	**NIR Table #**	**CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF6**	**NOx**	**CO**	**NMVOC**	**SO_2**	**CO_2eq**
		kt			**Kt CO_2e**			**kt**				**kt**
Category 1.A.2.a Table 1s1 Table1.A(a)s2	Table 3.30	4,574.59	0.08	0.01				35.8	170.32	17.41	124.12	4,579.58
MET	-	**1,045.86**	**0.08**	**0.01**		**62.17**						**1,113.02**
Category 2.C.2 Table2(I)s1	Table 4.27	153.69										153.69
Category 2.C.3 Table2(I)s1	Table 4.29	112.1				62.17		0.08	9.12		0.34	174.27
Category 1.A.2.b Table 1s1	Table 3.31	771.24	0.08	0.01				35.8	1.6	0.39	1.02	776.23
Category 2.C.5 Table2(I)s1	Table 4.33	8.82										8.82
CON Part of Category 1.A.2.g	**Part of Table 3.36**	**696.45**	**0.014**	**0.002**								**697.25**
OTH	-	**21,010.57**	**2.78**	**0.16**	**5814.75**	**0.01**	**115.71**	**19.33**	**12.28**	**361.5**	**15.93**	**27,057.29**
Category 1.A.1.b Table 1s1 Table1.A(a)s1	Table 3.23	7,025.28	0.11	0.01				6.33	3.32	0.22	0.02	7,031.86

Source: (Ministry of Energy and Natural Resources, 2020; TurkStat, 2021b, 2021c)

Table C. 1 Disaggragated Values of 2019 GHG Emissions of SAM Sectors (continued)

UNFCCC CRF Category and Table #	NIR Table #	CO_2	CH_4	N_2O	HFCs	PFCs	SF6	NOx	CO	NMVOC	SO_2	CO_2eq
		kt			Kt CO_2e			kt				kt
Category 1.A.1.c Table 1s1 Table1.A(a)s1	Table 3.24	2,392.52	0.01					3.22	0.92	0.12	2.89	2,393.37
Category 1.a.2.d Table 1s1 Table1.A(a)s2	Table 3.33	1,019.28	0.06	0.01				1.37	3.44	0.51	9.95	1,023.6
Category 1.a.2.g Table 1s1 Table1.A(a)s2	Table 3.36	10,355.69	0.95	0.13				8.16	3.22	1.58	2.56	10,419.28
Category 1.B.2.a.4 Table 1.B.2	Table 3.58		1.64									40.93
Category 2.D.1 Table2(I)s2	Table 4.35	203.06										217.8
Category 2.D.2 Table2(I)s2	Table 4.36	14.74										
Category 2.D.3 Table2(I)s2	-											
Category 2.E Table2(I)s2	-				0.1	0.01	57.46					57.56

Source: (Ministry of Energy and Natural Resources, 202s0; TurkStat, 2021b, 2021c)

Table C. 1 Disaggragated Values of 2019 GHG Emissions of SAM Sectors (continued)

UNFCCC CRF Category and Table #	NIR Table #	CO_2	CH_4	N_2O	HFCs	PFCs	SF6	NOx	CO	NMVOC	SO_2	CO_2eq
		kt			Kt CO_2e			kt				kt
Category 2.F.6 Table2(I)s2	Part of Table 4.38				5,814.65							5,814.65
Category 2.G Table2(I)s2	Table 4.41						58.25					58.25
Category 2.H Table2(I)s2	-							0.25	1.39	90.97	0.51	
WASTE Category 5 Table5	**Table 7.1**	**1.24**	**437.06**	**21.21**				**0.03**	**0.56**	**40.47**	**0.001**	**17,247.63**
SERVICES	**-**	**14,609.52**	**1.39**	**0.08**	**249.32**							**14,917.5**
Category 1.A.4.a Table 1s2 Table1.A(a)s4	Table 3.50	14,609.52	1.39	0.08								14,668.18
Category 2.F.3 Table2(I)s2	Part of Table 4.38				249.32							249.32
HOUSEHOLD 1.A.4.b Table 1s2	**Table 3.51**	**41,846.13**	**66.01**	**0.53**				**56.17**	**907.71**	**102.42**	**209.9**	**43,652.9**

Source: (Ministry of Energy and Natural Resources, 2020; TurkStat, 2021b, 2021c)

D. Detailed Exports to EU Values

Table D.1 Agr, Min and Fod Sectors' Exports of Turkey to EU in 2019

SAM Sector	NACE Code	HS Chapter	HS Section	Commodity	EU 28	UK	EU27	Total Value of EU27 Exports	EU27	Total Value of EU27 Exports
Agr	A	1	Live animals; animal products	Animals; live	$ 969,317	$ 35,217	$ 934,100		€ 834,390	
Agr	A	2	Live animals; animal products	Meat and edible meat offal	$ 3,015,156		$ 3,015,156		€ 2,693,306	
Agr	A	3	Live animals; animal products	Fish and crustaceans, molluscs and other aquatic invertebrates	$ 584,001,079	$ 59,306,892	$ 524,694,187		€ 468,686,188	
Agr	A	4	Live animals; animal products	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included	$ 14,175,716	$ 26,550	$ 14,149,166		€ 12,638,826	
Agr	A	5	Live animals; animal products	Animal originated products; not elsewhere specified or included	$ 23,421,387		$ 23,421,387		€ 20,921,293	
Agr	A	6	Vegetable products	Trees and other plants, live; bulbs, roots and the like; cut flowers and ornamental foliage	$ 65,928,151	$ 7,874,036	$ 58,054,115		€ 51,857,182	
Agr	A	7	Vegetable products	Vegetables and certain roots and tubers; edible	$ 437,381,081	$ 26,307,422	$ 411,073,659	$ 3,104,441,097	€ 367,193,979	€ 2,773,060,381
Agr	A	8	Vegetable products	Fruit and nuts, edible; peel of citrus fruit or melons	$ 2,082,055,079	$ 241,716,470	$ 1,840,338,609		€ 1,643,893,353	
Agr	A	9	Vegetable products	Coffee, tea, mate and spices	$ 61,754,492	$ 9,630,524	$ 52,123,968		€ 46,560,043	
Agr	A	10	Vegetable products	Cereals	$ 37,141,353	$ 8,551,982	$ 28,589,371		€ 25,537,625	
Agr	A	11	Vegetable products	Products of the milling industry; malt, starches, inulin, wheat gluten	$ 10,365,439	$ 212,575	$ 10,152,864		€ 9,069,106	
Agr	A	12	Vegetable products	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit, industrial or medicinal plants; straw and fodder	$ 131,679,735	$ 5,777,869	$ 125,901,866		€ 112,462,587	
Agr	A	13	Vegetable products	Lac; gums, resins and other vegetable saps and extracts	$ 8,382,410	$ 324,547	$ 8,057,863		€ 7,197,734	
Agr	A	14	Vegetable products	Vegetable plaiting materials; vegetable products not elsewhere specified or included	$ 4,150,410	$ 215,624	$ 3,934,786		€ 3,514,771	
Min	B	26	Mineral products	Ores, slag and ash	$ 361,619,009	$ 4,099,151	$ 357,519,858	$ 2,634,225,325	€ 319,356,729	€ 2,353,037,360
Min	B	27	Mineral products	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	$ 2,664,352,277	$ 387,646,810	$ 2,276,705,467		€ 2,033,680,632	
Fod	C10-C12	15	Animal or vegetable fats and oils	Animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes	$ 37,435,037	$ 1,557,676	$ 35,877,361		€ 32,047,665	
Fod	C10-C12	16	Foodstuffs, beverages, tobacco	Meat, fish or crustaceans, molluscs or other aquatic invertebrates; preparations thereof	$ 35,437,846	$ 220,642	$ 35,217,204		€ 31,457,976	
Fod	C10-C12	17	Foodstuffs, beverages, tobacco	Sugars and sugar confectionery	$ 150,074,558	$ 38,321,950	$ 111,752,608		€ 99,823,678	
Fod	C10-C12	18	Foodstuffs, beverages, tobacco	Cocoa and cocoa preparations	$ 64,104,709	$ 10,359,579	$ 53,745,130		€ 48,008,155	
Fod	C10-C12	19	Foodstuffs, beverages, tobacco	Preparations of cereals, flour, starch or milk; pastrycooks' products	$ 193,267,892	$ 24,185,214	$ 169,082,678	$ 1,990,626,584	€ 151,034,103	€ 1,778,138,976
Fod	C10-C12	20	Foodstuffs, beverages, tobacco	Preparations of vegetables, fruit, nuts or other parts of plants	$ 1,196,598,322	$ 106,504,593	$ 1,090,093,729		€ 973,732,674	
Fod	C10-C12	21	Foodstuffs, beverages, tobacco	Miscellaneous edible preparations	$ 203,044,542	$ 17,819,900	$ 185,224,642		€ 165,453,008	
Fod	C10-C12	22	Foodstuffs, beverages, tobacco	Beverages, spirits and vinegar	$ 152,493,702	$ 27,282,818	$ 125,210,884		€ 111,845,363	
Fod	C10-C12	23	Foodstuffs, beverages, tobacco	Food industries, residues and wastes thereof; prepared animal fodder	$ 19,262,241	$ 5,216,714	$ 14,045,527		€ 12,546,250	
Fod	C10-C12	24	Foodstuffs, beverages, tobacco	Tobacco and manufactured tobacco substitutes	$ 183,609,264	$ 13,232,443	$ 170,376,821		€ 152,190,104	

Table D.2 Che, Elec, Cem and Mnr Sectors' Exports of Turkey to EU in 2019

SAM Sector	NACE Code	HS Chapter	HS Section	Commodity	EU 28	UK	EU27	Total Value of EU27 Exports	EU27	Total Value of EU27 Exports
Che	C20-22	28	Products of the chemical or allied industries	Inorganic chemicals; organic and inorganic compounds of precious metals; of rare earth metals, of radio-active elements and of isotopes	$ 644,037,201	$ 73,107,061	$ 570,930,140	$ 6,374,314,822	€ 509,986,726	€ 5,693,894,437
Che	C20-22	29	Products of the chemical or allied industries	Organic chemicals	$ 326,011,898	$ 13,102,122	$ 312,909,776		€ 279,508,509	
Che	C20-22	30	Products of the chemical or allied industries	Pharmaceutical products	$ 255,679,185	$ 15,069,933	$ 240,609,252		€ 214,925,638	
Che	C20-22	31	Products of the chemical or allied industries	Fertilizers	$ 95,248,951	$ 31,309	$ 95,217,642		€ 85,053,722	
Che	C20-22	32	Products of the chemical or allied industries	Tanning or dyeing extracts; tannins and their derivatives; dyes, pigments and other colouring matter; paints, varnishes; putty, other mastics; inks	$ 144,542,788	$ 14,535,420	$ 130,007,368		€ 116,129,851	
Che	C20-22	33	Products of the chemical or allied industries	Essential oils and resinoids; perfumery, cosmetic or toilet preparations	$ 285,847,064	$ 34,614,071	$ 251,232,993		€ 224,415,358	
Che	C20-22	34	Products of the chemical or allied industries	Soap, organic surface-active agents; washing, lubricating, polishing or scouring preparations; artificial or prepared wa	$ 202,241,901	$ 30,135,230	$ 172,106,671		€ 153,735,302	
Che	C20-22	35	Products of the chemical or allied industries	Albuminoidal substances; modified starches; glues; enzymes	$ 40,552,583	$ 5,694,144	$ 34,858,439		€ 31,137,507	
Che	C20-22	36	Products of the chemical or allied industries	Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations	$ 9,240,068	$ 1,437,620	$ 7,802,448		€ 6,969,583	
Che	C20-22	37	Products of the chemical or allied industries	Photographic or cinematographic goods	$ 2,719,375	$ 18,695	$ 2,700,680		€ 2,412,398	
Che	C20-22	38	Products of the chemical or allied industries	Chemical products n.e.c.	$ 128,782,497	$ 5,734,033	$ 123,048,464		€ 109,913,769	
Che	C20-22	39	Plastics, rubber and articles thereof	Plastics and articles thereof	$ 3,055,541,062	$ 337,684,605	$ 2,717,856,457		€ 2,427,741,364	
Che	C20-22	40	Plastics, rubber and articles thereof	Rubber and articles thereof	$ 1,853,476,428	$ 138,441,936	$ 1,715,034,492		€ 1,531,964,709	
Elec	D	2716	Mineral fuels, mineral oils and products of the	Electrical energy	$ 63,200,649	$ -	$ 63,200,649	$ 63,200,649	€ 56,454,354	€ 56,454,354
Cem	C23.51	252310	Salt; sulphur, earths and stones; plastering materials, lime and cement	Cement clinkers (whether or not coloured)	$ 40,083,913		$ 40,083,913	$ 135,282,115	€ 35,805,192	€ 120,841,550
Cem	C23.51	252321		Cement; portland, white, whether or not artificially coloured	$ 39,396,155	$ 3,101,102	$ 36,295,053		€ 32,420,771	
Cem	C23.51	252329		Cement; portland, other than white, whether or not artificially coloured	$ 42,206,563		$ 42,206,563		€ 37,701,262	
Cem	C23.51	252330		Cement; aluminous (ciment fondu), whether or not coloured or in the form of clinkers	$ 6,087,122		$ 6,087,122		€ 5,437,358	
Cem	C23.51	252390		Cement; hydraulic kinds n.e.c. in heading no. 2523	$ 165,372		$ 165,372		€ 147,720	
Cem	C23.61	6810	Articles of stone, plaster, cement, asbestos, mica or similar materials	Articles of cement, of concrete or of artificial stone, whether or not reinforced Tiles, flagstones, bricks and similar articles	$ 9,613,089	$ 942,734	$ 8,670,355		€ 7,744,846	
Cem	C.23.65	6811		Articles of asbestos-cement, of cellulose fibre-cement or the like	$ 2,607,300	$ 833,563	$ 1,773,737		€ 1,584,401	
Mnr	Rest of C23	Rest of 25	Salt; sulphur, earths and stones		$ 578,686,540	$ 23,773,684	$ 554,912,856	$ 1,887,556,904	€ 495,679,192	€ 1,686,071,375
Mnr	Rest of C23	Rest of 68	Articles of stone, glass, cement and ceramics	Stone, plaster, cement, asbestos, mica or similar materials; articles thereof	$ 285,600,330	$ 26,983,811	$ 258,616,519		€ 231,010,736	
Mnr	Rest of C23	69	Articles of stone, glass, cement and ceramics	Ceramic products	$ 656,582,411	$ 118,181,321	$ 538,401,090		€ 480,929,960	
Mnr	Rest of C23	70	Articles of stone, glass, cement and ceramics	Glass and glassware	$ 591,968,197	$ 56,341,758	$ 535,626,439		€ 478,451,486	

Table D.3 Iro and Met Sectors' Exports of Turkey to EU in 2019

SAM Sector	NACE Code	HS Chapter	HS Section	Commodity	EU 28	UK	EU27	Total Value of EU27 Exports	EU27	Total Value of EU27 Exports
Iro	C24.1-2-3-5	72	Base metals and articles thereof	Iron and steel	$ 4,081,463,697	$ 262,728,052	$ 3,818,735,645		€ 3,411,108,213	
Iro	C25	73.01-...-11	Base metals and articles thereof	Iron or steel articles	$ 1,306,310,944	$ 534,515,513	$ 2,825,391,500	$ 6,644,127,145	€ 2,523,797,678	€ 5,934,905,891
Iro	C25	73.12-...-26	Base metals and articles thereof		$ 2,053,596,069				€ 0	
Met	Rest of C24	74	Base metals and articles thereof	Copper and articles thereof	$ 975,706,170	$ 100,993,111	$ 874,713,059		€ 781,342,616	
Met	Rest of C24	75	Base metals and articles thereof	Nickel and articles thereof	$ 18,898,409	$ 6,965,978	$ 11,932,431		€ 10,658,715	
Met	Rest of C24	76	Base metals and articles thereof	Aluminium and articles thereof	$ 1,773,360,176	$ 192,025,286	$ 1,581,334,890		€ 1,412,536,749	
Met	Rest of C24	78	Base metals and articles thereof	Lead and articles thereof	$ 14,264,744	$ 308,874	$ 13,955,870		€ 12,466,163	
Met	Rest of C24	79	Base metals and articles thereof	Zinc and articles thereof	$ 11,171,497	$ 109,727	$ 11,061,770	$ 3,100,971,286	€ 9,880,992	€ 2,769,960,952
Met	Rest of C24	80	Base metals and articles thereof	Tin; articles thereof	$ 846,392	$ 236,078	$ 610,314		€ 545,167	
Met	Rest of C24	81	Base metals and articles thereof	Metals; n.e.c., cermets and articles thereof	$ 70,556,538	$ 1,309,359	$ 69,247,179		€ 61,855,452	
Met	Rest of C24	82	Base metals and articles thereof	Tools, implements, cutlery, spoons and forks, of base metal; parts thereof, of base metal	$ 164,882,236	$ 4,824,579	$ 160,057,657		€ 142,972,449	
Met	Rest of C24	83	Base metals and articles thereof	Metal; miscellaneous products of base metal	$ 420,568,781	$ 42,510,665	$ 378,058,116		€ 337,702,649	

Table D.4 Oth Sectors’ Exports of Turkey to EU in 2019

SAM Sector	NACE Code	HS Chapter	Commodity	EU 28	UK	EU27	Total Value of EU27 Exports	EU27	Total Value of EU27 Exports
Oth	Rest of C	41	Raw hides and skins (other than furskins) and leather	$ 114,601,645	$ 2,136,924	$ 112,464,721		€ 100,459,778	
Oth	Rest of C	42	Articles of leather; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silk-worm gut)	$ 229,266,148	$ 27,758,223	$ 201,507,925		€ 179,998,146	
Oth	Rest of C	43	Furskins and artificial fur; manufactures thereof	$ 53,193,986	$ 6,378,665	$ 46,815,321		€ 41,818,063	
Oth	Rest of C	44	Wood and articles of wood; wood charcoal	$ 146,448,263	$ 10,628,902	$ 135,819,361		€ 121,321,448	
Oth	Rest of C	45	Cork and articles of cork	$ 206,838	$ 29,686	$ 177,152		€ 158,242	
Oth	Rest of C	46	Manufactures of straw, esparto or other plaiting materials; basketware and wickerwork	$ 558,556	$ 86,434	$ 472,122		€ 421,726	
Oth	Rest of C	47	Pulp of wood or other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard	$ 2,116,812	$ 1,727	$ 2,115,085		€ 1,889,312	
Oth	Rest of C	48	Paper and paperboard; articles of paper pulp, of paper or paperboard	$ 720,836,852	$ 232,411,547	$ 488,425,305		€ 436,288,794	
Oth	Rest of C	49	Printed books, newspapers, pictures and other products of the printing industry; manuscripts, typescripts and plans	$ 38,134,124	$ 9,115,279	$ 29,018,845		€ 25,921,255	
Oth	Rest of C	50	Silk	$ 2,169,354	$ 619,406	$ 1,549,948		€ 1,384,500	
Oth	Rest of C	51	Wool, fine or coarse animal hair; horsehair yarn and woven fabric	$ 44,788,985	$ 9,050,775	$ 35,738,210		€ 31,923,368	
Oth	Rest of C	52	Cotton	$ 841,319,185	$ 28,894,712	$ 812,424,473		€ 725,702,968	
Oth	Rest of C	53	Vegetable textile fibres; paper yarn and woven fabrics of paper yarn	$ 28,998,730	$ 4,439,119	$ 24,559,611		€ 21,938,018	
Oth	Rest of C	54	Man-made filaments; strip and the like of man-made textile materials	$ 808,170,133	$ 165,395,387	$ 642,774,746		€ 574,162,346	
Oth	Rest of C	55	Man-made staple fibres	$ 592,417,412	$ 60,580,513	$ 531,836,899		€ 475,066,457	
Oth	Rest of C	56	Wadding, felt and nonwovens, special yarns; twine, cordage, ropes and cables and articles thereof	$ 373,263,409	$ 77,705,978	$ 295,557,431		€ 264,008,424	
Oth	Rest of C	57	Carpets and other textile floor coverings	$ 506,177,668	$ 122,577,540	$ 383,600,128		€ 342,653,084	
Oth	Rest of C	58	Fabrics; special woven fabrics, tufted textile fabrics, lace, tapestries, trimmings, embroidery	$ 159,078,062	$ 24,587,955	$ 134,490,107		€ 120,134,084	
Oth	Rest of C	59	Textile fabrics; impregnated, coated, covered or laminated; textile articles of a kind suitable for industrial use	$ 173,275,253	$ 22,743,918	$ 150,531,335		€ 134,463,006	
Oth	Rest of C	60	Fabrics; knitted or crocheted	$ 671,011,502	$ 16,696,650	$ 654,314,852		€ 584,470,614	
Oth	Rest of C	61	Apparel and clothing accessories; knitted or crocheted	$ 6,550,814,565	$ 1,203,417,624	$ 5,347,396,941	$ 51,147,930,689	€ 4,776,593,962	€ 45,688,191,772
Oth	Rest of C	62	Apparel and clothing accessories; not knitted or crocheted	$ 4,851,560,937	$ 500,600,718	$ 4,350,960,219		€ 3,886,520,964	
Oth	Rest of C	63	Textiles, made up articles; sets; worn clothing and worn textile articles; rags	$ 1,245,421,914	$ 92,520,582	$ 1,152,901,332		€ 1,029,835,937	
Oth	Rest of C	64	Footwear; gaiters and the like; parts of such articles	$ 326,951,501	$ 25,235,385	$ 301,716,116		€ 269,509,706	
Oth	Rest of C	65	Headgear and parts thereof	$ 20,509,904	$ 1,138,419	$ 19,371,485		€ 17,303,694	
Oth	Rest of C	66	Umbrellas, sun umbrellas, walking-sticks, seat sticks, whips, riding crops; and parts thereof	$ 4,222,739	$ 134,213	$ 4,088,526		€ 3,652,100	
Oth	Rest of C	67	Feathers and down, prepared; and articles made of feather or of down; artificial flowers; articles of human hair	$ 955,182	$ 37,531	$ 917,651		€ 819,697	
Oth	Rest of C	71	Natural, cultured pearls; precious, semi-precious stones; precious metals, metals clad with precious metal, and articles thereof; imitation jewellery; coin	$ 2,019,733,285	$ 1,168,882,158	$ 850,851,127		€ 760,027,804	
Oth	Rest of C	84	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	$10,318,360,476	$ 1,302,865,176	$ 9,015,495,300		€ 8,053,144,529	
Oth	Rest of C	85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	$ 5,002,144,011	$ 1,272,624,038	$ 3,729,519,973		€ 3,331,415,787	
Oth	Rest of C	86	Railway, tramway locomotives, rolling-stock and parts thereof; railway or tramway track fixtures and fittings and parts thereof; mechanical (including electro-mechanical) traffic signalling equipment of all kinds	$ 96,757,287	$ 308,836	$ 96,448,451		€ 86,153,150	
Oth	Rest of C	87	Vehicles; other than railway or tramway rolling stock, and parts and accessories thereof	$21,350,585,059	$ 2,433,158,414	$ 18,917,426,645		€ 16,898,103,301	
Oth	Rest of C	88	Aircraft, spacecraft and parts thereof	$ 450,445,315	$ 32,648,141	$ 417,797,174		€ 373,199,798	
Oth	Rest of C	89	Ships, boats and floating structures	$ 207,188,404	$ 1,406,019	$ 205,782,385		€ 183,816,333	
Oth	Rest of C	90	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessorie	$ 576,167,614	$ 47,190,540	$ 528,977,074		€ 472,511,902	
Oth	Rest of C	91	Clocks and watches and parts thereof	$ 6,571,997	$ 998,135	$ 5,573,862		€ 4,978,885	
Oth	Rest of C	92	Musical instruments; parts and accessories of such articles	$ 4,370,816	$ 341,027	$ 4,029,789		€ 3,599,633	
Oth	Rest of C	93	Arms and ammunition; parts and accessories thereof	$ 61,151,032	$ 10,574,752	$ 50,576,280		€ 45,177,561	
Oth	Rest of C	94	Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illu	$ 1,432,797,978	$ 135,296,476	$ 1,297,501,502		€ 1,159,000,895	
Oth	Rest of C	95	Toys, games and sports requisites; parts and accessories thereof	$ 58,734,595	$ 6,706,863	$ 52,027,732		€ 46,474,079	
Oth	Rest of C	96	Miscellaneous manufactured articles	$ 124,013,452	$ 9,635,904	$ 114,377,548		€ 102,168,422	

E. LST File (Output of GAMS) Codes

E.1 Compilation

GAMS 24.2.3 r46072 Released May 22, 2014 WEX-WEI x86_64/MS Windows 03/17/22 14:32:40 Page 1

SAMbalance

C o m p i l a t i o n

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Sets


        i          all items          /AGR
                                       MIN
                                       FOD
                                       CHE
                                       TRA
                                       ELEC
                                       CEM
                                       MNR
                                       IRO
                                       MET
```

23	CON
24	OTH
25	WAS
26	SER
27	AGR_
28	MIN_
29	FOD_
30	CHE_
31	TRA_
32	ELEC_
33	CEM_
34	MNR_
35	IRO_
36	MET_
37	CON_
38	OTH_
39	WAS_
40	SER_
41	LAB
42	CAP
43	HH
44	GOV

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                     SvIn
                     ROW/

a(i)    activities     /AGR
                     MIN
                     FOD
                     CHE
                     TRA
                     ELEC
                     CEM
                     MNR
                     IRO
                     MET
                     CON
                     OTH
                     WAS
                     SER/

c(i)    commodities      /AGR_
                     MIN_
                     FOD_
                     CHE_
```

```
                    TRA_
                    ELEC_
                    CEM_
                    MNR_
                    IRO_
                    MET_
                    CON_
                    OTH_
                    WAS_
                    SER_/

    f(i)     other entries     /LAB
                    CAP
                    HH
                    GOV
                    SvIn
                    ROW/

;

Alias (i,j);
Alias (f,g);
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Parameters

        AA(a,a)        activity-activity flows
        AC(a,c)        activity-commodity flows
        AF(a,f)        activity-others flows
        CA(c,a)        commodity-activity flows
        CC(c,c)        commodity-commodity flows
        CF(c,f)        commodity-others flows
        GA(g,a)        others-activity flows
        GC(g,c)        others-commodity flows
        GF(g,f)        others-others flows
        SAM(i,j)       SAM entries
        SAMnew(i,j)    new SAM entries
        pTotR(i)       row total parameter - initial SAM
        pTotS(j)       column total parameter - initial SAM

        pTotInt        total intermediates     /4517312473.69/
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GDXIN   C:\Users\Aysegul\Desktop\00_Tezim\06_My
SAM\2019\GAMS\Aysegül\Ayseg
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113

114

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119

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--- LOAD CA = 1:CA

124

GDXIN   C:\Users\Aysegul\Desktop\00_Tezim\06_My SAM\2019\GAMS\Aysegül\Ayseg

ül\SAM Balance\CC.gdx

--- LOAD CC = 1:CC

129

GDXIN   C:\Users\Aysegul\Desktop\00_Tezim\06_My SAM\2019\GAMS\Aysegül\Ayseg

ül\SAM Balance\AF.gdx

--- LOAD AF = 1:AF

134

GDXIN C:\Users\Aysegul\Desktop\00_Tezim\06_My SAM\2019\GAMS\Aysegül\Ayseg

ül\SAM Balance\CF.gdx

--- LOAD CF = 1:CF

139

GDXIN C:\Users\Aysegul\Desktop\00_Tezim\06_My SAM\2019\GAMS\Aysegül\Ayseg

ül\SAM Balance\GA.gdx

--- LOAD GA = 1:GA

144

GDXIN C:\Users\Aysegul\Desktop\00_Tezim\06_My SAM\2019\GAMS\Aysegül\Ayseg

ül\SAM Balance\GC.gdx

--- LOAD GC = 1:GC

149

150

GDXIN C:\Users\Aysegul\Desktop\00_Tezim\06_My SAM\2019\GAMS\Aysegül\Ayseg

ül\SAM Balance\GF.gdx

--- LOAD GF = 1:GF

155

156 SAM(a,a)=AA(a,a);

```
SAM(a,c)=AC(a,c);
SAM(a,f)=AF(a,f);
SAM(c,a)=CA(c,a);
SAM(c,c)=CC(c,c);
SAM(c,f)=CF(c,f);
SAM(g,a)=GA(g,a);
SAM(g,c)=GC(g,c);
SAM(g,f)=GF(g,f);

pTotR(i)=sum(j,SAM(i,j));
pTotS(j)=sum(i,SAM(i,j));

POSITIVE VARIABLEs
        vR(i)           row multipliers
        vS(j)           column multipliers
        vTotR(i)        row total
        vTotS(j)        column total
```

```
;

FREE VARIABLEs

        vTotDev          total deviation
        vDev(i)          difference betweem sum and column totals
;

        vR.fx(i)=1;
        vS.fx(j)=1;

        vR.lo(c)=0.00;
        vS.lo(a)=0.00;
        vR.up(c)=1000.00;
        vS.up(a)=1000.00;
```

```
      vDev.lo(i)=-0.0001*pTotR(i);
      vDev.up(i)= 0.0001*pTotR(i);

EQUATIONs

      eTotDev        total deviation
      eTotR(i)       row totals
      eTotS(j)       column totals
      eDev(i)        difference betweem sum and column totals

;

      eTotDev..                    vTotDev
     =e=   sum(i, vdev(i)*vDev(i));
```

```
eTotR(i)..                    vTotR(i)
        =e=     sum(j, SAM(i,j)) + sum(j, SAM(i,j)*[ vR(i)*vS(j) -1 ]$(
  c(i) and a(j)));

eTotS(j)..                    vTotS(j)
        =e=     sum(i, SAM(i,j)) + sum(i, SAM(i,j)*[ vR(i)*vS(j) -1 ]$(
  c(i) and a(j)));

eDev(i)..                     vDev(i)
        =e=     vTotR(i) - vTotS(i);

MODEL SAMbalance /All/     ;
```

```
SAMbalance.optfile=1;

solve    SAMbalance using NLP minimizing vTotDev;

SAMnew(i,j)=SAM(i,j) + SAM(i,j)*[ vR.l(i)*vS.l(j) -1 ]$(c(i) and a(j));

Execute_unload   'Output3.gdx';
```

File Summary

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SAMbalance

Include File Summary

```
  SEQ   GLOBAL TYPE      PARENT   LOCAL  FILENAME

    1        1 INPUT          0       0  C:\Users\Aysegul\Desktop\00_Tezim\06_M
                                         y SAM\2019\GAMS ve RAS\GAMS 2612\SAMba
                                         lance-v4.gms
    2      109 CALL           1     109  gdxxrw.exe Data-v2.xlsx o=AA.gdx par=A
                                         A rng=AA!A1:O15
    3      110 GDXIN          1     110  C:\Users\Aysegul\Desktop\00_Tezim\06_M
                                         y SAM\2019\GAMS\Aysegül\Aysegül\S
                                         AM Balance\AA.gdx
    4      115 CALL           1     115  gdxxrw.exe Data-v2.xlsx o=AC.gdx par=A
                                         C rng=AC!A1:O15
    5      116 GDXIN          1     116  C:\Users\Aysegul\Desktop\00_Tezim\06_M
                                         y SAM\2019\GAMS\Aysegül\Aysegül\S
                                         AM Balance\AC.gdx
```

6 120 CALL 1 120 gdxxrw.exe Data-v2.xlsx o=CA.gdx par=C
A rng=CA!A1:O15
7 121 GDXIN 1 121 C:\Users\Aysegul\Desktop\00_Tezim\06_M
y SAM\2019\GAMS\Aysegül\Aysegül\S
AM Balance\CA.gdx
8 125 CALL 1 125 gdxxrw.exe Data-v2.xlsx o=CC.gdx par=C
C rng=CC!A1:O15
9 126 GDXIN 1 126 C:\Users\Aysegul\Desktop\00_Tezim\06_M
y SAM\2019\GAMS\Aysegül\Aysegül\S
AM Balance\CC.gdx
10 130 CALL 1 130 gdxxrw.exe Data-v2.xlsx o=AF.gdx par=A
F rng=AF!A1:G15
11 131 GDXIN 1 131 C:\Users\Aysegul\Desktop\00_Tezim\06_M
y SAM\2019\GAMS\Aysegül\Aysegül\S
AM Balance\AF.gdx
12 135 CALL 1 135 gdxxrw.exe Data-v2.xlsx o=CF.gdx par=C
F rng=CF!A1:G15
13 136 GDXIN 1 136 C:\Users\Aysegul\Desktop\00_Tezim\06_M
y SAM\2019\GAMS\Aysegül\Aysegül\S
AM Balance\CF.gdx
14 140 CALL 1 140 gdxxrw.exe Data-v2.xlsx o=GA.gdx par=G
A rng=GA!A1:O7

```
   15      141 GDXIN          1     141  C:\Users\Aysegul\Desktop\00_Tezim\06_M
                                  y SAM\2019\GAMS\Aysegül\Aysegül\S
                                  AM Balance\GA.gdx
   16      145 CALL           1     145  gdxxrw.exe Data-v2.xlsx o=GC.gdx par=G
                                  C rng=GC!A1:O7
   17      146 GDXIN          1     146  C:\Users\Aysegul\Desktop\00_Tezim\06_M
                                  y SAM\2019\GAMS\Aysegül\Aysegül\S
                                  AM Balance\GC.gdx
   18      151 CALL           1     151  gdxxrw.exe Data-v2.xlsx o=GF.gdx par=G
                                  F rng=GF!A1:G7
   19      152 GDXIN          1     152  C:\Users\Aysegul\Desktop\00_Tezim\06_M
                                  y SAM\2019\GAMS\Aysegül\Aysegül\S
                                  AM Balance\GF.gdx


COMPILATION TIME     =        8.110 SECONDS      3 MB  24.2.3 r46072 WEX-
WEI
```

Equation Listing – SOLVE SAMbalance using NLP from line 242

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SAMbalance

Equation Listing SOLVE SAMbalance Using NLP From line 242

---- eTotDev =E= total deviation

eTotDev.. vTotDev + (0)*vDev(AGR) + (0)*vDev(MIN) + (0)*vDev(FOD)

+ (0)*vDev(CHE) + (0)*vDev(TRA) + (0)*vDev(ELEC) + (0)*vDev(CEM)

+ (0)*vDev(MNR) + (0)*vDev(IRO) + (0)*vDev(MET) + (0)*vDev(CON)

+ (0)*vDev(OTH) + (0)*vDev(WAS) + (0)*vDev(SER) + (0)*vDev(AGR_)

+ (0)*vDev(MIN_) + (0)*vDev(FOD_) + (0)*vDev(CHE_) + (0)*vDev(TRA_)

+ (0)*vDev(ELEC_) + (0)*vDev(CEM_) + (0)*vDev(MNR_) + (0)*vDev(IRO_)

+ (0)*vDev(MET_) + (0)*vDev(CON_) + (0)*vDev(OTH_) + (0)*vDev(WAS_)

+ (0)*vDev(SER_) + (0)*vDev(LAB) + (0)*vDev(CAP) + (0)*vDev(HH)

+ (0)*vDev(GOV) + (0)*vDev(SvIn) + (0)*vDev(ROW) =E= 0 ; (LHS = 0)

---- eTotR =E= row totals

eTotR(AGR).. vTotR(AGR) =E= 494771190.824664 ;

(LHS = 0, INFES = 494771190.824664 ****)

eTotR(MIN).. vTotR(MIN) =E= 93110958.7429069 ;

(LHS = 0, INFES = 93110958.7429069 ****)

eTotR(FOD).. vTotR(FOD) =E= 506410894.101286 ;

(LHS = 0, INFES = 506410894.101286 ****)

REMAINING 31 ENTRIES SKIPPED

---- eTotS =E= column totals

eTotS(AGR).. - (89198233.4338294)*vR(AGR_) - (1369765.09801381)*vR(MIN_)

- (19293881.6062223)*vR(FOD_) - (27099891.465751)*vR(CHE_)

- (8053041.3930462)*vR(TRA_) - (2734628.64921661)*vR(ELEC_)

- (111979.482599826)*vR(CEM_) - (285502.904380826)*vR(MNR_)

- (183842.538067568)*vR(IRO_) - (28043.6949018087)*vR(MET_)

- (1103125.33084304)*vR(CON_) - (16786306.8505492)*vR(OTH_)

- (1663462.9249996)*vR(WAS_) - (19648252.7616825)*vR(SER_)

- (187559958.134104)*vS(AGR) + vTotS(AGR) =E= 276371821.528902 ;

(LHS = -187559958.134104, INFES = 463931779.663006 ****)

eTotS(MIN).. - (403874.626682935)*vR(AGR_) - (5897410.39919633)*vR(MIN_)

- (112645.017650158)*vR(FOD_) - (2023448.37864178)*vR(CHE_)

- (5982755.92380147)*vR(TRA_) - (2968897.64574085)*vR(ELEC_)

- (176503.484121521)*vR(CEM_) - (450013.307617369)*vR(MNR_)

- (1362265.70090489)*vR(IRO_) - (207802.634215888)*vR(MET_)

- (282523.823626012)*vR(CON_) - (8971509.36012091)*vR(OTH_)

- (17473.4867160985)*vR(WAS_) - (9028310.87938893)*vR(SER_)

- (37885434.6684251)*vS(MIN) + vTotS(MIN) =E= 48219733.989416 ;

(LHS = -37885434.6684251, INFES = 86105168.6578412 ****)

eTotS(FOD).. - (171723691.587114)*vR(AGR_) - (2543595.02592473)*vR(MIN_)

- (72227322.4546367)*vR(FOD_) - (17133824.8079835)*vR(CHE_)

- (23471548.5941098)*vR(TRA_) - (5560977.9819852)*vR(ELEC_)

- (470899.025453118)*vR(CEM_) - (1200604.22066261)*vR(MNR_)

- (2050613.16359661)*vR(IRO_) - (312804.482172675)*vR(MET_)

- (1061680.07015791)*vR(CON_) - (13458000.8822634)*vR(OTH_)

- (514400.916769888)*vR(WAS_) - (55902796.5493841)*vR(SER_)

- (367632759.762214)*vS(FOD) + vTotS(FOD) =E= 155767623.255618 ;

(LHS = -367632759.762214, INFES = 523400383.017832 ****)

REMAINING 31 ENTRIES SKIPPED

---- eDev =E= difference betweem sum and column totals eDev(AGR).. - vTotR(AGR) + vTotS(AGR) + vDev(AGR) =E= 0 ; (LHS = 0)

eDev(MIN).. - vTotR(MIN) + vTotS(MIN) + vDev(MIN) =E= 0 ; (LHS = 0)

eDev(FOD).. - vTotR(FOD) + vTotS(FOD) + vDev(FOD) =E= 0 ; (LHS = 0)

REMAINING 31 ENTRIES SKIPPED

Column Listing

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SAMbalance

Column Listing SOLVE SAMbalance Using NLP From line 242

---- vR row multipliers

vR(AGR_)

(.LO, .L, .UP, .M = 0, 1, 1000, 0)

(-3.039854E+8) eTotR(AGR_)

(-8.919823E+7) eTotS(AGR)

(-403874.6267) eTotS(MIN)

(-1.717237E+8) eTotS(FOD)

(-1.900490E+6) eTotS(CHE)

(-47519.5366) eTotS(TRA)

(-660.9105) eTotS(ELEC)

(-20653.462) eTotS(CEM)

(-68526.8172) eTotS(MNR)

(-4547.1051) eTotS(IRO)

(-737.1568) eTotS(MET)

(-345862.5305) eTotS(CON)

(-2.358534E+7) eTotS(OTH)

(-26446.6996) eTotS(WAS)

(-1.665882E+7) eTotS(SER)

vR(MIN_)

(.LO, .L, .UP, .M = 0, 1, 1000, 0)

(-2.870512E+8) eTotR(MIN_)

(-1.369765E+6) eTotS(AGR)

(-5.897410E+6) eTotS(MIN)

(-2.543595E+6) eTotS(FOD)

(-7.494171E+6) eTotS(CHE)

(-1.271176E+6) eTotS(TRA)

(-8.531522E+7) eTotS(ELEC)

(-5.760795E+6) eTotS(CEM)

(-1.911393E+7) eTotS(MNR)

(-2.598711E+7) eTotS(IRO)

(-4.212917E+6) eTotS(MET)

(-1.485454E+7) eTotS(CON)

(-1.023247E+8) eTotS(OTH)

(-262346.7138) eTotS(WAS)

(-1.064348E+7) eTotS(SER)

vR(FOD_)

(.LO, .L, .UP, .M = 0, 1, 1000, 0)

(-1.630365E+8) eTotR(FOD_)

(-1.929388E+7) eTotS(AGR)

(-112645.0177) eTotS(MIN)

(-7.222732E+7) eTotS(FOD)

(-495723.4686) eTotS(CHE)

(-653950.7409) eTotS(TRA)

(-62843.6373) eTotS(ELEC)

(-24754.1584) eTotS(CEM)

(-82132.6559) eTotS(MNR)

(-126260.0792) eTotS(IRO)

(-20468.7322) eTotS(MET)

(-341073.9057) eTotS(CON)

(-2.572229E+6) eTotS(OTH)

(-133743.0607) eTotS(WAS)

(-6.688951E+7) eTotS(SER)

REMAINING 11 ENTRIES SKIPPED

---- vS column multipliers

vS(AGR)

(.LO, .L, .UP, .M = 0, 1, 1000, 0)

(-8.919823E+7) eTotR(AGR_)

(-1.369765E+6) eTotR(MIN_)

(-1.929388E+7) eTotR(FOD_)

(-2.709989E+7) eTotR(CHE_)

(-8.053041E+6) eTotR(TRA_)

(-2.734629E+6) eTotR(ELEC_)

(-111979.4826) eTotR(CEM_)

(-285502.9044) eTotR(MNR_)

(-183842.5381) eTotR(IRO_)

(-28043.6949) eTotR(MET_)

(-1.103125E+6) eTotR(CON_)

(-1.678631E+7) eTotR(OTH_)

(-1.663463E+6) eTotR(WAS_)

(-1.964825E+7) eTotR(SER_)

(-1.875600E+8) eTotS(AGR)

vS(MIN)

(.LO, .L, .UP, .M = 0, 1, 1000, 0)

(-403874.6267) eTotR(AGR_)

(-5.897410E+6) eTotR(MIN_)

(-112645.0177) eTotR(FOD_)

(-2.023448E+6) eTotR(CHE_)

(-5.982756E+6) eTotR(TRA_)

(-2.968898E+6) eTotR(ELEC_)

(-176503.4841) eTotR(CEM_)

(-450013.3076) eTotR(MNR_)

(-1.362266E+6) eTotR(IRO_)

(-207802.6342) eTotR(MET_)

(-282523.8236) eTotR(CON_)

(-8.971509E+6) eTotR(OTH_)

(-17473.4867) eTotR(WAS_)

(-9.028311E+6) eTotR(SER_)

(-3.788543E+7) eTotS(MIN)

vS(FOD)

(.LO, .L, .UP, .M = 0, 1, 1000, 0)

(-1.717237E+8) eTotR(AGR_)

(-2.543595E+6) eTotR(MIN_)

(-7.222732E+7) eTotR(FOD_)

(-1.713382E+7) eTotR(CHE_)

(-2.347155E+7) eTotR(TRA_)

(-5.560978E+6) eTotR(ELEC_)

(-470899.0255) eTotR(CEM_)

(-1.200604E+6) eTotR(MNR_)

(-2.050613E+6) eTotR(IRO_)

(-312804.4822) eTotR(MET_)

(-1.061680E+6) eTotR(CON_)

(-1.345800E+7) eTotR(OTH_)

(-514400.9168) eTotR(WAS_)

(-5.590280E+7) eTotR(SER_)

(-3.676328E+8) eTotS(FOD)

REMAINING 11 ENTRIES SKIPPED

---- vTotR row total

vTotR(AGR)

(.LO, .L, .UP, .M = 0, 0, +INF, 0)

1   eTotR(AGR)

-1   eDev(AGR)

vTotR(MIN)

(.LO, .L, .UP, .M = 0, 0, +INF, 0)

```
        1       eTotR(MIN)
       -1       eDev(MIN)

vTotR(FOD)
                (.LO, .L, .UP, .M = 0, 0, +INF, 0)
        1       eTotR(FOD)
       -1       eDev(FOD)

REMAINING 31 ENTRIES SKIPPED

---- vTotS  column total

vTotS(AGR)
                (.LO, .L, .UP, .M = 0, 0, +INF, 0)
        1       eTotS(AGR)
        1       eDev(AGR)

vTotS(MIN)
                (.LO, .L, .UP, .M = 0, 0, +INF, 0)
        1       eTotS(MIN)
        1       eDev(MIN)
```

vTotS(FOD)

(.LO, .L, .UP, .M = 0, 0, +INF, 0)

1 eTotS(FOD)

1 eDev(FOD)

REMAINING 31 ENTRIES SKIPPED

---- vTotDev total deviation

vTotDev

(.LO, .L, .UP, .M = -INF, 0, +INF, 0)

1 eTotDev

---- vDev difference betweem sum and column totals

vDev(AGR)

(.LO, .L, .UP, .M = -49477.1190824664, 0, 49477.1190824664, 0)

(0) eTotDev

1 eDev(AGR)

vDev(MIN)

(.LO, .L, .UP, .M = -9311.09587429069, 0, 9311.09587429069, 0)

(0) eTotDev

1 eDev(MIN)

vDev(FOD)

(.LO, .L, .UP, .M = -50641.0894101286, 0, 50641.0894101286, 0)

(0) eTotDev

1 eDev(FOD)

REMAINING 31 ENTRIES SKIPPED

Model Statistics

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SAMbalance

Model Statistics SOLVE SAMbalance Using NLP From line 242

MODEL STATISTICS

BLOCKS OF EQUATIONS	4	SINGLE EQUATIONS	103
BLOCKS OF VARIABLES	6	SINGLE VARIABLES	131
NON ZERO ELEMENTS	625	NON LINEAR N-Z	454
DERIVATIVE POOL	10	CONSTANT POOL	212
CODE LENGTH	1,364		

GENERATION TIME = 0.015 SECONDS 4 MB 24.2.3 r46072 WEX-WEI

EXECUTION TIME = 0.015 SECONDS 4 MB 24.2.3 r46072 WEX-WEI

Solution Report

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SAMbalance

Solution Report SOLVE SAMbalance Using NLP From line 242

S O L V E S U M M A R Y

MODEL SAMbalance OBJECTIVE vTotDev

TYPE NLP DIRECTION MINIMIZE

SOLVER CONOPT FROM LINE 242

**** SOLVER STATUS 1 Normal Completion

**** MODEL STATUS 2 Locally Optimal

**** OBJECTIVE VALUE 0.0000

RESOURCE USAGE, LIMIT 0.063 1000.000

ITERATION COUNT, LIMIT 14 2000000000

EVALUATION ERRORS 0 0

CONOPT 3 24.2.3 r46072 Released May 22, 2014 WEI x86_64/MS Windows

Reading parameter(s) from "C:\Users\Aysegul\Desktop\00_Tezim\06_My SAM\2019\

\Aysegül\Aysegül\SAM Balance\conopt.opt"

>> *GAMS CONOPT options file

>> rtobjr 0.0000000000001

>> rtredg 0.0000000000001

Finished reading from "C:\Users\Aysegul\Desktop\00_Tezim\06_My SAM\2019\

\Aysegül\Aysegül\SAM Balance\conopt.opt"

C O N O P T 3   version 3.15P

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Bagsvaerdvej 246 A

DK-2880 Bagsvaerd, Denmark

The model has 131 variables and 103 constraints

with 625 Jacobian elements, 454 of which are nonlinear.

The Hessian of the Lagrangian has 34 elements on the diagonal,

196 elements below the diagonal, and 62 nonlinear variables.

** Warning ** The value of RTREDG is out of range.

RTREDG is increased from 3.00000000E-13 to 3.00021235E-13.

** Optimal solution. Reduced gradient less than tolerance.

CONOPT time Total 0.060 seconds

of which: Function evaluations 0.000 = 0.0%

1st Derivative evaluations 0.000 = 0.0%

E.2 Solution Listing

E.2.1 SolEQU

	LOWER	LEVEL	UPPER	MARGINAL
---- EQU eTotDev	.	.	.	1.000

eTotDev total deviation

---- EQU eTotR row totals

	LOWER	LEVEL	UPPER	MARGINAL
AGR	4.9477E+8	4.9477E+8	4.9477E+8	EPS

MIN	9.3111E+7	9.3111E+7	9.3111E+7	EPS
FOD	5.0641E+8	5.0641E+8	5.0641E+8	EPS
CHE	3.0382E+8	3.0382E+8	3.0382E+8	EPS
TRA	6.5133E+8	6.5133E+8	6.5133E+8	EPS
ELEC	3.3253E+8	3.3253E+8	3.3253E+8	EPS
CEM	3.4265E+7	3.4265E+7	3.4265E+7	EPS
MNR	1.1369E+8	1.1369E+8	1.1369E+8	EPS
IRO	3.0802E+8	3.0802E+8	3.0802E+8	EPS
MET	7.1379E+7	7.1379E+7	7.1379E+7	EPS
CON	8.0703E+8	8.0703E+8	8.0703E+8	EPS
OTH	1.4020E+9	1.4020E+9	1.4020E+9	EPS
WAS	9.1320E+7	9.1320E+7	9.1320E+7	EPS
SER	3.1956E+9	3.1956E+9	3.1956E+9	EPS
AGR_	2.0352E+8	2.0352E+8	2.0352E+8	EPS
MIN_	2.5970E+7	2.5970E+7	2.5970E+7	EPS
FOD_	3.3822E+8	3.3822E+8	3.3822E+8	EPS
CHE_	7.0113E+7	7.0113E+7	7.0113E+7	EPS
TRA_	2.6289E+8	2.6289E+8	2.6289E+8	EPS
ELEC_	6.0608E+7	6.0608E+7	6.0608E+7	EPS
CEM_	2.5674E+6	2.5674E+6	2.5674E+6	EPS
MNR_	6.5459E+6	6.5459E+6	6.5459E+6	EPS
IRO_	5.0239E+7	5.0239E+7	5.0239E+7	EPS

MET_	7.6635E+6	7.6635E+6	7.6635E+6	EPS
CON_	6.9213E+8	6.9213E+8	6.9213E+8	EPS
OTH_	6.9938E+8	6.9938E+8	6.9938E+8	EPS
WAS_	3.5934E+7	3.5934E+7	3.5934E+7	EPS
SER_	1.9808E+9	1.9808E+9	1.9808E+9	EPS
LAB	1.3543E+9	1.3543E+9	1.3543E+9	EPS
CAP	2.5336E+9	2.5336E+9	2.5336E+9	EPS
HH	3.9702E+9	3.9702E+9	3.9702E+9	EPS
GOV	8.1560E+8	8.1560E+8	8.1560E+8	EPS
SvIn	1.3119E+9	1.3119E+9	1.3119E+9	-1.431E-6
ROW	1.3581E+9	1.3581E+9	1.3581E+9	EPS

---- EQU eTotS column totals

	LOWER	LEVEL	UPPER	MARGINAL
AGR	2.7637E+8	2.7637E+8	2.7637E+8	EPS
MIN	4.8220E+7	4.8220E+7	4.8220E+7	EPS
FOD	1.5577E+8	1.5577E+8	1.5577E+8	EPS
CHE	8.3312E+7	8.3312E+7	8.3312E+7	EPS
TRA	3.7051E+8	3.7051E+8	3.7051E+8	EPS
ELEC	7.1348E+7	7.1348E+7	7.1348E+7	EPS

CEM	1.3029E+7	1.3029E+7	1.3029E+7	EPS
MNR	4.3230E+7	4.3230E+7	4.3230E+7	EPS
IRO	9.1709E+7	9.1709E+7	9.1709E+7	EPS
MET	1.4867E+7	1.4867E+7	1.4867E+7	EPS
CON	2.3331E+8	2.3331E+8	2.3331E+8	EPS
OTH	3.8742E+8	3.8742E+8	3.8742E+8	EPS
WAS	3.3776E+7	3.3776E+7	3.3776E+7	EPS
SER	2.0651E+9	2.0651E+9	2.0651E+9	.
AGR_	5.1060E+8	5.1060E+8	5.1060E+8	EPS
MIN_	2.8409E+8	2.8409E+8	2.8409E+8	EPS
FOD_	5.3790E+8	5.3790E+8	5.3790E+8	EPS
CHE_	4.3143E+8	4.3143E+8	4.3143E+8	EPS
TRA_	6.6028E+8	6.6028E+8	6.6028E+8	EPS
ELEC_	3.3913E+8	3.3913E+8	3.3913E+8	EPS
CEM_	3.0534E+7	3.0534E+7	3.0534E+7	EPS
MNR_	1.0131E+8	1.0131E+8	1.0131E+8	EPS
IRO_	2.9365E+8	2.9365E+8	2.9365E+8	EPS
MET_	1.5194E+8	1.5194E+8	1.5194E+8	EPS
CON_	8.2046E+8	8.2046E+8	8.2046E+8	EPS
OTH_	1.4439E+9	1.4439E+9	1.4439E+9	EPS
WAS_	1.3033E+8	1.3033E+8	1.3033E+8	EPS
SER_	3.2183E+9	3.2183E+9	3.2183E+9	EPS

LAB	1.3543E+9	1.3543E+9	1.3543E+9	EPS
CAP	2.5336E+9	2.5336E+9	2.5336E+9	EPS
HH	3.9702E+9	3.9702E+9	3.9702E+9	EPS
GOV	8.1560E+8	8.1560E+8	8.1560E+8	EPS
SvIn	1.3119E+9	1.3119E+9	1.3119E+9	1.4305E-6
ROW	1.3581E+9	1.3581E+9	1.3581E+9	EPS

---- EQU eDev difference betweem sum and column totals

	LOWER	LEVEL	UPPER	MARGINAL
AGR	.	.	.	EPS
MIN	.	.	.	EPS
FOD	.	.	.	EPS
CHE	.	.	.	EPS
TRA	.	.	.	EPS
ELEC	.	.	.	EPS
CEM	.	.	.	EPS
MNR	.	.	.	EPS
IRO	.	.	.	EPS
MET	.	.	.	EPS
CON	.	.	.	EPS

OTH	.	.	.	EPS
WAS	.	.	.	EPS
SER	.	.	.	EPS
AGR_	.	.	.	EPS
MIN_	.	.	.	EPS
FOD_	.	.	.	EPS
CHE_	.	.	.	EPS
TRA_	.	.	.	EPS
ELEC_	.	.	.	EPS
CEM_	.	.	.	EPS
MNR_	.	.	.	EPS
IRO_	.	.	.	EPS
MET_	.	.	.	EPS
CON_	.	.	.	EPS
OTH_	.	.	.	EPS
WAS_	.	.	.	EPS
SER_	.	.	.	EPS
LAB	.	.	.	EPS
CAP	.	.	.	EPS
HH	.	.	.	EPS
GOV	.	.	.	EPS
SvIn	.	.	.	-1.431E-6

ROW	.	.	.	EPS

E.2.2 SolVAR

---- VAR vR row multipliers

	LOWER	LEVEL	UPPER	MARGINAL
AGR_	.	0.973	1000.000	.
MIN_	.	0.790	1000.000	.
FOD_	.	1.228	1000.000	.
CHE_	.	0.892	1000.000	.
TRA_	.	0.996	1000.000	.
ELEC_	.	0.880	1000.000	.
CEM_	.	0.612	1000.000	.
MNR_	.	0.813	1000.000	.
IRO_	.	0.641	1000.000	.
MET_	.	2.492	1000.000	.
CON_	.	0.509	1000.000	.
OTH_	.	0.874	1000.000	.
WAS_	.	0.788	1000.000	.
SER_	.	1.050	1000.000	.

---- VAR vS column multipliers

	LOWER	LEVEL	UPPER	MARGINAL
AGR	.	1.188	1000.000	.
MIN	.	1.286	1000.000	.
FOD	.	0.932	1000.000	.
CHE	.	1.217	1000.000	.
TRA	.	0.757	1000.000	.
ELEC	.	1.047	1000.000	.
CEM	.	1.123	1000.000	.
MNR	.	1.123	1000.000	.
IRO	.	0.894	1000.000	.
MET	.	1.441	1000.000	.
CON	.	1.319	1000.000	.
OTH	.	1.248	1000.000	.
WAS	.	1.577	1000.000	.
SER	.	1.000	1000.000	EPS

---- VAR vTotR row total

	LOWER	LEVEL	UPPER	MARGINAL
AGR	.	4.9477E+8	+INF	.
MIN	.	9.3111E+7	+INF	.
FOD	.	5.0641E+8	+INF	.
CHE	.	3.0382E+8	+INF	.
TRA	.	6.5133E+8	+INF	.
ELEC	.	3.3253E+8	+INF	.
CEM	.	3.4265E+7	+INF	.
MNR	.	1.1369E+8	+INF	.
IRO	.	3.0802E+8	+INF	.
MET	.	7.1379E+7	+INF	.
CON	.	8.0703E+8	+INF	.
OTH	.	1.4020E+9	+INF	.
WAS	.	9.1320E+7	+INF	.
SER	.	3.1956E+9	+INF	.
AGR_	.	5.1060E+8	+INF	.
MIN_	.	2.8409E+8	+INF	.
FOD_	.	5.3790E+8	+INF	.
CHE_	.	4.3143E+8	+INF	.
TRA_	.	6.6028E+8	+INF	.
ELEC_	.	3.3913E+8	+INF	.

CEM_	.	3.0534E+7	+INF	.
MNR_	.	1.0131E+8	+INF	.
IRO_	.	2.9365E+8	+INF	.
MET_	.	1.5194E+8	+INF	.
CON_	.	8.2046E+8	+INF	.
OTH_	.	1.4439E+9	+INF	.
WAS_	.	1.3033E+8	+INF	.
SER_	.	3.2183E+9	+INF	.
LAB	.	1.3543E+9	+INF	.
CAP	.	2.5336E+9	+INF	.
HH	.	3.9702E+9	+INF	.
GOV	.	8.1560E+8	+INF	.
SvIn	.	1.3119E+9	+INF	.
ROW	.	1.3581E+9	+INF	.

---- VAR vTotS column total

	LOWER	LEVEL	UPPER	MARGINAL
AGR	.	4.9477E+8	+INF	.
MIN	.	9.3111E+7	+INF	.
FOD	.	5.0641E+8	+INF	.

CHE	.	3.0382E+8	+INF	.
TRA	.	6.5133E+8	+INF	.
ELEC	.	3.3253E+8	+INF	.
CEM	.	3.4265E+7	+INF	.
MNR	.	1.1369E+8	+INF	.
IRO	.	3.0802E+8	+INF	.
MET	.	7.1379E+7	+INF	.
CON	.	8.0703E+8	+INF	.
OTH	.	1.4020E+9	+INF	.
WAS	.	9.1320E+7	+INF	.
SER	.	3.1956E+9	+INF	.
AGR_	.	5.1060E+8	+INF	.
MIN_	.	2.8409E+8	+INF	.
FOD_	.	5.3790E+8	+INF	.
CHE_	.	4.3143E+8	+INF	.
TRA_	.	6.6028E+8	+INF	.
ELEC_	.	3.3913E+8	+INF	.
CEM_	.	3.0534E+7	+INF	.
MNR_	.	1.0131E+8	+INF	.
IRO_	.	2.9365E+8	+INF	.
MET_	.	1.5194E+8	+INF	.
CON_	.	8.2046E+8	+INF	.

OTH_	.	1.4439E+9	+INF	.
WAS_	.	1.3033E+8	+INF	.
SER_	.	3.2183E+9	+INF	.
LAB	.	1.3543E+9	+INF	.
CAP	.	2.5336E+9	+INF	.
HH	.	3.9702E+9	+INF	.
GOV	.	8.1560E+8	+INF	.
SvIn	.	1.3119E+9	+INF	.
ROW	.	1.3581E+9	+INF	.

	LOWER	LEVEL	UPPER	MARGINAL
---- VAR vTotDev	-INF	5.116E-13	+INF	.

vTotDev total deviation

---- VAR vDev difference betweem sum and column totals

	LOWER	LEVEL	UPPER	MARGINAL
AGR	-4.948E+4	.	49477.119	EPS
MIN	-9311.096	.	9311.096	EPS

FOD	-5.064E+4	.	50641.089	EPS
CHE	-3.038E+4	.	30381.726	EPS
TRA	-6.513E+4	.	65133.441	EPS
ELEC	-3.325E+4	.	33253.030	EPS
CEM	-3426.467	.	3426.467	EPS
MNR	-1.137E+4	.	11368.789	EPS
IRO	-3.080E+4	.	30801.588	EPS
MET	-7137.907	.	7137.907	EPS
CON	-8.070E+4	.	80703.458	EPS
OTH	-1.402E+5	.	1.4020E+5	EPS
WAS	-9131.954	.	9131.954	EPS
SER	-3.196E+5	.	3.1956E+5	EPS
AGR_	-5.075E+4	.	50750.362	EPS
MIN_	-3.130E+4	.	31302.081	EPS
FOD_	-5.013E+4	.	50125.269	EPS
CHE_	-4.154E+4	.	41536.379	EPS
TRA_	-6.830E+4	.	68302.513	EPS
ELEC_	-3.587E+4	.	35867.095	EPS
CEM_	-4006.209	.	4006.209	EPS
MNR_	-1.021E+4	.	10214.232	EPS
IRO_	-3.777E+4	.	37766.894	EPS
MET_	-5761.035	.	5761.035	EPS

CON_	-8.944E+4	.	89436.263	EPS
OTH_	-1.454E+5	.	1.4542E+5	EPS
WAS_	-1.481E+4	.	14806.903	EPS
SER_	-3.101E+5	.	3.1009E+5	EPS
LAB	-1.354E+5	.	1.3543E+5	.
CAP	-2.534E+5	.	2.5336E+5	.
HH	-3.970E+5	.	3.9702E+5	.
GOV	-8.156E+4	.	81560.295	.
SvIn	-1.312E+5	-7.153E-7	1.3119E+5	.
ROW	-1.358E+5	.	1.3581E+5	.

**** REPORT SUMMARY :   0   NONOPT

0 INFEASIBLE

0 UNBOUNDED

0   ERRORS

Execution

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SAMbalance

E x e c u t i o n

EXECUTION TIME   =   0.000 SECONDS   3 MB 24.2.3 r46072 WEX-WEI

F. Multiplier Effects

F.1 Unitary Shock

Table F.1 Unconstrained Multipliers of a Unitary Shock in All Sectors

		Commodities													
		Agr	Min	Fod	Che	Tra	Elc	Cem	Mnr	Iro	Met	Con	Oth	Was	Ser
Activities	Agr	1.25128	0.03330	0.41125	0.04573	0.12955	0.08986	0.09891	0.09891	0.06406	0.01870	0.10400	0.06542	0.07901	0.13868
	Min	0.01186	0.27260	0.01102	0.00910	0.01322	0.11924	0.05715	0.05715	0.02286	0.00777	0.02412	0.01903	0.01520	0.01363
	Fod	0.18526	0.03576	1.02839	0.04729	0.14534	0.10103	0.11039	0.11039	0.07247	0.02118	0.11633	0.05881	0.09018	0.16457
	Che	0.06376	0.01170	0.04695	0.57810	0.03650	0.02262	0.05026	0.05026	0.02774	0.00899	0.05576	0.03676	0.03629	0.03611
	Tra	0.18384	0.07116	0.18641	0.09265	1.41131	0.14487	0.19962	0.19962	0.14476	0.04599	0.20156	0.10287	0.14864	0.21241
	Elec	0.08661	0.04012	0.08203	0.05234	0.08937	2.01051	0.17289	0.17289	0.10987	0.03645	0.09589	0.05557	0.16476	0.10753
	Cem	0.00221	0.00101	0.00230	0.00159	0.00294	0.00226	0.94530	0.02781	0.00222	0.00072	0.02797	0.00155	0.00317	0.00335
	Mnr	0.00697	0.00329	0.00738	0.00519	0.00939	0.00724	0.09381	1.01130	0.00724	0.00237	0.09432	0.00502	0.01040	0.01077
	Iro	0.01193	0.00647	0.01176	0.00866	0.01742	0.01092	0.01729	0.01729	0.78935	0.03653	0.10449	0.03372	0.01674	0.01534
	Met	0.00201	0.00115	0.00202	0.00154	0.00300	0.00187	0.00304	0.00304	0.01926	0.22138	0.01922	0.00617	0.00297	0.00262
	Con	0.01028	0.00318	0.00912	0.00455	0.01104	0.01153	0.00960	0.00960	0.01297	0.00432	1.12411	0.00554	0.05695	0.01753
	Oth	0.14442	0.05323	0.12147	0.05897	0.21096	0.11179	0.15717	0.15717	0.08369	0.02562	0.18081	0.70636	0.10768	0.15924
	Was	0.01115	0.00286	0.00861	0.00547	0.01033	0.00697	0.00995	0.00995	0.10047	0.03522	0.02207	0.00967	0.78077	0.01162
	Ser	0.64652	0.20288	0.61061	0.29008	0.79894	0.56858	0.65383	0.65383	0.42268	0.12958	0.74588	0.35753	0.56619	1.78648
Commodities	Agr	1.37991	0.03672	0.45352	0.05043	0.14287	0.09910	0.10908	0.10908	0.07065	0.02062	0.11469	0.07214	0.08714	0.15293
	Min	0.04498	1.03371	0.04178	0.03451	0.05015	0.45217	0.21672	0.21672	0.08669	0.02945	0.09147	0.07216	0.05764	0.05167
	Fod	0.23471	0.04530	1.30292	0.05992	0.18414	0.12799	0.13986	0.13986	0.09181	0.02684	0.14738	0.07451	0.11425	0.20850
	Che	0.13984	0.02566	0.10298	1.26795	0.08005	0.04962	0.11024	0.11024	0.06084	0.01971	0.12229	0.08062	0.07959	0.07920
	Tra	0.18636	0.07214	0.18897	0.09392	1.43069	0.14686	0.20236	0.20236	0.14675	0.04662	0.20432	0.10428	0.15069	0.21533
	Elec	0.08848	0.04099	0.08381	0.05347	0.09130	2.05407	0.17664	0.17664	0.11225	0.03724	0.09797	0.05678	0.16833	0.10986
	Cem	0.00241	0.00110	0.00251	0.00173	0.00321	0.00246	1.03031	0.03031	0.00242	0.00079	0.03048	0.00169	0.00345	0.00365
	Mnr	0.00760	0.00359	0.00804	0.00566	0.01023	0.00789	0.10224	1.10224	0.00789	0.00258	0.10280	0.00547	0.01133	0.01174
	Iro	0.01741	0.00944	0.01717	0.01264	0.02543	0.01595	0.02524	0.02524	1.15231	0.05332	0.15253	0.04923	0.02443	0.02239
	Met	0.00936	0.00534	0.00939	0.00716	0.01399	0.00870	0.01416	0.01416	0.08975	1.03145	0.08957	0.02877	0.01384	0.01222
	Con	0.01045	0.00324	0.00927	0.00462	0.01123	0.01172	0.00976	0.00976	0.01319	0.00439	1.14282	0.00563	0.05790	0.01782
	Oth	0.26391	0.09727	0.22197	0.10776	0.38550	0.20428	0.28721	0.28721	0.15294	0.04682	0.33040	1.29075	0.19677	0.29099
	Was	0.01651	0.00424	0.01275	0.00810	0.01531	0.01033	0.01474	0.01474	0.14882	0.05217	0.03268	0.01433	1.15644	0.01721
	Ser	0.69179	0.21709	0.65336	0.31039	0.85487	0.60838	0.69960	0.69960	0.45227	0.13865	0.79810	0.38256	0.60583	1.91156
Labor		0.27978	0.11631	0.31580	0.16655	0.43806	0.27991	0.39279	0.39279	0.25563	0.07324	0.40950	0.20921	0.27914	0.55997
Capital		1.09519	0.25835	0.81404	0.31327	1.10997	0.79458	0.76374	0.76374	0.50763	0.14744	0.79410	0.38103	0.64211	0.94727
Household		1.37497	0.37466	1.12984	0.47982	1.54803	1.07449	1.15653	1.15653	0.76326	0.22068	1.20360	0.59025	0.92125	1.50724
Government		0.16154	0.15616	0.30014	0.12574	0.21959	0.21654	0.19260	0.19260	0.18267	0.05662	0.20534	0.23849	0.17747	0.21518
Saving/Investment		0.43996	0.11988	0.36152	0.15353	0.49533	0.34381	0.37006	0.37006	0.24422	0.07061	0.38513	0.18887	0.29478	0.48228
Rest of World		0.39851	0.72395	0.33834	0.72072	0.28508	0.43965	0.43733	0.43733	0.57310	0.87277	0.40954	0.57265	0.52775	0.30254

F.2 CP_1 Simulation

Table F.2 Unconstrained Multipliers of a Decrease in Sectoral Exports by the Amount of Respective Carbon Cost Shock in All Sectors under CP_1 Simulation

		Commodities										
		Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.19955	0.00117	0.02217	0.00424	0.00128	0.00525	0.01043	0.01426	0.00081	0.05420	0.02182
	Min	0.00189	0.00958	0.00059	0.00084	0.00170	0.00303	0.00603	0.00509	0.00034	0.01577	0.00214
	Fod	0.02954	0.00126	0.05545	0.00439	0.00144	0.00586	0.01165	0.01613	0.00092	0.04872	0.02589
	Che	0.01017	0.00041	0.00253	0.05363	0.00032	0.00267	0.00530	0.00617	0.00039	0.03045	0.00568
	Tra	0.02932	0.00250	0.01005	0.00859	0.00207	0.01059	0.02106	0.03222	0.00199	0.08522	0.03341
	Elec	0.01381	0.00141	0.00442	0.00486	0.02873	0.00917	0.01824	0.02445	0.00158	0.04604	0.01692
	Cem	0.00035	0.00004	0.00012	0.00015	0.00003	0.05015	0.00293	0.00049	0.00003	0.00128	0.00053
	Mnr	0.00111	0.00012	0.00040	0.00048	0.00010	0.00498	0.10668	0.00161	0.00010	0.00416	0.00169
	Iro	0.00190	0.00023	0.00063	0.00080	0.00016	0.00092	0.00182	0.17566	0.00158	0.02794	0.00241
	Met	0.00032	0.00004	0.00011	0.00014	0.00003	0.00016	0.00032	0.00429	0.00960	0.00512	0.00041
	Con	0.00164	0.00011	0.00049	0.00042	0.00016	0.00051	0.00101	0.00289	0.00019	0.00459	0.00276
	Oth	0.02303	0.00187	0.00655	0.00547	0.00160	0.00834	0.01658	0.01863	0.00111	0.58519	0.02505
	Was	0.00178	0.00010	0.00046	0.00051	0.00010	0.00053	0.00105	0.02236	0.00153	0.00801	0.00183
	Ser	0.10311	0.00713	0.03292	0.02691	0.00813	0.03468	0.06897	0.09406	0.00562	0.29620	0.28103
Commodities	Agr	0.22007	0.00129	0.02445	0.00468	0.00142	0.00579	0.01151	0.01572	0.00089	0.05977	0.02406
	Min	0.00717	0.03632	0.00225	0.00320	0.00646	0.01150	0.02286	0.01929	0.00128	0.05978	0.00813
	Fod	0.03743	0.00159	0.07025	0.00556	0.00183	0.00742	0.01475	0.02043	0.00116	0.06173	0.03280
	Che	0.02230	0.00090	0.00555	0.11763	0.00071	0.00585	0.01163	0.01354	0.00085	0.06679	0.01246
	Tra	0.02972	0.00253	0.01019	0.00871	0.00210	0.01073	0.02135	0.03266	0.00202	0.08639	0.03387
	Elec	0.01411	0.00144	0.00452	0.00496	0.02936	0.00937	0.01863	0.02498	0.00161	0.04704	0.01728
	Cem	0.00038	0.00004	0.00014	0.00016	0.00004	0.05466	0.00320	0.00054	0.00003	0.00140	0.00057
	Mnr	0.00121	0.00013	0.00043	0.00053	0.00011	0.00542	0.11628	0.00176	0.00011	0.00454	0.00185
	Iro	0.00278	0.00033	0.00093	0.00117	0.00023	0.00134	0.00266	0.25644	0.00231	0.04078	0.00352
	Met	0.00149	0.00019	0.00051	0.00066	0.00012	0.00075	0.00149	0.01997	0.04472	0.02383	0.00192
	Con	0.00167	0.00011	0.00050	0.00043	0.00017	0.00052	0.00103	0.00293	0.00019	0.00466	0.00280
	Oth	0.04209	0.00342	0.01197	0.01000	0.00292	0.01524	0.03030	0.03403	0.00203	1.06934	0.04578
	Was	0.00263	0.00015	0.00069	0.00075	0.00015	0.00078	0.00155	0.03312	0.00226	0.01187	0.00271
	Ser	0.11032	0.00763	0.03523	0.02879	0.00869	0.03711	0.07380	0.10065	0.00601	0.31694	0.30071
Factors of Production	Labor	0.04462	0.00409	0.01703	0.01545	0.00400	0.02084	0.04144	0.05689	0.00318	0.17333	0.08809
	Capital	0.17466	0.00908	0.04389	0.02906	0.01136	0.04051	0.08057	0.11297	0.00639	0.31567	0.14902
Household		0.21928	0.01317	0.06092	0.04451	0.01536	0.06135	0.12200	0.16986	0.00957	0.48900	0.23711
Government		0.02576	0.00549	0.01618	0.01167	0.00309	0.01022	0.02032	0.04065	0.00245	0.19758	0.03385
Saving/Investment		0.07016	0.00421	0.01949	0.01424	0.00491	0.01963	0.03904	0.05435	0.00306	0.15647	0.07587
Rest of World		0.06355	0.02544	0.01824	0.06686	0.00628	0.02320	0.04614	0.12754	0.03784	0.47442	0.04759

F.3 CP_2 Simulation

Table F.3 Unconstrained Multipliers of a Decrease in Sectoral Exports by the Amount of Respective Carbon Cost Shock in All Sectors under CP_2 Simulation

		Commodities										
		Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.31928	0.00187	0.03548	0.00679	0.00205	0.00840	0.01669	0.02281	0.00130	0.08671	0.03490
	Min	0.00303	0.01533	0.00095	0.00135	0.00273	0.00485	0.00965	0.00814	0.00054	0.02522	0.00343
	Fod	0.04727	0.00201	0.08872	0.00702	0.00231	0.00937	0.01863	0.02580	0.00147	0.07796	0.04142
	Che	0.01627	0.00066	0.00405	0.08581	0.00052	0.00427	0.00848	0.00988	0.00062	0.04872	0.00909
	Tra	0.04691	0.00400	0.01608	0.01375	0.00331	0.01694	0.03369	0.05155	0.00319	0.13635	0.05346
	Elec	0.02210	0.00226	0.00708	0.00777	0.04597	0.01467	0.02918	0.03912	0.00253	0.07366	0.02707
	Cem	0.00056	0.00006	0.00020	0.00024	0.00005	0.08023	0.00469	0.00079	0.00005	0.00205	0.00084
	Mnr	0.00178	0.00018	0.00064	0.00077	0.00017	0.00796	0.17069	0.00258	0.00016	0.00666	0.00271
	Iro	0.00304	0.00036	0.00101	0.00129	0.00025	0.00147	0.00292	0.28106	0.00253	0.04470	0.00386
	Met	0.00051	0.00006	0.00017	0.00023	0.00004	0.00026	0.00051	0.00686	0.01536	0.00818	0.00066
	Con	0.00262	0.00018	0.00079	0.00067	0.00026	0.00081	0.00162	0.00462	0.00030	0.00734	0.00441
	Oth	0.03685	0.00299	0.01048	0.00875	0.00256	0.01334	0.02653	0.02980	0.00178	0.93630	0.04008
	Was	0.00284	0.00016	0.00074	0.00081	0.00016	0.00084	0.00168	0.03578	0.00244	0.01282	0.00292
	Ser	0.16497	0.01141	0.05268	0.04306	0.01300	0.05549	0.11036	0.15050	0.00899	0.47392	0.44965
Commodities	Agr	0.35211	0.00206	0.03913	0.00749	0.00227	0.00926	0.01841	0.02516	0.00143	0.09563	0.03849
	Min	0.01148	0.05812	0.00360	0.00512	0.01034	0.01839	0.03658	0.03087	0.00204	0.09565	0.01301
	Fod	0.05989	0.00255	0.11241	0.00889	0.00293	0.01187	0.02361	0.03269	0.00186	0.09877	0.05248
	Che	0.03568	0.00144	0.00888	0.18820	0.00113	0.00936	0.01861	0.02166	0.00137	0.10687	0.01994
	Tra	0.04755	0.00406	0.01630	0.01394	0.00336	0.01718	0.03416	0.05225	0.00323	0.13823	0.05420
	Elec	0.02258	0.00230	0.00723	0.00794	0.04697	0.01499	0.02981	0.03997	0.00258	0.07526	0.02765
	Cem	0.00061	0.00006	0.00022	0.00026	0.00006	0.08745	0.00512	0.00086	0.00005	0.00224	0.00092
	Mnr	0.00194	0.00020	0.00069	0.00084	0.00018	0.00868	0.18604	0.00281	0.00018	0.00726	0.00296
	Iro	0.00444	0.00053	0.00148	0.00188	0.00036	0.00214	0.00426	0.41030	0.00370	0.06525	0.00564
	Met	0.00239	0.00030	0.00081	0.00106	0.00020	0.00120	0.00239	0.03196	0.07156	0.03813	0.00308
	Con	0.00267	0.00018	0.00080	0.00069	0.00027	0.00083	0.00165	0.00469	0.00030	0.00746	0.00449
	Oth	0.06734	0.00547	0.01915	0.01599	0.00467	0.02438	0.04848	0.05446	0.00325	1.71095	0.07324
	Was	0.00421	0.00024	0.00110	0.00120	0.00024	0.00125	0.00249	0.05299	0.00362	0.01899	0.00433
	Ser	0.17652	0.01220	0.05637	0.04607	0.01391	0.05938	0.11808	0.16104	0.00962	0.50710	0.48113
Factors of Production	Labor	0.07139	0.00654	0.02724	0.02472	0.00640	0.03334	0.06630	0.09102	0.00508	0.27732	0.14094
	Capital	0.27945	0.01452	0.07023	0.04650	0.01817	0.06482	0.12891	0.18075	0.01023	0.50507	0.23843
Household		0.35084	0.02106	0.09747	0.07122	0.02457	0.09816	0.19521	0.27177	0.01531	0.78239	0.37937
Government		0.04122	0.00878	0.02589	0.01866	0.00495	0.01635	0.03251	0.06504	0.00393	0.31612	0.05416
Saving/Investment		0.11226	0.00674	0.03119	0.02279	0.00786	0.03141	0.06246	0.08696	0.00490	0.25035	0.12139
Rest of World		0.10168	0.04070	0.02919	0.10698	0.01005	0.03712	0.07382	0.20406	0.06055	0.75907	0.07615

F.4 CP_3 Simulation

Table F.4 Unconstrained Multipliers of a Decrease in Sectoral Exports by the Amount of Respective Carbon Cost Shock in All Sectors under CP_3 Simulation

		Commodities										
		Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.44695	0.00262	0.04967	0.00950	0.00288	0.01175	0.02337	0.03193	0.00182	0.12139	0.04886
	Min	0.00424	0.02145	0.00133	0.00189	0.00382	0.00679	0.01350	0.01140	0.00075	0.03531	0.00480
	Fod	0.06617	0.00281	0.12420	0.00983	0.00323	0.01312	0.02608	0.03612	0.00206	0.10913	0.05798
	Che	0.02277	0.00092	0.00567	0.12012	0.00072	0.00597	0.01188	0.01383	0.00087	0.06821	0.01272
	Tra	0.06567	0.00560	0.02251	0.01925	0.00464	0.02372	0.04717	0.07216	0.00447	0.19088	0.07484
	Elec	0.03094	0.00316	0.00991	0.01087	0.06436	0.02054	0.04085	0.05476	0.00354	0.10312	0.03789
	Cem	0.00079	0.00008	0.00028	0.00033	0.00007	0.11232	0.00657	0.00111	0.00007	0.00287	0.00118
	Mnr	0.00249	0.00026	0.00089	0.00108	0.00023	0.01115	0.23895	0.00361	0.00023	0.00932	0.00380
	Iro	0.00426	0.00051	0.00142	0.00180	0.00035	0.00205	0.00409	0.39345	0.00355	0.06257	0.00541
	Met	0.00072	0.00009	0.00024	0.00032	0.00006	0.00036	0.00072	0.00960	0.02150	0.01146	0.00092
	Con	0.00367	0.00025	0.00110	0.00094	0.00037	0.00114	0.00227	0.00646	0.00042	0.01028	0.00618
	Oth	0.05159	0.00419	0.01467	0.01225	0.00358	0.01867	0.03714	0.04172	0.00249	1.31070	0.05611
	Was	0.00398	0.00023	0.00104	0.00114	0.00022	0.00118	0.00235	0.05008	0.00342	0.01795	0.00409
	Ser	0.23094	0.01597	0.07374	0.06027	0.01820	0.07768	0.15449	0.21068	0.01258	0.66343	0.62946
Commodities	Agr	0.49290	0.00289	0.05477	0.01048	0.00317	0.01296	0.02577	0.03522	0.00200	0.13387	0.05389
	Min	0.01607	0.08136	0.00505	0.00717	0.01447	0.02575	0.05121	0.04321	0.00286	0.13390	0.01821
	Fod	0.08384	0.00357	0.15735	0.01245	0.00410	0.01662	0.03305	0.04576	0.00261	0.13826	0.07346
	Che	0.04995	0.00202	0.01244	0.26346	0.00159	0.01310	0.02605	0.03033	0.00191	0.14960	0.02791
	Tra	0.06657	0.00568	0.02282	0.01951	0.00470	0.02404	0.04781	0.07315	0.00453	0.19350	0.07587
	Elec	0.03161	0.00323	0.01012	0.01111	0.06575	0.02099	0.04174	0.05595	0.00362	0.10535	0.03871
	Cem	0.00086	0.00009	0.00030	0.00036	0.00008	0.12242	0.00716	0.00121	0.00008	0.00313	0.00128
	Mnr	0.00271	0.00028	0.00097	0.00118	0.00025	0.01215	0.26044	0.00393	0.00025	0.01016	0.00414
	Iro	0.00622	0.00074	0.00207	0.00263	0.00051	0.00300	0.00596	0.57437	0.00518	0.09135	0.00789
	Met	0.00334	0.00042	0.00113	0.00149	0.00028	0.00168	0.00335	0.04473	0.10017	0.05338	0.00431
	Con	0.00373	0.00025	0.00112	0.00096	0.00038	0.00116	0.00231	0.00657	0.00043	0.01045	0.00628
	Oth	0.09427	0.00766	0.02681	0.02239	0.00654	0.03413	0.06786	0.07623	0.00455	2.39511	0.10253
	Was	0.00590	0.00033	0.00154	0.00168	0.00033	0.00175	0.00348	0.07418	0.00507	0.02659	0.00606
	Ser	0.24710	0.01709	0.07891	0.06449	0.01947	0.08312	0.16530	0.22543	0.01347	0.70988	0.67353
Factors of Production	Labor	0.09994	0.00915	0.03814	0.03461	0.00896	0.04667	0.09281	0.12742	0.00711	0.38822	0.19730
	Capital	0.39120	0.02033	0.09831	0.06509	0.02543	0.09074	0.18046	0.25303	0.01432	0.70704	0.33377
Household		0.49114	0.02949	0.13645	0.09970	0.03439	0.13741	0.27327	0.38044	0.02143	1.09525	0.53107
Government		0.05770	0.01229	0.03625	0.02613	0.00693	0.02288	0.04551	0.09105	0.00550	0.44253	0.07582
Saving/Investment		0.15715	0.00944	0.04366	0.03190	0.01101	0.04397	0.08744	0.12173	0.00686	0.35046	0.16993
Rest of World		0.14235	0.05698	0.04086	0.14975	0.00000	0.01407	0.05196	0.10333	0.28566	1.06260	0.10660

G. Carbon Costs and Multiplier Analysis Results Under Difference in Demand Response Based on Free Allocation of Allowances

G.1 CP_1 Simulation

Table G.1 Sectoral Carbon Costs Under Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

	Carbon Costs (€ billion) under Different Elasticies for CP_1 Simulation									
	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Agr	0.016	0.032	0.048	0.064	0.080	0.096	0.112	0.128	0.144	0.159
Min	0.004	0.007	0.011	0.014	0.018	0.021	0.025	0.028	0.032	0.035
Fod	0.005	0.011	0.016	0.022	0.027	0.032	0.038	0.043	0.049	0.054
Che	0.009	0.019	0.028	0.037	0.046	0.056	0.065	0.074	0.083	0.093
Elec	0.001	0.003	0.004	0.006	0.007	0.009	0.010	0.011	0.013	0.014
Cem	0.005	0.011	0.016	0.021	0.027	0.032	0.037	0.042	0.048	0.053
Mnr	0.011	0.021	0.032	0.042	0.053	0.063	0.074	0.084	0.095	0.105
Iro	0.022	0.045	0.067	0.089	0.111	0.134	0.156	0.178	0.200	0.223
Met	0.004	0.009	0.013	0.017	0.022	0.026	0.030	0.035	0.039	0.043
Con	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oth	0.083	0.166	0.249	0.331	0.414	0.497	0.580	0.663	0.746	0.828
Ser	0.016	0.031	0.047	0.063	0.079	0.094	0.110	0.126	0.142	0.157

Table G.2 Multiplier Analysis Results for All Sectors under 10% Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

		Commodities										
	10%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.01996	0.00012	0.00222	0.00042	0.00013	0.00052	0.00104	0.00143	0.00008	0.00542	0.00218
	Min	0.00019	0.00096	0.00006	0.00008	0.00017	0.00030	0.00060	0.00051	0.00003	0.00158	0.00021
	Fod	0.00295	0.00013	0.00555	0.00044	0.00014	0.00059	0.00116	0.00161	0.00009	0.00487	0.00259
	Che	0.00102	0.00004	0.00025	0.00536	0.00003	0.00027	0.00053	0.00062	0.00004	0.00305	0.00057
	Tra	0.00293	0.00025	0.00101	0.00086	0.00021	0.00106	0.00211	0.00322	0.00020	0.00852	0.00334
	Elec	0.00138	0.00014	0.00044	0.00049	0.00287	0.00092	0.00182	0.00245	0.00016	0.00460	0.00169
	Cem	0.00004	0.00000	0.00001	0.00001	0.00000	0.00501	0.00029	0.00005	0.00000	0.00013	0.00005
	Mnr	0.00011	0.00001	0.00004	0.00005	0.00001	0.00050	0.01067	0.00016	0.00001	0.00042	0.00017
	Iro	0.00019	0.00002	0.00006	0.00008	0.00002	0.00009	0.00018	0.01757	0.00016	0.00279	0.00024
	Met	0.00003	0.00000	0.00001	0.00001	0.00000	0.00002	0.00003	0.00043	0.00096	0.00051	0.00004
	Con	0.00016	0.00001	0.00005	0.00004	0.00002	0.00005	0.00010	0.00029	0.00002	0.00046	0.00028
	Oth	0.00230	0.00019	0.00065	0.00055	0.00016	0.00083	0.00166	0.00186	0.00011	0.05852	0.00251
	Was	0.00018	0.00001	0.00005	0.00005	0.00001	0.00005	0.00010	0.00224	0.00015	0.00080	0.00018
	Ser	0.01031	0.00071	0.00329	0.00269	0.00081	0.00347	0.00690	0.00941	0.00056	0.02962	0.02810
Commodities	Agr	0.02201	0.00013	0.00245	0.00047	0.00014	0.00058	0.00115	0.00157	0.00009	0.00598	0.00241
	Min	0.00072	0.00363	0.00023	0.00032	0.00065	0.00115	0.00229	0.00193	0.00013	0.00598	0.00081
	Fod	0.00374	0.00016	0.00703	0.00056	0.00018	0.00074	0.00148	0.00204	0.00012	0.00617	0.00328
	Che	0.00223	0.00009	0.00056	0.01176	0.00007	0.00058	0.00116	0.00135	0.00009	0.00668	0.00125
	Tra	0.00297	0.00025	0.00102	0.00087	0.00021	0.00107	0.00213	0.00327	0.00020	0.00864	0.00339
	Elec	0.00141	0.00014	0.00045	0.00050	0.00294	0.00094	0.00186	0.00250	0.00016	0.00470	0.00173
	Cem	0.00004	0.00000	0.00001	0.00002	0.00000	0.00547	0.00032	0.00005	0.00000	0.00014	0.00006
	Mnr	0.00012	0.00001	0.00004	0.00005	0.00001	0.00054	0.01163	0.00018	0.00001	0.00045	0.00018
	Iro	0.00028	0.00003	0.00009	0.00012	0.00002	0.00013	0.00027	0.02564	0.00023	0.00408	0.00035
	Met	0.00015	0.00002	0.00005	0.00007	0.00001	0.00008	0.00015	0.00200	0.00447	0.00238	0.00019
	Con	0.00017	0.00001	0.00005	0.00004	0.00002	0.00005	0.00010	0.00029	0.00002	0.00047	0.00028
	Oth	0.00421	0.00034	0.00120	0.00100	0.00029	0.00152	0.00303	0.00340	0.00020	0.10693	0.00458
	Was	0.00026	0.00001	0.00007	0.00008	0.00001	0.00008	0.00016	0.00331	0.00023	0.00119	0.00027
	Ser	0.01103	0.00076	0.00352	0.00288	0.00087	0.00371	0.00738	0.01006	0.00060	0.03169	0.03007
Labor		0.00446	0.00041	0.00170	0.00155	0.00040	0.00208	0.00414	0.00569	0.00032	0.01733	0.00881
Capital		0.01747	0.00091	0.00439	0.00291	0.00114	0.00405	0.00806	0.01130	0.00064	0.03157	0.01490
Household		0.02193	0.00132	0.00609	0.00445	0.00154	0.00614	0.01220	0.01699	0.00096	0.04890	0.02371
Government		0.00258	0.00055	0.00162	0.00117	0.00031	0.00102	0.00203	0.00407	0.00025	0.01976	0.00338
Saving/Investment		0.00702	0.00042	0.00195	0.00142	0.00049	0.00196	0.00390	0.00544	0.00031	0.01565	0.00759
Rest of World		0.00636	0.00254	0.00182	0.00669	0.00063	0.00232	0.00461	0.01275	0.00378	0.04744	0.00476

Table G.3 Multiplier Analysis Results for All Sectors under 20% Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

		Commodities									
	20%	Agr	Min	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.03991	0.00023	0.00085	0.00026	0.00105	0.00209	0.00285	0.00016	0.01084	0.00436
	Min	0.00038	0.00192	0.00017	0.00034	0.00061	0.00121	0.00102	0.00007	0.00315	0.00043
	Fod	0.00591	0.00025	0.00088	0.00029	0.00117	0.00233	0.00323	0.00018	0.00974	0.00518
	Che	0.00203	0.00008	0.01073	0.00006	0.00053	0.00106	0.00123	0.00008	0.00609	0.00114
	Tra	0.00586	0.00050	0.00172	0.00041	0.00212	0.00421	0.00644	0.00040	0.01704	0.00668
	Elec	0.00276	0.00028	0.00097	0.00575	0.00183	0.00365	0.00489	0.00032	0.00921	0.00338
	Cem	0.00007	0.00001	0.00003	0.00001	0.01003	0.00059	0.00010	0.00001	0.00026	0.00011
	Mnr	0.00022	0.00002	0.00010	0.00002	0.00100	0.02134	0.00032	0.00002	0.00083	0.00034
	Iro	0.00038	0.00005	0.00016	0.00003	0.00018	0.00036	0.03513	0.00032	0.00559	0.00048
	Met	0.00006	0.00001	0.00003	0.00001	0.00003	0.00006	0.00086	0.00192	0.00102	0.00008
	Con	0.00033	0.00002	0.00008	0.00003	0.00010	0.00020	0.00058	0.00004	0.00092	0.00055
	Oth	0.00461	0.00037	0.00109	0.00032	0.00167	0.00332	0.00373	0.00022	0.11704	0.00501
	Was	0.00036	0.00002	0.00010	0.00002	0.00011	0.00021	0.00447	0.00031	0.00160	0.00037
	Ser	0.02062	0.00143	0.00538	0.00163	0.00694	0.01379	0.01881	0.00112	0.05924	0.05621
Commodities	Agr	0.04401	0.00026	0.00094	0.00028	0.00116	0.00230	0.00314	0.00018	0.01195	0.00481
	Min	0.00143	0.00726	0.00064	0.00129	0.00230	0.00457	0.00386	0.00026	0.01196	0.00163
	Fod	0.00749	0.00032	0.00111	0.00037	0.00148	0.00295	0.00409	0.00023	0.01235	0.00656
	Che	0.00446	0.00018	0.02353	0.00014	0.00117	0.00233	0.00271	0.00017	0.01336	0.00249
	Tra	0.00594	0.00051	0.00174	0.00042	0.00215	0.00427	0.00653	0.00040	0.01728	0.00677
	Elec	0.00282	0.00029	0.00099	0.00587	0.00187	0.00373	0.00500	0.00032	0.00941	0.00346
	Cem	0.00008	0.00001	0.00003	0.00001	0.01093	0.00064	0.00011	0.00001	0.00028	0.00011
	Mnr	0.00024	0.00003	0.00011	0.00002	0.00108	0.02326	0.00035	0.00002	0.00091	0.00037
	Iro	0.00056	0.00007	0.00023	0.00005	0.00027	0.00053	0.05129	0.00046	0.00816	0.00070
	Met	0.00030	0.00004	0.00013	0.00002	0.00015	0.00030	0.00399	0.00894	0.00477	0.00038
	Con	0.00033	0.00002	0.00009	0.00003	0.00010	0.00021	0.00059	0.00004	0.00093	0.00056
	Oth	0.00842	0.00068	0.00200	0.00058	0.00305	0.00606	0.00681	0.00041	0.21387	0.00916
	Was	0.00053	0.00003	0.00015	0.00003	0.00016	0.00031	0.00662	0.00045	0.00237	0.00054
	Ser	0.02206	0.00153	0.00576	0.00174	0.00742	0.01476	0.02013	0.00120	0.06339	0.06014
Labor		0.00892	0.00082	0.00309	0.00080	0.00417	0.00829	0.01138	0.00064	0.03467	0.01762
Capital		0.03493	0.00182	0.00581	0.00227	0.00810	0.01611	0.02259	0.00128	0.06313	0.02980
Household		0.04386	0.00263	0.00890	0.00307	0.01227	0.02440	0.03397	0.00191	0.09780	0.04742
Government		0.00515	0.00110	0.00233	0.00062	0.00204	0.00406	0.00813	0.00049	0.03952	0.00677
Saving/Investment		0.01403	0.00084	0.00285	0.00098	0.00393	0.00781	0.01087	0.00061	0.03129	0.01517
Rest of World		0.01271	0.00509	0.01337	0.00126	0.00464	0.00923	0.02551	0.00757	0.09488	0.00952

Table G.4 Multiplier Analysis Results for All Sectors under 30% Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

		Commodities										
	30%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.05987	0.00035	0.00665	0.00127	0.00039	0.00157	0.00313	0.00428	0.00024	0.01626	0.00654
	Min	0.00057	0.00287	0.00018	0.00025	0.00051	0.00091	0.00181	0.00153	0.00010	0.00473	0.00064
	Fod	0.00886	0.00038	0.01664	0.00132	0.00043	0.00176	0.00349	0.00484	0.00028	0.01462	0.00777
	Che	0.00305	0.00012	0.00076	0.01609	0.00010	0.00080	0.00159	0.00185	0.00012	0.00914	0.00170
	Tra	0.00880	0.00075	0.00302	0.00258	0.00062	0.00318	0.00632	0.00966	0.00060	0.02557	0.01002
	Elec	0.00414	0.00042	0.00133	0.00146	0.00862	0.00275	0.00547	0.00734	0.00047	0.01381	0.00507
	Cem	0.00011	0.00001	0.00004	0.00004	0.00001	0.01504	0.00088	0.00015	0.00001	0.00038	0.00016
	Mnr	0.00033	0.00003	0.00012	0.00014	0.00003	0.00149	0.03201	0.00048	0.00003	0.00125	0.00051
	Iro	0.00057	0.00007	0.00019	0.00024	0.00005	0.00028	0.00055	0.05270	0.00048	0.00838	0.00072
	Met	0.00010	0.00001	0.00003	0.00004	0.00001	0.00005	0.00010	0.00129	0.00288	0.00153	0.00012
	Con	0.00049	0.00003	0.00015	0.00013	0.00005	0.00015	0.00030	0.00087	0.00006	0.00138	0.00083
	Oth	0.00691	0.00056	0.00196	0.00164	0.00048	0.00250	0.00497	0.00559	0.00033	0.17556	0.00752
	Was	0.00053	0.00003	0.00014	0.00015	0.00003	0.00016	0.00031	0.00671	0.00046	0.00240	0.00055
	Ser	0.03093	0.00214	0.00988	0.00807	0.00244	0.01041	0.02069	0.02822	0.00169	0.08886	0.08431
Commodities	Agr	0.06602	0.00039	0.00734	0.00140	0.00042	0.00174	0.00345	0.00472	0.00027	0.01793	0.00722
	Min	0.00215	0.01090	0.00068	0.00096	0.00194	0.00345	0.00686	0.00579	0.00038	0.01794	0.00244
	Fod	0.01123	0.00048	0.02108	0.00167	0.00055	0.00223	0.00443	0.00613	0.00035	0.01852	0.00984
	Che	0.00669	0.00027	0.00167	0.03529	0.00021	0.00175	0.00349	0.00406	0.00026	0.02004	0.00374
	Tra	0.00892	0.00076	0.00306	0.00261	0.00063	0.00322	0.00640	0.00980	0.00061	0.02592	0.01016
	Elec	0.00423	0.00043	0.00136	0.00149	0.00881	0.00281	0.00559	0.00749	0.00048	0.01411	0.00518
	Cem	0.00012	0.00001	0.00004	0.00005	0.00001	0.01640	0.00096	0.00016	0.00001	0.00042	0.00017
	Mnr	0.00036	0.00004	0.00013	0.00016	0.00003	0.00163	0.03488	0.00053	0.00003	0.00136	0.00055
	Iro	0.00083	0.00010	0.00028	0.00035	0.00007	0.00040	0.00080	0.07693	0.00069	0.01223	0.00106
	Met	0.00045	0.00006	0.00015	0.00020	0.00004	0.00023	0.00045	0.00599	0.01342	0.00715	0.00058
	Con	0.00050	0.00003	0.00015	0.00013	0.00005	0.00016	0.00031	0.00088	0.00006	0.00140	0.00084
	Oth	0.01263	0.00103	0.00359	0.00300	0.00088	0.00457	0.00909	0.01021	0.00061	0.32080	0.01373
	Was	0.00079	0.00004	0.00021	0.00023	0.00004	0.00023	0.00047	0.00994	0.00068	0.00356	0.00081
	Ser	0.03310	0.00229	0.01057	0.00864	0.00261	0.01113	0.02214	0.03019	0.00180	0.09508	0.09021
Labor		0.01339	0.00123	0.00511	0.00464	0.00120	0.00625	0.01243	0.01707	0.00095	0.05200	0.02643
Capital		0.05240	0.00272	0.01317	0.00872	0.00341	0.01215	0.02417	0.03389	0.00192	0.09470	0.04470
Household		0.06578	0.00395	0.01828	0.01335	0.00461	0.01841	0.03660	0.05096	0.00287	0.14670	0.07113
Government		0.00773	0.00165	0.00486	0.00350	0.00093	0.00307	0.00610	0.01220	0.00074	0.05927	0.01015
Saving/Investment		0.02105	0.00126	0.00585	0.00427	0.00147	0.00589	0.01171	0.01631	0.00092	0.04694	0.02276
Rest of World		0.01907	0.00763	0.00547	0.02006	0.00189	0.00696	0.01384	0.03826	0.01135	0.14233	0.01428

Table G.5 Multiplier Analysis Results for All Sectors under 40% Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

		Commodities										
	40%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.07982	0.00047	0.00887	0.00170	0.00051	0.00210	0.00417	0.00570	0.00032	0.02168	0.00873
	Min	0.00076	0.00383	0.00024	0.00034	0.00068	0.00121	0.00241	0.00204	0.00013	0.00631	0.00086
	Fod	0.01182	0.00050	0.02218	0.00175	0.00058	0.00234	0.00466	0.00645	0.00037	0.01949	0.01036
	Che	0.00407	0.00016	0.00101	0.02145	0.00013	0.00107	0.00212	0.00247	0.00016	0.01218	0.00227
	Tra	0.01173	0.00100	0.00402	0.00344	0.00083	0.00424	0.00842	0.01289	0.00080	0.03409	0.01337
	Elec	0.00552	0.00056	0.00177	0.00194	0.01149	0.00367	0.00730	0.00978	0.00063	0.01842	0.00677
	Cem	0.00014	0.00001	0.00005	0.00006	0.00001	0.02006	0.00117	0.00020	0.00001	0.00051	0.00021
	Mnr	0.00044	0.00005	0.00016	0.00019	0.00004	0.00199	0.04267	0.00064	0.00004	0.00166	0.00068
	Iro	0.00076	0.00009	0.00025	0.00032	0.00006	0.00037	0.00073	0.07027	0.00063	0.01117	0.00097
	Met	0.00013	0.00002	0.00004	0.00006	0.00001	0.00006	0.00013	0.00171	0.00384	0.00205	0.00017
	Con	0.00066	0.00004	0.00020	0.00017	0.00007	0.00020	0.00041	0.00115	0.00007	0.00184	0.00110
	Oth	0.00921	0.00075	0.00262	0.00219	0.00064	0.00334	0.00663	0.00745	0.00044	0.23408	0.01002
	Was	0.00071	0.00004	0.00019	0.00020	0.00004	0.00021	0.00042	0.00894	0.00061	0.00321	0.00073
	Ser	0.04124	0.00285	0.01317	0.01076	0.00325	0.01387	0.02759	0.03763	0.00225	0.11848	0.11241
Commodities	Agr	0.08803	0.00052	0.00978	0.00187	0.00057	0.00231	0.00460	0.00629	0.00036	0.02391	0.00962
	Min	0.00287	0.01453	0.00090	0.00128	0.00258	0.00460	0.00914	0.00772	0.00051	0.02391	0.00325
	Fod	0.01497	0.00064	0.02810	0.00222	0.00073	0.00297	0.00590	0.00817	0.00047	0.02469	0.01312
	Che	0.00892	0.00036	0.00222	0.04705	0.00028	0.00234	0.00465	0.00542	0.00034	0.02672	0.00498
	Tra	0.01189	0.00101	0.00408	0.00349	0.00084	0.00429	0.00854	0.01306	0.00081	0.03456	0.01355
	Elec	0.00564	0.00058	0.00181	0.00198	0.01174	0.00375	0.00745	0.00999	0.00065	0.01881	0.00691
	Cem	0.00015	0.00002	0.00005	0.00006	0.00001	0.02186	0.00128	0.00022	0.00001	0.00056	0.00023
	Mnr	0.00048	0.00005	0.00017	0.00021	0.00005	0.00217	0.04651	0.00070	0.00004	0.00181	0.00074
	Iro	0.00111	0.00013	0.00037	0.00047	0.00009	0.00054	0.00107	0.10258	0.00092	0.01631	0.00141
	Met	0.00060	0.00007	0.00020	0.00027	0.00005	0.00030	0.00060	0.00799	0.01789	0.00953	0.00077
	Con	0.00067	0.00005	0.00020	0.00017	0.00007	0.00021	0.00041	0.00117	0.00008	0.00187	0.00112
	Oth	0.01684	0.00137	0.00479	0.00400	0.00117	0.00609	0.01212	0.01361	0.00081	0.42774	0.01831
	Was	0.00105	0.00006	0.00027	0.00030	0.00006	0.00031	0.00062	0.01325	0.00090	0.00475	0.00108
	Ser	0.04413	0.00305	0.01409	0.01152	0.00348	0.01484	0.02952	0.04026	0.00240	0.12678	0.12028
Labor		0.01785	0.00163	0.00681	0.00618	0.00160	0.00833	0.01657	0.02276	0.00127	0.06933	0.03524
Capital		0.06986	0.00363	0.01756	0.01162	0.00454	0.01621	0.03223	0.04519	0.00256	0.12627	0.05961
Household		0.08771	0.00527	0.02437	0.01781	0.00614	0.02454	0.04880	0.06794	0.00383	0.19560	0.09484
Government		0.01030	0.00219	0.00647	0.00467	0.00124	0.00409	0.00813	0.01626	0.00098	0.07903	0.01354
Saving/Investment		0.02807	0.00169	0.00780	0.00570	0.00197	0.00785	0.01562	0.02174	0.00122	0.06259	0.03035
Rest of World		0.02542	0.01018	0.00730	0.02674	0.00251	0.00928	0.01845	0.05102	0.01514	0.18977	0.01904

Table G.6 Multiplier Analysis Results for All Sectors under 50% Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

		Commodities										
	50%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.09978	0.00059	0.01109	0.00212	0.00064	0.00262	0.00522	0.00713	0.00041	0.02710	0.01091
	Min	0.00095	0.00479	0.00030	0.00042	0.00085	0.00152	0.00301	0.00254	0.00017	0.00788	0.00107
	Fod	0.01477	0.00063	0.02773	0.00219	0.00072	0.00293	0.00582	0.00806	0.00046	0.02436	0.01294
	Che	0.00508	0.00021	0.00127	0.02681	0.00016	0.00133	0.00265	0.00309	0.00019	0.01523	0.00284
	Tra	0.01466	0.00125	0.00503	0.00430	0.00104	0.00529	0.01053	0.01611	0.00100	0.04261	0.01671
	Elec	0.00691	0.00070	0.00221	0.00243	0.01437	0.00459	0.00912	0.01223	0.00079	0.02302	0.00846
	Cem	0.00018	0.00002	0.00006	0.00007	0.00002	0.02507	0.00147	0.00025	0.00002	0.00064	0.00026
	Mnr	0.00056	0.00006	0.00020	0.00024	0.00005	0.00249	0.05334	0.00081	0.00005	0.00208	0.00085
	Iro	0.00095	0.00011	0.00032	0.00040	0.00008	0.00046	0.00091	0.08783	0.00079	0.01397	0.00121
	Met	0.00016	0.00002	0.00005	0.00007	0.00001	0.00008	0.00016	0.00214	0.00480	0.00256	0.00021
	Con	0.00082	0.00006	0.00025	0.00021	0.00008	0.00025	0.00051	0.00144	0.00009	0.00229	0.00138
	Oth	0.01152	0.00094	0.00327	0.00274	0.00080	0.00417	0.00829	0.00931	0.00056	0.29259	0.01253
	Was	0.00089	0.00005	0.00023	0.00025	0.00005	0.00026	0.00052	0.01118	0.00076	0.00401	0.00091
	Ser	0.05155	0.00356	0.01646	0.01346	0.00406	0.01734	0.03449	0.04703	0.00281	0.14810	0.14052
Commodities	Agr	0.11003	0.00065	0.01223	0.00234	0.00071	0.00289	0.00575	0.00786	0.00045	0.02988	0.01203
	Min	0.00359	0.01816	0.00113	0.00160	0.00323	0.00575	0.01143	0.00965	0.00064	0.02989	0.00406
	Fod	0.01872	0.00080	0.03513	0.00278	0.00091	0.00371	0.00738	0.01022	0.00058	0.03086	0.01640
	Che	0.01115	0.00045	0.00278	0.05881	0.00035	0.00292	0.00581	0.00677	0.00043	0.03340	0.00623
	Tra	0.01486	0.00127	0.00509	0.00436	0.00105	0.00537	0.01067	0.01633	0.00101	0.04320	0.01694
	Elec	0.00706	0.00072	0.00226	0.00248	0.01468	0.00469	0.00932	0.01249	0.00081	0.02352	0.00864
	Cem	0.00019	0.00002	0.00007	0.00008	0.00002	0.02733	0.00160	0.00027	0.00002	0.00070	0.00029
	Mnr	0.00061	0.00006	0.00022	0.00026	0.00006	0.00271	0.05814	0.00088	0.00006	0.00227	0.00092
	Iro	0.00139	0.00017	0.00046	0.00059	0.00011	0.00067	0.00133	0.12822	0.00116	0.02039	0.00176
	Met	0.00075	0.00009	0.00025	0.00033	0.00006	0.00038	0.00075	0.00999	0.02236	0.01192	0.00096
	Con	0.00083	0.00006	0.00025	0.00021	0.00008	0.00026	0.00051	0.00147	0.00010	0.00233	0.00140
	Oth	0.02104	0.00171	0.00598	0.00500	0.00146	0.00762	0.01515	0.01702	0.00102	0.53467	0.02289
	Was	0.00132	0.00007	0.00034	0.00038	0.00007	0.00039	0.00078	0.01656	0.00113	0.00594	0.00135
	Ser	0.05516	0.00381	0.01761	0.01440	0.00435	0.01856	0.03690	0.05032	0.00301	0.15847	0.15035
Labor		0.02231	0.00204	0.00851	0.00773	0.00200	0.01042	0.02072	0.02844	0.00159	0.08666	0.04404
Capital		0.08733	0.00454	0.02195	0.01453	0.00568	0.02026	0.04028	0.05648	0.00320	0.15783	0.07451
Household		0.10964	0.00658	0.03046	0.02226	0.00768	0.03068	0.06100	0.08493	0.00478	0.24450	0.11855
Government		0.01288	0.00274	0.00809	0.00583	0.00155	0.00511	0.01016	0.02033	0.00123	0.09879	0.01692
Saving/Investment		0.03508	0.00211	0.00975	0.00712	0.00246	0.00982	0.01952	0.02718	0.00153	0.07823	0.03793
Rest of World		0.03178	0.01272	0.00912	0.03343	0.00314	0.01160	0.02307	0.06377	0.01892	0.23721	0.02380

Table G.7 Multiplier Analysis Results for All Sectors under 60% Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

		Commodities										
	60%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.11973	0.00070	0.01330	0.00255	0.00077	0.00315	0.00626	0.00855	0.00049	0.03252	0.01309
	Min	0.00113	0.00575	0.00036	0.00051	0.00102	0.00182	0.00362	0.00305	0.00020	0.00946	0.00129
	Fod	0.01773	0.00075	0.03327	0.00263	0.00087	0.00351	0.00699	0.00968	0.00055	0.02923	0.01553
	Che	0.00610	0.00025	0.00152	0.03218	0.00019	0.00160	0.00318	0.00370	0.00023	0.01827	0.00341
	Tra	0.01759	0.00150	0.00603	0.00516	0.00124	0.00635	0.01263	0.01933	0.00120	0.05113	0.02005
	Elec	0.00829	0.00085	0.00265	0.00291	0.01724	0.00550	0.01094	0.01467	0.00095	0.02762	0.01015
	Cem	0.00021	0.00002	0.00007	0.00009	0.00002	0.03009	0.00176	0.00030	0.00002	0.00077	0.00032
	Mnr	0.00067	0.00007	0.00024	0.00029	0.00006	0.00299	0.06401	0.00097	0.00006	0.00250	0.00102
	Iro	0.00114	0.00014	0.00038	0.00048	0.00009	0.00055	0.00109	0.10540	0.00095	0.01676	0.00145
	Met	0.00019	0.00002	0.00007	0.00009	0.00002	0.00010	0.00019	0.00257	0.00576	0.00307	0.00025
	Con	0.00098	0.00007	0.00029	0.00025	0.00010	0.00031	0.00061	0.00173	0.00011	0.00275	0.00165
	Oth	0.01382	0.00112	0.00393	0.00328	0.00096	0.00500	0.00995	0.01118	0.00067	0.35111	0.01503
	Was	0.00107	0.00006	0.00028	0.00030	0.00006	0.00032	0.00063	0.01342	0.00092	0.00481	0.00110
	Ser	0.06186	0.00428	0.01975	0.01615	0.00488	0.02081	0.04138	0.05644	0.00337	0.17772	0.16862
Commodities	Agr	0.13204	0.00077	0.01467	0.00281	0.00085	0.00347	0.00690	0.00943	0.00054	0.03586	0.01443
	Min	0.00430	0.02179	0.00135	0.00192	0.00388	0.00690	0.01372	0.01158	0.00077	0.03587	0.00488
	Fod	0.02246	0.00096	0.04215	0.00334	0.00110	0.00445	0.00885	0.01226	0.00070	0.03704	0.01968
	Che	0.01338	0.00054	0.00333	0.07058	0.00043	0.00351	0.00698	0.00812	0.00051	0.04007	0.00748
	Tra	0.01783	0.00152	0.00611	0.00523	0.00126	0.00644	0.01281	0.01959	0.00121	0.05183	0.02032
	Elec	0.00847	0.00086	0.00271	0.00298	0.01761	0.00562	0.01118	0.01499	0.00097	0.02822	0.01037
	Cem	0.00023	0.00002	0.00008	0.00010	0.00002	0.03279	0.00192	0.00032	0.00002	0.00084	0.00034
	Mnr	0.00073	0.00008	0.00026	0.00032	0.00007	0.00325	0.06977	0.00105	0.00007	0.00272	0.00111
	Iro	0.00167	0.00020	0.00056	0.00070	0.00014	0.00080	0.00160	0.15386	0.00139	0.02447	0.00211
	Met	0.00090	0.00011	0.00030	0.00040	0.00007	0.00045	0.00090	0.01198	0.02683	0.01430	0.00115
	Con	0.00100	0.00007	0.00030	0.00026	0.00010	0.00031	0.00062	0.00176	0.00011	0.00280	0.00168
	Oth	0.02525	0.00205	0.00718	0.00600	0.00175	0.00914	0.01818	0.02042	0.00122	0.64160	0.02747
	Was	0.00158	0.00009	0.00041	0.00045	0.00009	0.00047	0.00093	0.01987	0.00136	0.00712	0.00162
	Ser	0.06619	0.00458	0.02114	0.01728	0.00522	0.02227	0.04428	0.06039	0.00361	0.19016	0.18043
Labor		0.02677	0.00245	0.01022	0.00927	0.00240	0.01250	0.02486	0.03413	0.00191	0.10400	0.05285
Capital		0.10480	0.00545	0.02634	0.01744	0.00681	0.02431	0.04834	0.06778	0.00384	0.18940	0.08941
Household		0.13157	0.00790	0.03655	0.02671	0.00921	0.03681	0.07320	0.10191	0.00574	0.29340	0.14226
Government		0.01546	0.00329	0.00971	0.00700	0.00186	0.00613	0.01219	0.02439	0.00147	0.11855	0.02031
Saving/Investment		0.04210	0.00253	0.01170	0.00855	0.00295	0.01178	0.02342	0.03261	0.00184	0.09388	0.04552
Rest of World		0.03813	0.01526	0.01095	0.04012	0.00377	0.01392	0.02768	0.07652	0.02271	0.28465	0.02856

Table G.8 Multiplier Analysis Results for All Sectors under 70% Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

		Commodities										
	70%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.13969	0.00082	0.01552	0.00297	0.00090	0.00367	0.00730	0.00998	0.00057	0.03794	0.01527
	Min	0.00132	0.00671	0.00042	0.00059	0.00119	0.00212	0.00422	0.00356	0.00024	0.01104	0.00150
	Fod	0.02068	0.00088	0.03882	0.00307	0.00101	0.00410	0.00815	0.01129	0.00064	0.03411	0.01812
	Che	0.00712	0.00029	0.00177	0.03754	0.00023	0.00187	0.00371	0.00432	0.00027	0.02132	0.00398
	Tra	0.02052	0.00175	0.00704	0.00602	0.00145	0.00741	0.01474	0.02255	0.00140	0.05965	0.02339
	Elec	0.00967	0.00099	0.00310	0.00340	0.02011	0.00642	0.01277	0.01712	0.00111	0.03223	0.01184
	Cem	0.00025	0.00002	0.00009	0.00010	0.00002	0.03510	0.00205	0.00035	0.00002	0.00090	0.00037
	Mnr	0.00078	0.00008	0.00028	0.00034	0.00007	0.00348	0.07468	0.00113	0.00007	0.00291	0.00119
	Iro	0.00133	0.00016	0.00044	0.00056	0.00011	0.00064	0.00128	0.12296	0.00111	0.01956	0.00169
	Met	0.00022	0.00003	0.00008	0.00010	0.00002	0.00011	0.00022	0.00300	0.00672	0.00358	0.00029
	Con	0.00115	0.00008	0.00034	0.00030	0.00012	0.00036	0.00071	0.00202	0.00013	0.00321	0.00193
	Oth	0.01612	0.00131	0.00458	0.00383	0.00112	0.00584	0.01161	0.01304	0.00078	0.40963	0.01754
	Was	0.00124	0.00007	0.00032	0.00036	0.00007	0.00037	0.00073	0.01565	0.00107	0.00561	0.00128
	Ser	0.07217	0.00499	0.02305	0.01884	0.00569	0.02428	0.04828	0.06584	0.00393	0.20734	0.19672
Commodities	Agr	0.15405	0.00090	0.01712	0.00327	0.00099	0.00405	0.00805	0.01101	0.00063	0.04184	0.01684
	Min	0.00502	0.02543	0.00158	0.00224	0.00452	0.00805	0.01600	0.01350	0.00089	0.04185	0.00569
	Fod	0.02620	0.00111	0.04918	0.00389	0.00128	0.00519	0.01033	0.01430	0.00081	0.04321	0.02296
	Che	0.01561	0.00063	0.00389	0.08234	0.00050	0.00409	0.00814	0.00948	0.00060	0.04675	0.00872
	Tra	0.02080	0.00177	0.00713	0.00610	0.00147	0.00751	0.01494	0.02286	0.00141	0.06047	0.02371
	Elec	0.00988	0.00101	0.00316	0.00347	0.02055	0.00656	0.01304	0.01749	0.00113	0.03293	0.01210
	Cem	0.00027	0.00003	0.00009	0.00011	0.00002	0.03826	0.00224	0.00038	0.00002	0.00098	0.00040
	Mnr	0.00085	0.00009	0.00030	0.00037	0.00008	0.00380	0.08139	0.00123	0.00008	0.00317	0.00129
	Iro	0.00194	0.00023	0.00065	0.00082	0.00016	0.00094	0.00186	0.17951	0.00162	0.02855	0.00247
	Met	0.00105	0.00013	0.00035	0.00046	0.00009	0.00053	0.00105	0.01398	0.03131	0.01668	0.00135
	Con	0.00117	0.00008	0.00035	0.00030	0.00012	0.00036	0.00072	0.00205	0.00013	0.00327	0.00196
	Oth	0.02946	0.00239	0.00838	0.00700	0.00204	0.01067	0.02121	0.02382	0.00142	0.74854	0.03204
	Was	0.00184	0.00010	0.00048	0.00053	0.00010	0.00055	0.00109	0.02318	0.00158	0.00831	0.00190
	Ser	0.07723	0.00534	0.02466	0.02016	0.00609	0.02598	0.05166	0.07045	0.00421	0.22186	0.21050
Labor		0.03123	0.00286	0.01192	0.01082	0.00280	0.01459	0.02901	0.03982	0.00222	0.12133	0.06166
Capital		0.12226	0.00635	0.03073	0.02034	0.00795	0.02836	0.05640	0.07908	0.00448	0.22097	0.10431
Household		0.15349	0.00922	0.04264	0.03116	0.01075	0.04295	0.08540	0.11890	0.00670	0.34230	0.16597
Government		0.01803	0.00384	0.01133	0.00817	0.00217	0.00715	0.01422	0.02846	0.00172	0.13830	0.02369
Saving/Investment		0.04911	0.00295	0.01365	0.00997	0.00344	0.01374	0.02733	0.03805	0.00214	0.10953	0.05311
Rest of World		0.04449	0.01781	0.01277	0.04680	0.00440	0.01624	0.03229	0.08928	0.02649	0.33209	0.03332

Table G.9 Multiplier Analysis Results for All Sectors under 80% Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

		Commodities										
	80%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.15964	0.00094	0.01774	0.00339	0.00103	0.00420	0.00835	0.01141	0.00065	0.04336	0.01745
	Min	0.00151	0.00766	0.00048	0.00068	0.00136	0.00243	0.00482	0.00407	0.00027	0.01261	0.00171
	Fod	0.02364	0.00101	0.04436	0.00351	0.00116	0.00468	0.00932	0.01290	0.00073	0.03898	0.02071
	Che	0.00813	0.00033	0.00203	0.04290	0.00026	0.00213	0.00424	0.00494	0.00031	0.02436	0.00454
	Tra	0.02345	0.00200	0.00804	0.00688	0.00166	0.00847	0.01685	0.02577	0.00160	0.06818	0.02673
	Elec	0.01105	0.00113	0.00354	0.00388	0.02299	0.00734	0.01459	0.01956	0.00126	0.03683	0.01353
	Cem	0.00028	0.00003	0.00010	0.00012	0.00003	0.04012	0.00235	0.00040	0.00003	0.00103	0.00042
	Mnr	0.00089	0.00009	0.00032	0.00039	0.00008	0.00398	0.08535	0.00129	0.00008	0.00333	0.00136
	Iro	0.00152	0.00018	0.00051	0.00064	0.00012	0.00073	0.00146	0.14053	0.00127	0.02235	0.00193
	Met	0.00026	0.00003	0.00009	0.00011	0.00002	0.00013	0.00026	0.00343	0.00768	0.00409	0.00033
	Con	0.00131	0.00009	0.00039	0.00034	0.00013	0.00041	0.00081	0.00231	0.00015	0.00367	0.00221
	Oth	0.01843	0.00150	0.00524	0.00438	0.00128	0.00667	0.01326	0.01490	0.00089	0.46815	0.02004
	Was	0.00142	0.00008	0.00037	0.00041	0.00008	0.00042	0.00084	0.01789	0.00122	0.00641	0.00146
	Ser	0.08248	0.00570	0.02634	0.02153	0.00650	0.02775	0.05518	0.07525	0.00449	0.23696	0.22483
Commodities	Agr	0.17605	0.00103	0.01956	0.00374	0.00113	0.00463	0.00921	0.01258	0.00072	0.04781	0.01925
	Min	0.00574	0.02906	0.00180	0.00256	0.00517	0.00920	0.01829	0.01543	0.00102	0.04783	0.00650
	Fod	0.02995	0.00127	0.05620	0.00445	0.00146	0.00594	0.01180	0.01635	0.00093	0.04938	0.02624
	Che	0.01784	0.00072	0.00444	0.09410	0.00057	0.00468	0.00930	0.01083	0.00068	0.05343	0.00997
	Tra	0.02378	0.00203	0.00815	0.00697	0.00168	0.00859	0.01708	0.02613	0.00162	0.06911	0.02710
	Elec	0.01129	0.00115	0.00362	0.00397	0.02348	0.00750	0.01491	0.01998	0.00129	0.03763	0.01383
	Cem	0.00031	0.00003	0.00011	0.00013	0.00003	0.04372	0.00256	0.00043	0.00003	0.00112	0.00046
	Mnr	0.00097	0.00010	0.00035	0.00042	0.00009	0.00434	0.09302	0.00140	0.00009	0.00363	0.00148
	Iro	0.00222	0.00027	0.00074	0.00094	0.00018	0.00107	0.00213	0.20515	0.00185	0.03263	0.00282
	Met	0.00119	0.00015	0.00041	0.00053	0.00010	0.00060	0.00119	0.01598	0.03578	0.01907	0.00154
	Con	0.00133	0.00009	0.00040	0.00034	0.00013	0.00041	0.00082	0.00235	0.00015	0.00373	0.00224
	Oth	0.03367	0.00273	0.00957	0.00800	0.00234	0.01219	0.02424	0.02723	0.00162	0.85547	0.03662
	Was	0.00211	0.00012	0.00055	0.00060	0.00012	0.00063	0.00124	0.02649	0.00181	0.00950	0.00217
	Ser	0.08826	0.00610	0.02818	0.02304	0.00696	0.02969	0.05904	0.08052	0.00481	0.25355	0.24057
Labor		0.03570	0.00327	0.01362	0.01236	0.00320	0.01667	0.03315	0.04551	0.00254	0.13866	0.07047
Capital		0.13973	0.00726	0.03511	0.02325	0.00908	0.03241	0.06446	0.09037	0.00511	0.25254	0.11921
Household		0.17542	0.01053	0.04874	0.03561	0.01228	0.04908	0.09760	0.13589	0.00766	0.39120	0.18968
Government		0.02061	0.00439	0.01295	0.00933	0.00248	0.00817	0.01625	0.03252	0.00196	0.15806	0.02708
Saving/Investment		0.05613	0.00337	0.01559	0.01139	0.00393	0.01570	0.03123	0.04348	0.00245	0.12517	0.06069
Rest of World		0.05084	0.02035	0.01459	0.05349	0.00503	0.01856	0.03691	0.10203	0.03027	0.37953	0.03807

Table G.10 Multiplier Analysis Results for All Sectors under 90% Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

		Commodities										
	90%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.17960	0.00105	0.01996	0.00382	0.00116	0.00472	0.00939	0.01283	0.00073	0.04878	0.01963
	Min	0.00170	0.00862	0.00053	0.00076	0.00153	0.00273	0.00543	0.00458	0.00030	0.01419	0.00193
	Fod	0.02659	0.00113	0.04991	0.00395	0.00130	0.00527	0.01048	0.01451	0.00083	0.04385	0.02330
	Che	0.00915	0.00037	0.00228	0.04827	0.00029	0.00240	0.00477	0.00556	0.00035	0.02741	0.00511
	Tra	0.02639	0.00225	0.00905	0.00774	0.00186	0.00953	0.01895	0.02899	0.00179	0.07670	0.03007
	Elec	0.01243	0.00127	0.00398	0.00437	0.02586	0.00825	0.01641	0.02201	0.00142	0.04144	0.01522
	Cem	0.00032	0.00003	0.00011	0.00013	0.00003	0.04513	0.00264	0.00044	0.00003	0.00115	0.00047
	Mnr	0.00100	0.00010	0.00036	0.00043	0.00009	0.00448	0.09602	0.00145	0.00009	0.00375	0.00153
	Iro	0.00171	0.00020	0.00057	0.00072	0.00014	0.00083	0.00164	0.15810	0.00143	0.02514	0.00217
	Met	0.00029	0.00004	0.00010	0.00013	0.00002	0.00015	0.00029	0.00386	0.00864	0.00460	0.00037
	Con	0.00148	0.00010	0.00044	0.00038	0.00015	0.00046	0.00091	0.00260	0.00017	0.00413	0.00248
	Oth	0.02073	0.00168	0.00589	0.00492	0.00144	0.00750	0.01492	0.01676	0.00100	0.52667	0.02255
	Was	0.00160	0.00009	0.00042	0.00046	0.00009	0.00048	0.00094	0.02012	0.00137	0.00721	0.00165
	Ser	0.09280	0.00642	0.02963	0.02422	0.00731	0.03122	0.06208	0.08466	0.00506	0.26658	0.25293
Commodities	Agr	0.19806	0.00116	0.02201	0.00421	0.00127	0.00521	0.01036	0.01415	0.00080	0.05379	0.02165
	Min	0.00646	0.03269	0.00203	0.00288	0.00582	0.01035	0.02058	0.01736	0.00115	0.05381	0.00732
	Fod	0.03369	0.00143	0.06323	0.00500	0.00165	0.00668	0.01328	0.01839	0.00105	0.05556	0.02952
	Che	0.02007	0.00081	0.00500	0.10586	0.00064	0.00526	0.01047	0.01219	0.00077	0.06011	0.01121
	Tra	0.02675	0.00228	0.00917	0.00784	0.00189	0.00966	0.01921	0.02939	0.00182	0.07775	0.03049
	Elec	0.01270	0.00130	0.00407	0.00446	0.02642	0.00843	0.01677	0.02248	0.00145	0.04233	0.01555
	Cem	0.00035	0.00003	0.00012	0.00014	0.00003	0.04919	0.00288	0.00048	0.00003	0.00126	0.00052
	Mnr	0.00109	0.00011	0.00039	0.00047	0.00010	0.00488	0.10465	0.00158	0.00010	0.00408	0.00166
	Iro	0.00250	0.00030	0.00083	0.00106	0.00021	0.00121	0.00240	0.23079	0.00208	0.03670	0.00317
	Met	0.00134	0.00017	0.00046	0.00060	0.00011	0.00068	0.00134	0.01798	0.04025	0.02145	0.00173
	Con	0.00150	0.00010	0.00045	0.00039	0.00015	0.00047	0.00093	0.00264	0.00017	0.00420	0.00252
	Oth	0.03788	0.00308	0.01077	0.00900	0.00263	0.01371	0.02727	0.03063	0.00183	0.96241	0.04120
	Was	0.00237	0.00013	0.00062	0.00068	0.00013	0.00070	0.00140	0.02981	0.00204	0.01068	0.00244
	Ser	0.09929	0.00687	0.03171	0.02591	0.00783	0.03340	0.06642	0.09058	0.00541	0.28524	0.27064
Labor		0.04016	0.00368	0.01533	0.01391	0.00360	0.01875	0.03729	0.05120	0.00286	0.15599	0.07928
Capital		0.15719	0.00817	0.03950	0.02616	0.01022	0.03646	0.07251	0.10167	0.00575	0.28410	0.13411
Household		0.19735	0.01185	0.05483	0.04006	0.01382	0.05522	0.10980	0.15287	0.00861	0.44010	0.21340
Government		0.02319	0.00494	0.01457	0.01050	0.00279	0.00920	0.01829	0.03659	0.00221	0.17782	0.03046
Saving/Investment		0.06315	0.00379	0.01754	0.01282	0.00442	0.01767	0.03513	0.04892	0.00276	0.14082	0.06828
Rest of World		0.05720	0.02289	0.01642	0.06017	0.00566	0.02088	0.04152	0.11479	0.03406	0.42698	0.04283

Table G.11 Multiplier Analysis Results for All Sectors under 100% Difference in Demand Response Based on Free Allocation of Allowances in CP_1 Simulation

		Commodities										
	100%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.19955	0.00117	0.02217	0.00424	0.00128	0.00525	0.01043	0.01426	0.00081	0.05420	0.02182
	Min	0.00189	0.00958	0.00059	0.00084	0.00170	0.00303	0.00603	0.00509	0.00034	0.01577	0.00214
	Fod	0.02954	0.00126	0.05545	0.00439	0.00144	0.00586	0.01165	0.01613	0.00092	0.04872	0.02589
	Che	0.01017	0.00041	0.00253	0.05363	0.00032	0.00267	0.00530	0.00617	0.00039	0.03045	0.00568
	Tra	0.02932	0.00250	0.01005	0.00859	0.00207	0.01059	0.02106	0.03222	0.00199	0.08522	0.03341
	Elec	0.01381	0.00141	0.00442	0.00486	0.02873	0.00917	0.01824	0.02445	0.00158	0.04604	0.01692
	Cem	0.00035	0.00004	0.00012	0.00015	0.00003	0.05015	0.00293	0.00049	0.00003	0.00128	0.00053
	Mnr	0.00111	0.00012	0.00040	0.00048	0.00010	0.00498	0.10668	0.00161	0.00010	0.00416	0.00169
	Iro	0.00190	0.00023	0.00063	0.00080	0.00016	0.00092	0.00182	0.17566	0.00158	0.02794	0.00241
	Met	0.00032	0.00004	0.00011	0.00014	0.00003	0.00016	0.00032	0.00429	0.00960	0.00512	0.00041
	Con	0.00164	0.00011	0.00049	0.00042	0.00016	0.00051	0.00101	0.00289	0.00019	0.00459	0.00276
	Oth	0.02303	0.00187	0.00655	0.00547	0.00160	0.00834	0.01658	0.01863	0.00111	0.58519	0.02505
	Was	0.00178	0.00010	0.00046	0.00051	0.00010	0.00053	0.00105	0.02236	0.00153	0.00801	0.00183
	Ser	0.10311	0.00713	0.03292	0.02691	0.00813	0.03468	0.06897	0.09406	0.00562	0.29620	0.28103
Commodities	Agr	0.22007	0.00129	0.02445	0.00468	0.00142	0.00579	0.01151	0.01572	0.00089	0.05977	0.02406
	Min	0.00717	0.03632	0.00225	0.00320	0.00646	0.01150	0.02286	0.01929	0.00128	0.05978	0.00813
	Fod	0.03743	0.00159	0.07025	0.00556	0.00183	0.00742	0.01475	0.02043	0.00116	0.06173	0.03280
	Che	0.02230	0.00090	0.00555	0.11763	0.00071	0.00585	0.01163	0.01354	0.00085	0.06679	0.01246
	Tra	0.02972	0.00253	0.01019	0.00871	0.00210	0.01073	0.02135	0.03266	0.00202	0.08639	0.03387
	Elec	0.01411	0.00144	0.00452	0.00496	0.02936	0.00937	0.01863	0.02498	0.00161	0.04704	0.01728
	Cem	0.00038	0.00004	0.00014	0.00016	0.00004	0.05466	0.00320	0.00054	0.00003	0.00140	0.00057
	Mnr	0.00121	0.00013	0.00043	0.00053	0.00011	0.00542	0.11628	0.00176	0.00011	0.00454	0.00185
	Iro	0.00278	0.00033	0.00093	0.00117	0.00023	0.00134	0.00266	0.25644	0.00231	0.04078	0.00352
	Met	0.00149	0.00019	0.00051	0.00066	0.00012	0.00075	0.00149	0.01997	0.04472	0.02383	0.00192
	Con	0.00167	0.00011	0.00050	0.00043	0.00017	0.00052	0.00103	0.00293	0.00019	0.00466	0.00280
	Oth	0.04209	0.00342	0.01197	0.01000	0.00292	0.01524	0.03030	0.03403	0.00203	1.06934	0.04578
	Was	0.00263	0.00015	0.00069	0.00075	0.00015	0.00078	0.00155	0.03312	0.00226	0.01187	0.00271
	Ser	0.11032	0.00763	0.03523	0.02879	0.00869	0.03711	0.07380	0.10065	0.00601	0.31694	0.30071
Labor		0.04462	0.00409	0.01703	0.01545	0.00400	0.02084	0.04144	0.05689	0.00318	0.17333	0.08809
Capital		0.17466	0.00908	0.04389	0.02906	0.01136	0.04051	0.08057	0.11297	0.00639	0.31567	0.14902
Household		0.21928	0.01317	0.06092	0.04451	0.01536	0.06135	0.12200	0.16986	0.00957	0.48900	0.23711
Government		0.02576	0.00549	0.01618	0.01167	0.00309	0.01022	0.02032	0.04065	0.00245	0.19758	0.03385
Saving/Investment		0.07016	0.00421	0.01949	0.01424	0.00491	0.01963	0.03904	0.05435	0.00306	0.15647	0.07587
Rest of World		0.06355	0.02544	0.01824	0.06686	0.00628	0.02320	0.04614	0.12754	0.03784	0.47442	0.04759

G.2 CP_2 Simulation

Table G.12 Sectoral Carbon Costs Under Difference in Demand Response Based on Free Allocation of Allowances for CP_2 Simulation

	Carbon Costs (€ billion) under Different Elasticies for CP_2 Simulation								
	10%	20%	30%	40%	50%	70%	80%	90%	100%
Agr	0.026	0.051	0.077	0.102	0.128	0.179	0.204	0.230	0.255
Min	0.006	0.011	0.017	0.022	0.028	0.039	0.045	0.051	0.056
Fod	0.009	0.017	0.026	0.035	0.043	0.060	0.069	0.078	0.086
Che	0.015	0.030	0.045	0.059	0.074	0.104	0.119	0.134	0.148
Elec	0.002	0.005	0.007	0.009	0.011	0.016	0.018	0.021	0.023
Cem	0.008	0.017	0.025	0.034	0.042	0.059	0.068	0.076	0.085
Mnr	0.017	0.034	0.051	0.068	0.084	0.118	0.135	0.152	0.169
Iro	0.036	0.071	0.107	0.142	0.178	0.249	0.285	0.320	0.356
Met	0.007	0.014	0.021	0.028	0.035	0.049	0.056	0.062	0.069
Con	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oth	0.133	0.265	0.398	0.530	0.663	0.928	1.060	1.193	1.326
Ser	0.025	0.050	0.076	0.101	0.126	0.176	0.201	0.227	0.252

Table G.13 Multiplier Analysis Results for All Sectors under 10% Difference in Demand Response Based on Free Allocation of Allowances in CP_2 Simulation

		Commodities										
	10%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.03193	0.00019	0.00355	0.00068	0.00021	0.00084	0.00167	0.00228	0.00013	0.00867	0.00349
	Min	0.00030	0.00153	0.00010	0.00014	0.00027	0.00049	0.00096	0.00081	0.00005	0.00252	0.00034
	Fod	0.00473	0.00020	0.00887	0.00070	0.00023	0.00094	0.00186	0.00258	0.00015	0.00780	0.00414
	Che	0.00163	0.00007	0.00041	0.00858	0.00005	0.00043	0.00085	0.00099	0.00006	0.00487	0.00091
	Tra	0.00469	0.00040	0.00161	0.00138	0.00033	0.00169	0.00337	0.00515	0.00032	0.01364	0.00535
	Elec	0.00221	0.00023	0.00071	0.00078	0.00460	0.00147	0.00292	0.00391	0.00025	0.00737	0.00271
	Cem	0.00006	0.00001	0.00002	0.00002	0.00001	0.00802	0.00047	0.00008	0.00001	0.00021	0.00008
	Mnr	0.00018	0.00002	0.00006	0.00008	0.00002	0.00080	0.01707	0.00026	0.00002	0.00067	0.00027
	Iro	0.00030	0.00004	0.00010	0.00013	0.00002	0.00015	0.00029	0.02811	0.00025	0.00447	0.00039
	Met	0.00005	0.00001	0.00002	0.00002	0.00000	0.00003	0.00005	0.00069	0.00154	0.00082	0.00007
	Con	0.00026	0.00002	0.00008	0.00007	0.00003	0.00008	0.00016	0.00046	0.00003	0.00073	0.00044
	Oth	0.00369	0.00030	0.00105	0.00088	0.00026	0.00133	0.00265	0.00298	0.00018	0.09363	0.00401
	Was	0.00028	0.00002	0.00007	0.00008	0.00002	0.00008	0.00017	0.00358	0.00024	0.00128	0.00029
	Ser	0.01650	0.00114	0.00527	0.00431	0.00130	0.00555	0.01104	0.01505	0.00090	0.04739	0.04497
Commodities	Agr	0.03521	0.00021	0.00391	0.00075	0.00023	0.00093	0.00184	0.00252	0.00014	0.00956	0.00385
	Min	0.00115	0.00581	0.00036	0.00051	0.00103	0.00184	0.00366	0.00309	0.00020	0.00957	0.00130
	Fod	0.00599	0.00025	0.01124	0.00089	0.00029	0.00119	0.00236	0.00327	0.00019	0.00988	0.00525
	Che	0.00357	0.00014	0.00089	0.01882	0.00011	0.00094	0.00186	0.00217	0.00014	0.01069	0.00199
	Tra	0.00476	0.00041	0.00163	0.00139	0.00034	0.00172	0.00342	0.00523	0.00032	0.01382	0.00542
	Elec	0.00226	0.00023	0.00072	0.00079	0.00470	0.00150	0.00298	0.00400	0.00026	0.00753	0.00277
	Cem	0.00006	0.00001	0.00002	0.00003	0.00001	0.00874	0.00051	0.00009	0.00001	0.00022	0.00009
	Mnr	0.00019	0.00002	0.00007	0.00008	0.00002	0.00087	0.01860	0.00028	0.00002	0.00073	0.00030
	Iro	0.00044	0.00005	0.00015	0.00019	0.00004	0.00021	0.00043	0.04103	0.00037	0.00653	0.00056
	Met	0.00024	0.00003	0.00008	0.00011	0.00002	0.00012	0.00024	0.00320	0.00716	0.00381	0.00031
	Con	0.00027	0.00002	0.00008	0.00007	0.00003	0.00008	0.00016	0.00047	0.00003	0.00075	0.00045
	Oth	0.00673	0.00055	0.00191	0.00160	0.00047	0.00244	0.00485	0.00545	0.00032	0.17109	0.00732
	Was	0.00042	0.00002	0.00011	0.00012	0.00002	0.00013	0.00025	0.00530	0.00036	0.00190	0.00043
	Ser	0.01765	0.00122	0.00564	0.00461	0.00139	0.00594	0.01181	0.01610	0.00096	0.05071	0.04811
Labor		0.00714	0.00065	0.00272	0.00247	0.00064	0.00333	0.00663	0.00910	0.00051	0.02773	0.01409
Capital		0.02795	0.00145	0.00702	0.00465	0.00182	0.00648	0.01289	0.01807	0.00102	0.05051	0.02384
Household		0.03508	0.00211	0.00975	0.00712	0.00246	0.00982	0.01952	0.02718	0.00153	0.07824	0.03794
Government		0.00412	0.00088	0.00259	0.00187	0.00050	0.00163	0.00325	0.00650	0.00039	0.03161	0.00542
Saving/Investment		0.01123	0.00067	0.00312	0.00228	0.00079	0.00314	0.00625	0.00870	0.00049	0.02503	0.01214
Rest of World		0.01017	0.00407	0.00292	0.01070	0.00101	0.00371	0.00738	0.02041	0.00605	0.07591	0.00761

Table G.14 Multiplier Analysis Results for All Sectors under 20% Difference in Demand Response Based on Free Allocation of Allowances in CP_2 Simulation

		Commodities									
	20%	Agr	Min	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.06386	0.00037	0.00136	0.00041	0.00168	0.00334	0.00456	0.00026	0.01734	0.00698
	Min	0.00061	0.00307	0.00027	0.00055	0.00097	0.00193	0.00163	0.00011	0.00504	0.00069
	Fod	0.00945	0.00040	0.00140	0.00046	0.00187	0.00373	0.00516	0.00029	0.01559	0.00828
	Che	0.00325	0.00013	0.01716	0.00010	0.00085	0.00170	0.00198	0.00012	0.00974	0.00182
	Tra	0.00938	0.00080	0.00275	0.00066	0.00339	0.00674	0.01031	0.00064	0.02727	0.01069
	Elec	0.00442	0.00045	0.00155	0.00919	0.00293	0.00584	0.00782	0.00051	0.01473	0.00541
	Cem	0.00011	0.00001	0.00005	0.00001	0.01605	0.00094	0.00016	0.00001	0.00041	0.00017
	Mnr	0.00036	0.00004	0.00015	0.00003	0.00159	0.03414	0.00052	0.00003	0.00133	0.00054
	Iro	0.00061	0.00007	0.00026	0.00005	0.00029	0.00058	0.05621	0.00051	0.00894	0.00077
	Met	0.00010	0.00001	0.00005	0.00001	0.00005	0.00010	0.00137	0.00307	0.00164	0.00013
	Con	0.00052	0.00004	0.00013	0.00005	0.00016	0.00032	0.00092	0.00006	0.00147	0.00088
	Oth	0.00737	0.00060	0.00175	0.00051	0.00267	0.00531	0.00596	0.00036	0.18726	0.00802
	Was	0.00057	0.00003	0.00016	0.00003	0.00017	0.00034	0.00716	0.00049	0.00256	0.00058
	Ser	0.03299	0.00228	0.00861	0.00260	0.01110	0.02207	0.03010	0.00180	0.09478	0.08993
Commodities	Agr	0.07042	0.00041	0.00150	0.00045	0.00185	0.00368	0.00503	0.00029	0.01913	0.00770
	Min	0.00230	0.01162	0.00102	0.00207	0.00368	0.00732	0.00617	0.00041	0.01913	0.00260
	Fod	0.01198	0.00051	0.00178	0.00059	0.00237	0.00472	0.00654	0.00037	0.01975	0.01050
	Che	0.00714	0.00029	0.03764	0.00023	0.00187	0.00372	0.00433	0.00027	0.02137	0.00399
	Tra	0.00951	0.00081	0.00279	0.00067	0.00344	0.00683	0.01045	0.00065	0.02765	0.01084
	Elec	0.00452	0.00046	0.00159	0.00939	0.00300	0.00596	0.00799	0.00052	0.01505	0.00553
	Cem	0.00012	0.00001	0.00005	0.00001	0.01749	0.00102	0.00017	0.00001	0.00045	0.00018
	Mnr	0.00039	0.00004	0.00017	0.00004	0.00174	0.03721	0.00056	0.00004	0.00145	0.00059
	Iro	0.00089	0.00011	0.00038	0.00007	0.00043	0.00085	0.08206	0.00074	0.01305	0.00113
	Met	0.00048	0.00006	0.00021	0.00004	0.00024	0.00048	0.00639	0.01431	0.00763	0.00062
	Con	0.00053	0.00004	0.00014	0.00005	0.00017	0.00033	0.00094	0.00006	0.00149	0.00090
	Oth	0.01347	0.00109	0.00320	0.00093	0.00488	0.00970	0.01089	0.00065	0.34219	0.01465
	Was	0.00084	0.00005	0.00024	0.00005	0.00025	0.00050	0.01060	0.00072	0.00380	0.00087
	Ser	0.03530	0.00244	0.00921	0.00278	0.01188	0.02362	0.03221	0.00192	0.10142	0.09623
Labor		0.01428	0.00131	0.00494	0.00128	0.00667	0.01326	0.01820	0.00102	0.05546	0.02819
Capital		0.05589	0.00290	0.00930	0.00363	0.01296	0.02578	0.03615	0.00205	0.10101	0.04769
Household		0.07017	0.00421	0.01424	0.00491	0.01963	0.03904	0.05435	0.00306	0.15648	0.07587
Government		0.00824	0.00176	0.00373	0.00099	0.00327	0.00650	0.01301	0.00079	0.06322	0.01083
Saving/Investment		0.02245	0.00135	0.00456	0.00157	0.00628	0.01249	0.01739	0.00098	0.05007	0.02428
Rest of World		0.02034	0.00814	0.02140	0.00201	0.00742	0.01476	0.04081	0.01211	0.15181	0.01523

Table G.15 Multiplier Analysis Results for All Sectors under 30% Difference in Demand Response Based on Free Allocation of Allowances in CP_2 Simulation

		Commodities										
	30%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.09578	0.00056	0.01064	0.00204	0.00062	0.00252	0.00501	0.00684	0.00039	0.02601	0.01047
	Min	0.00091	0.00460	0.00029	0.00041	0.00082	0.00146	0.00289	0.00244	0.00016	0.00757	0.00103
	Fod	0.01418	0.00060	0.02662	0.00211	0.00069	0.00281	0.00559	0.00774	0.00044	0.02339	0.01243
	Che	0.00488	0.00020	0.00122	0.02574	0.00016	0.00128	0.00255	0.00296	0.00019	0.01462	0.00273
	Tra	0.01407	0.00120	0.00482	0.00413	0.00099	0.00508	0.01011	0.01546	0.00096	0.04091	0.01604
	Elec	0.00663	0.00068	0.00212	0.00233	0.01379	0.00440	0.00875	0.01174	0.00076	0.02210	0.00812
	Cem	0.00017	0.00002	0.00006	0.00007	0.00002	0.02407	0.00141	0.00024	0.00002	0.00062	0.00025
	Mnr	0.00053	0.00006	0.00019	0.00023	0.00005	0.00239	0.05121	0.00077	0.00005	0.00200	0.00081
	Iro	0.00091	0.00011	0.00030	0.00039	0.00007	0.00044	0.00088	0.08432	0.00076	0.01341	0.00116
	Met	0.00015	0.00002	0.00005	0.00007	0.00001	0.00008	0.00015	0.00206	0.00461	0.00246	0.00020
	Con	0.00079	0.00005	0.00024	0.00020	0.00008	0.00024	0.00049	0.00139	0.00009	0.00220	0.00132
	Oth	0.01106	0.00090	0.00314	0.00263	0.00077	0.00400	0.00796	0.00894	0.00053	0.28089	0.01202
	Was	0.00085	0.00005	0.00022	0.00024	0.00005	0.00025	0.00050	0.01073	0.00073	0.00385	0.00088
	Ser	0.04949	0.00342	0.01580	0.01292	0.00390	0.01665	0.03311	0.04515	0.00270	0.14218	0.13490
Commodities	Agr	0.10563	0.00062	0.01174	0.00225	0.00068	0.00278	0.00552	0.00755	0.00043	0.02869	0.01155
	Min	0.00344	0.01744	0.00108	0.00154	0.00310	0.00552	0.01097	0.00926	0.00061	0.02870	0.00390
	Fod	0.01797	0.00076	0.03372	0.00267	0.00088	0.00356	0.00708	0.00981	0.00056	0.02963	0.01574
	Che	0.01070	0.00043	0.00267	0.05646	0.00034	0.00281	0.00558	0.00650	0.00041	0.03206	0.00598
	Tra	0.01427	0.00122	0.00489	0.00418	0.00101	0.00515	0.01025	0.01568	0.00097	0.04147	0.01626
	Elec	0.00677	0.00069	0.00217	0.00238	0.01409	0.00450	0.00894	0.01199	0.00078	0.02258	0.00830
	Cem	0.00018	0.00002	0.00006	0.00008	0.00002	0.02623	0.00153	0.00026	0.00002	0.00067	0.00028
	Mnr	0.00058	0.00006	0.00021	0.00025	0.00005	0.00260	0.05581	0.00084	0.00005	0.00218	0.00089
	Iro	0.00133	0.00016	0.00044	0.00056	0.00011	0.00064	0.00128	0.12309	0.00111	0.01958	0.00169
	Met	0.00072	0.00009	0.00024	0.00032	0.00006	0.00036	0.00072	0.00959	0.02147	0.01144	0.00092
	Con	0.00080	0.00005	0.00024	0.00021	0.00008	0.00025	0.00049	0.00141	0.00009	0.00224	0.00135
	Oth	0.02020	0.00164	0.00574	0.00480	0.00140	0.00731	0.01454	0.01634	0.00097	0.51328	0.02197
	Was	0.00126	0.00007	0.00033	0.00036	0.00007	0.00038	0.00075	0.01590	0.00109	0.00570	0.00130
	Ser	0.05296	0.00366	0.01691	0.01382	0.00417	0.01781	0.03543	0.04831	0.00289	0.15213	0.14434
Labor		0.02142	0.00196	0.00817	0.00742	0.00192	0.01000	0.01989	0.02731	0.00152	0.08320	0.04228
Capital		0.08384	0.00436	0.02107	0.01395	0.00545	0.01945	0.03867	0.05422	0.00307	0.15152	0.07153
Household		0.10525	0.00632	0.02924	0.02137	0.00737	0.02945	0.05856	0.08153	0.00459	0.23472	0.11381
Government		0.01237	0.00263	0.00777	0.00560	0.00149	0.00490	0.00975	0.01951	0.00118	0.09484	0.01625
Saving/Investment		0.03368	0.00202	0.00936	0.00684	0.00236	0.00942	0.01874	0.02609	0.00147	0.07510	0.03642
Rest of World		0.03051	0.01221	0.00876	0.03209	0.00302	0.01114	0.02214	0.06122	0.01816	0.22772	0.02284

Table G.16 Multiplier Analysis Results for All Sectors under 40% Difference in Demand Response Based on Free Allocation of Allowances in CP_2 Simulation

		Commodities										
	40%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.12771	0.00075	0.01419	0.00271	0.00082	0.00336	0.00668	0.00912	0.00052	0.03468	0.01396
	Min	0.00121	0.00613	0.00038	0.00054	0.00109	0.00194	0.00386	0.00326	0.00022	0.01009	0.00137
	Fod	0.01891	0.00080	0.03549	0.00281	0.00092	0.00375	0.00745	0.01032	0.00059	0.03118	0.01657
	Che	0.00651	0.00026	0.00162	0.03432	0.00021	0.00171	0.00339	0.00395	0.00025	0.01949	0.00364
	Tra	0.01876	0.00160	0.00643	0.00550	0.00133	0.00678	0.01348	0.02062	0.00128	0.05454	0.02139
	Elec	0.00884	0.00090	0.00283	0.00311	0.01839	0.00587	0.01167	0.01565	0.00101	0.02947	0.01083
	Cem	0.00023	0.00002	0.00008	0.00009	0.00002	0.03209	0.00188	0.00032	0.00002	0.00082	0.00034
	Mnr	0.00071	0.00007	0.00025	0.00031	0.00007	0.00318	0.06828	0.00103	0.00007	0.00266	0.00108
	Iro	0.00122	0.00015	0.00041	0.00051	0.00010	0.00059	0.00117	0.11242	0.00101	0.01788	0.00154
	Met	0.00021	0.00003	0.00007	0.00009	0.00002	0.00010	0.00021	0.00274	0.00614	0.00327	0.00026
	Con	0.00105	0.00007	0.00031	0.00027	0.00011	0.00033	0.00065	0.00185	0.00012	0.00294	0.00176
	Oth	0.01474	0.00120	0.00419	0.00350	0.00102	0.00534	0.01061	0.01192	0.00071	0.37452	0.01603
	Was	0.00114	0.00006	0.00030	0.00032	0.00006	0.00034	0.00067	0.01431	0.00098	0.00513	0.00117
	Ser	0.06599	0.00456	0.02107	0.01722	0.00520	0.02220	0.04414	0.06020	0.00360	0.18957	0.17986
Commodities	Agr	0.14084	0.00083	0.01565	0.00299	0.00091	0.00370	0.00736	0.01006	0.00057	0.03825	0.01540
	Min	0.00459	0.02325	0.00144	0.00205	0.00414	0.00736	0.01463	0.01235	0.00082	0.03826	0.00520
	Fod	0.02396	0.00102	0.04496	0.00356	0.00117	0.00475	0.00944	0.01308	0.00074	0.03951	0.02099
	Che	0.01427	0.00058	0.00355	0.07528	0.00045	0.00374	0.00744	0.00867	0.00055	0.04275	0.00797
	Tra	0.01902	0.00162	0.00652	0.00558	0.00134	0.00687	0.01366	0.02090	0.00129	0.05529	0.02168
	Elec	0.00903	0.00092	0.00289	0.00317	0.01879	0.00600	0.01193	0.01599	0.00103	0.03010	0.01106
	Cem	0.00025	0.00002	0.00009	0.00010	0.00002	0.03498	0.00205	0.00034	0.00002	0.00089	0.00037
	Mnr	0.00078	0.00008	0.00028	0.00034	0.00007	0.00347	0.07442	0.00112	0.00007	0.00290	0.00118
	Iro	0.00178	0.00021	0.00059	0.00075	0.00015	0.00086	0.00170	0.16412	0.00148	0.02610	0.00225
	Met	0.00096	0.00012	0.00032	0.00043	0.00008	0.00048	0.00096	0.01278	0.02862	0.01525	0.00123
	Con	0.00107	0.00007	0.00032	0.00027	0.00011	0.00033	0.00066	0.00188	0.00012	0.00299	0.00179
	Oth	0.02694	0.00219	0.00766	0.00640	0.00187	0.00975	0.01939	0.02178	0.00130	0.68438	0.02930
	Was	0.00169	0.00010	0.00044	0.00048	0.00009	0.00050	0.00100	0.02120	0.00145	0.00760	0.00173
	Ser	0.07061	0.00488	0.02255	0.01843	0.00556	0.02375	0.04723	0.06442	0.00385	0.20284	0.19245
Labor		0.02856	0.00262	0.01090	0.00989	0.00256	0.01334	0.02652	0.03641	0.00203	0.11093	0.05638
Capital		0.11178	0.00581	0.02809	0.01860	0.00727	0.02593	0.05156	0.07230	0.00409	0.20203	0.09537
Household		0.14034	0.00843	0.03899	0.02849	0.00983	0.03926	0.07808	0.10871	0.00612	0.31296	0.15175
Government		0.01649	0.00351	0.01036	0.00747	0.00198	0.00654	0.01300	0.02602	0.00157	0.12645	0.02166
Saving/Investment		0.04490	0.00270	0.01248	0.00912	0.00314	0.01256	0.02498	0.03478	0.00196	0.10014	0.04856
Rest of World		0.04067	0.01628	0.01168	0.04279	0.00402	0.01485	0.02953	0.08163	0.02422	0.30363	0.03046

Table G.17 Multiplier Analysis Results for All Sectors under 50% Difference in Demand Response Based on Free Allocation of Allowances in CP_2 Simulation

		Commodities										
	50%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.15964	0.00094	0.01774	0.00339	0.00103	0.00420	0.00835	0.01141	0.00065	0.04336	0.01745
	Min	0.00151	0.00766	0.00048	0.00068	0.00136	0.00243	0.00482	0.00407	0.00027	0.01261	0.00171
	Fod	0.02364	0.00101	0.04436	0.00351	0.00116	0.00468	0.00932	0.01290	0.00073	0.03898	0.02071
	Che	0.00813	0.00033	0.00203	0.04290	0.00026	0.00213	0.00424	0.00494	0.00031	0.02436	0.00454
	Tra	0.02345	0.00200	0.00804	0.00688	0.00166	0.00847	0.01685	0.02577	0.00160	0.06818	0.02673
	Elec	0.01105	0.00113	0.00354	0.00388	0.02299	0.00734	0.01459	0.01956	0.00126	0.03683	0.01353
	Cem	0.00028	0.00003	0.00010	0.00012	0.00003	0.04012	0.00235	0.00040	0.00003	0.00103	0.00042
	Mnr	0.00089	0.00009	0.00032	0.00039	0.00008	0.00398	0.08535	0.00129	0.00008	0.00333	0.00136
	Iro	0.00152	0.00018	0.00051	0.00064	0.00012	0.00073	0.00146	0.14053	0.00127	0.02235	0.00193
	Met	0.00026	0.00003	0.00009	0.00011	0.00002	0.00013	0.00026	0.00343	0.00768	0.00409	0.00033
	Con	0.00131	0.00009	0.00039	0.00034	0.00013	0.00041	0.00081	0.00231	0.00015	0.00367	0.00221
	Oth	0.01843	0.00150	0.00524	0.00438	0.00128	0.00667	0.01326	0.01490	0.00089	0.46815	0.02004
	Was	0.00142	0.00008	0.00037	0.00041	0.00008	0.00042	0.00084	0.01789	0.00122	0.00641	0.00146
	Ser	0.08248	0.00570	0.02634	0.02153	0.00650	0.02775	0.05518	0.07525	0.00449	0.23696	0.22483
Commodities	Agr	0.17605	0.00103	0.01956	0.00374	0.00113	0.00463	0.00921	0.01258	0.00072	0.04781	0.01925
	Min	0.00574	0.02906	0.00180	0.00256	0.00517	0.00920	0.01829	0.01543	0.00102	0.04783	0.00650
	Fod	0.02995	0.00127	0.05620	0.00445	0.00146	0.00594	0.01180	0.01635	0.00093	0.04938	0.02624
	Che	0.01784	0.00072	0.00444	0.09410	0.00057	0.00468	0.00930	0.01083	0.00068	0.05343	0.00997
	Tra	0.02378	0.00203	0.00815	0.00697	0.00168	0.00859	0.01708	0.02613	0.00162	0.06911	0.02710
	Elec	0.01129	0.00115	0.00362	0.00397	0.02348	0.00750	0.01491	0.01998	0.00129	0.03763	0.01383
	Cem	0.00031	0.00003	0.00011	0.00013	0.00003	0.04372	0.00256	0.00043	0.00003	0.00112	0.00046
	Mnr	0.00097	0.00010	0.00035	0.00042	0.00009	0.00434	0.09302	0.00140	0.00009	0.00363	0.00148
	Iro	0.00222	0.00027	0.00074	0.00094	0.00018	0.00107	0.00213	0.20515	0.00185	0.03263	0.00282
	Met	0.00119	0.00015	0.00041	0.00053	0.00010	0.00060	0.00119	0.01598	0.03578	0.01907	0.00154
	Con	0.00133	0.00009	0.00040	0.00034	0.00013	0.00041	0.00082	0.00235	0.00015	0.00373	0.00224
	Oth	0.03367	0.00273	0.00957	0.00800	0.00234	0.01219	0.02424	0.02723	0.00162	0.85547	0.03662
	Was	0.00211	0.00012	0.00055	0.00060	0.00012	0.00063	0.00124	0.02649	0.00181	0.00950	0.00217
	Ser	0.08826	0.00610	0.02818	0.02304	0.00696	0.02969	0.05904	0.08052	0.00481	0.25355	0.24057
Labor		0.03570	0.00327	0.01362	0.01236	0.00320	0.01667	0.03315	0.04551	0.00254	0.13866	0.07047
Capital		0.13973	0.00726	0.03511	0.02325	0.00908	0.03241	0.06446	0.09037	0.00511	0.25254	0.11921
Household		0.17542	0.01053	0.04874	0.03561	0.01228	0.04908	0.09760	0.13589	0.00766	0.39120	0.18968
Government		0.02061	0.00439	0.01295	0.00933	0.00248	0.00817	0.01625	0.03252	0.00196	0.15806	0.02708
Saving/Investment		0.05613	0.00337	0.01559	0.01139	0.00393	0.01570	0.03123	0.04348	0.00245	0.12517	0.06069
Rest of World		0.05084	0.02035	0.01459	0.05349	0.00503	0.01856	0.03691	0.10203	0.03027	0.37953	0.03807

Table G.18 Multiplier Analysis Results for All Sectors under 60% Difference in Demand Response Based on Free Allocation of Allowances in CP_2 Simulation

		Commodities										
	60%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.19157	0.00112	0.02129	0.00407	0.00123	0.00504	0.01002	0.01369	0.00078	0.05203	0.02094
	Min	0.00182	0.00920	0.00057	0.00081	0.00164	0.00291	0.00579	0.00488	0.00032	0.01513	0.00206
	Fod	0.02836	0.00121	0.05323	0.00421	0.00139	0.00562	0.01118	0.01548	0.00088	0.04677	0.02485
	Che	0.00976	0.00039	0.00243	0.05148	0.00031	0.00256	0.00509	0.00593	0.00037	0.02923	0.00545
	Tra	0.02815	0.00240	0.00965	0.00825	0.00199	0.01017	0.02022	0.03093	0.00191	0.08181	0.03208
	Elec	0.01326	0.00135	0.00425	0.00466	0.02758	0.00880	0.01751	0.02347	0.00152	0.04420	0.01624
	Cem	0.00034	0.00003	0.00012	0.00014	0.00003	0.04814	0.00282	0.00047	0.00003	0.00123	0.00051
	Mnr	0.00107	0.00011	0.00038	0.00046	0.00010	0.00478	0.10242	0.00155	0.00010	0.00399	0.00163
	Iro	0.00183	0.00022	0.00061	0.00077	0.00015	0.00088	0.00175	0.16864	0.00152	0.02682	0.00232
	Met	0.00031	0.00004	0.00010	0.00014	0.00003	0.00015	0.00031	0.00412	0.00922	0.00491	0.00040
	Con	0.00157	0.00011	0.00047	0.00040	0.00016	0.00049	0.00097	0.00277	0.00018	0.00440	0.00265
	Oth	0.02211	0.00180	0.00629	0.00525	0.00153	0.00800	0.01592	0.01788	0.00107	0.56178	0.02405
	Was	0.00171	0.00010	0.00045	0.00049	0.00010	0.00051	0.00101	0.02147	0.00147	0.00769	0.00175
	Ser	0.09898	0.00684	0.03161	0.02583	0.00780	0.03330	0.06621	0.09030	0.00539	0.28435	0.26979
Commodities	Agr	0.21126	0.00124	0.02348	0.00449	0.00136	0.00555	0.01105	0.01509	0.00086	0.05738	0.02310
	Min	0.00689	0.03487	0.00216	0.00307	0.00620	0.01104	0.02195	0.01852	0.00123	0.05739	0.00780
	Fod	0.03593	0.00153	0.06744	0.00534	0.00176	0.00712	0.01416	0.01961	0.00112	0.05926	0.03149
	Che	0.02141	0.00087	0.00533	0.11292	0.00068	0.00561	0.01116	0.01300	0.00082	0.06412	0.01196
	Tra	0.02853	0.00243	0.00978	0.00836	0.00201	0.01031	0.02049	0.03135	0.00194	0.08294	0.03252
	Elec	0.01355	0.00138	0.00434	0.00476	0.02818	0.00900	0.01789	0.02398	0.00155	0.04516	0.01659
	Cem	0.00037	0.00004	0.00013	0.00015	0.00003	0.05247	0.00307	0.00052	0.00003	0.00134	0.00055
	Mnr	0.00116	0.00012	0.00042	0.00050	0.00011	0.00521	0.11163	0.00169	0.00011	0.00435	0.00177
	Iro	0.00267	0.00032	0.00089	0.00113	0.00022	0.00129	0.00256	0.24618	0.00222	0.03915	0.00338
	Met	0.00143	0.00018	0.00049	0.00064	0.00012	0.00072	0.00143	0.01917	0.04293	0.02288	0.00185
	Con	0.00160	0.00011	0.00048	0.00041	0.00016	0.00050	0.00099	0.00282	0.00018	0.00448	0.00269
	Oth	0.04040	0.00328	0.01149	0.00960	0.00280	0.01463	0.02909	0.03267	0.00195	1.02657	0.04394
	Was	0.00253	0.00014	0.00066	0.00072	0.00014	0.00075	0.00149	0.03179	0.00217	0.01140	0.00260
	Ser	0.10591	0.00732	0.03382	0.02764	0.00835	0.03563	0.07085	0.09662	0.00577	0.30426	0.28868
Labor		0.04283	0.00392	0.01635	0.01483	0.00384	0.02000	0.03978	0.05461	0.00305	0.16639	0.08457
Capital		0.16767	0.00871	0.04214	0.02790	0.01090	0.03889	0.07735	0.10845	0.00614	0.30304	0.14306
Household		0.21051	0.01264	0.05848	0.04273	0.01474	0.05890	0.11712	0.16306	0.00919	0.46944	0.22762
Government		0.02473	0.00527	0.01554	0.01120	0.00297	0.00981	0.01951	0.03903	0.00236	0.18967	0.03250
Saving/Investment		0.06736	0.00404	0.01871	0.01367	0.00472	0.01885	0.03748	0.05218	0.00294	0.15021	0.07283
Rest of World		0.06101	0.02442	0.01751	0.06419	0.00603	0.02227	0.04429	0.12244	0.03633	0.45544	0.04569

Table G.19 Multiplier Analysis Results for All Sectors under 70% Difference in Demand Response Based on Free Allocation of Allowances in CP_2 Simulation

		Commodities										
	70%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.22350	0.00131	0.02484	0.00475	0.00144	0.00588	0.01169	0.01597	0.00091	0.06070	0.02443
	Min	0.00212	0.01073	0.00067	0.00095	0.00191	0.00340	0.00675	0.00570	0.00038	0.01766	0.00240
	Fod	0.03309	0.00141	0.06211	0.00491	0.00162	0.00656	0.01304	0.01806	0.00103	0.05457	0.02899
	Che	0.01139	0.00046	0.00284	0.06007	0.00036	0.00299	0.00594	0.00691	0.00044	0.03411	0.00636
	Tra	0.03284	0.00280	0.01126	0.00963	0.00232	0.01186	0.02358	0.03608	0.00223	0.09545	0.03742
	Elec	0.01547	0.00158	0.00495	0.00544	0.03218	0.01027	0.02043	0.02738	0.00177	0.05156	0.01895
	Cem	0.00039	0.00004	0.00014	0.00016	0.00004	0.05616	0.00329	0.00055	0.00004	0.00144	0.00059
	Mnr	0.00125	0.00013	0.00045	0.00054	0.00012	0.00557	0.11949	0.00180	0.00012	0.00466	0.00190
	Iro	0.00213	0.00025	0.00071	0.00090	0.00017	0.00103	0.00204	0.19674	0.00177	0.03129	0.00270
	Met	0.00036	0.00005	0.00012	0.00016	0.00003	0.00018	0.00036	0.00480	0.01075	0.00573	0.00046
	Con	0.00184	0.00013	0.00055	0.00047	0.00018	0.00057	0.00113	0.00323	0.00021	0.00514	0.00309
	Oth	0.02580	0.00209	0.00734	0.00613	0.00179	0.00934	0.01857	0.02086	0.00124	0.65541	0.02806
	Was	0.00199	0.00011	0.00052	0.00057	0.00011	0.00059	0.00118	0.02504	0.00171	0.00898	0.00205
	Ser	0.11548	0.00798	0.03688	0.03014	0.00910	0.03885	0.07725	0.10535	0.00629	0.33174	0.31476
Commodities	Agr	0.24647	0.00145	0.02739	0.00524	0.00159	0.00648	0.01289	0.01761	0.00100	0.06694	0.02695
	Min	0.00803	0.04068	0.00252	0.00359	0.00724	0.01288	0.02561	0.02161	0.00143	0.06696	0.00910
	Fod	0.04192	0.00178	0.07868	0.00623	0.00205	0.00831	0.01652	0.02288	0.00130	0.06914	0.03673
	Che	0.02498	0.00101	0.00622	0.13174	0.00079	0.00655	0.01303	0.01516	0.00096	0.07481	0.01395
	Tra	0.03329	0.00284	0.01141	0.00976	0.00235	0.01202	0.02391	0.03658	0.00226	0.09676	0.03794
	Elec	0.01580	0.00161	0.00506	0.00556	0.03288	0.01049	0.02087	0.02798	0.00181	0.05268	0.01936
	Cem	0.00043	0.00004	0.00015	0.00018	0.00004	0.06121	0.00358	0.00060	0.00004	0.00157	0.00064
	Mnr	0.00136	0.00014	0.00049	0.00059	0.00013	0.00607	0.13023	0.00197	0.00013	0.00508	0.00207
	Iro	0.00311	0.00037	0.00104	0.00131	0.00026	0.00150	0.00298	0.28721	0.00259	0.04568	0.00395
	Met	0.00167	0.00021	0.00057	0.00074	0.00014	0.00084	0.00167	0.02237	0.05009	0.02669	0.00215
	Con	0.00187	0.00013	0.00056	0.00048	0.00019	0.00058	0.00115	0.00329	0.00021	0.00522	0.00314
	Oth	0.04714	0.00383	0.01340	0.01120	0.00327	0.01706	0.03393	0.03812	0.00227	1.19766	0.05127
	Was	0.00295	0.00017	0.00077	0.00084	0.00017	0.00088	0.00174	0.03709	0.00253	0.01330	0.00303
	Ser	0.12356	0.00854	0.03946	0.03225	0.00974	0.04157	0.08266	0.11273	0.00673	0.35497	0.33679
Labor		0.04997	0.00458	0.01907	0.01730	0.00448	0.02334	0.04641	0.06371	0.00356	0.19413	0.09866
Capital		0.19562	0.01017	0.04916	0.03255	0.01272	0.04538	0.09024	0.12652	0.00716	0.35355	0.16690
Household		0.24559	0.01474	0.06823	0.04985	0.01720	0.06871	0.13665	0.19024	0.01072	0.54768	0.26556
Government		0.02885	0.00615	0.01813	0.01306	0.00347	0.01144	0.02276	0.04553	0.00275	0.22128	0.03791
Saving/Investment		0.07858	0.00472	0.02183	0.01595	0.00550	0.02199	0.04372	0.06087	0.00343	0.17524	0.08497
Rest of World		0.07118	0.02849	0.02043	0.07488	0.00704	0.02598	0.05167	0.14284	0.04238	0.53135	0.05330

Table G.20 Multiplier Analysis Results for All Sectors under 80% Difference in Demand Response Based on Free Allocation of Allowances in CP_2 Simulation

		Commodities										
	80%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.25543	0.00150	0.02838	0.00543	0.00164	0.00672	0.01336	0.01825	0.00104	0.06937	0.02792
	Min	0.00242	0.01226	0.00076	0.00108	0.00218	0.00388	0.00772	0.00651	0.00043	0.02018	0.00274
	Fod	0.03782	0.00161	0.07098	0.00562	0.00185	0.00750	0.01491	0.02064	0.00118	0.06237	0.03314
	Che	0.01301	0.00053	0.00324	0.06865	0.00041	0.00341	0.00679	0.00790	0.00050	0.03898	0.00727
	Tra	0.03753	0.00320	0.01287	0.01100	0.00265	0.01355	0.02695	0.04124	0.00255	0.10908	0.04277
	Elec	0.01768	0.00180	0.00566	0.00621	0.03678	0.01174	0.02335	0.03130	0.00202	0.05893	0.02165
	Cem	0.00045	0.00005	0.00016	0.00019	0.00004	0.06419	0.00376	0.00063	0.00004	0.00164	0.00067
	Mnr	0.00142	0.00015	0.00051	0.00062	0.00013	0.00637	0.13656	0.00206	0.00013	0.00533	0.00217
	Iro	0.00244	0.00029	0.00081	0.00103	0.00020	0.00117	0.00234	0.22485	0.00203	0.03576	0.00309
	Met	0.00041	0.00005	0.00014	0.00018	0.00003	0.00021	0.00041	0.00549	0.01229	0.00655	0.00053
	Con	0.00210	0.00014	0.00063	0.00054	0.00021	0.00065	0.00130	0.00369	0.00024	0.00587	0.00353
	Oth	0.02948	0.00239	0.00838	0.00700	0.00204	0.01067	0.02122	0.02384	0.00142	0.74904	0.03206
	Was	0.00228	0.00013	0.00059	0.00065	0.00013	0.00068	0.00134	0.02862	0.00195	0.01026	0.00234
	Ser	0.13198	0.00913	0.04214	0.03444	0.01040	0.04440	0.08829	0.12040	0.00719	0.37914	0.35972
Commodities	Agr	0.28168	0.00165	0.03130	0.00599	0.00181	0.00741	0.01473	0.02013	0.00114	0.07650	0.03079
	Min	0.00918	0.04649	0.00288	0.00410	0.00827	0.01472	0.02926	0.02469	0.00163	0.07652	0.01040
	Fod	0.04791	0.00204	0.08992	0.00712	0.00234	0.00950	0.01888	0.02615	0.00149	0.07901	0.04198
	Che	0.02855	0.00115	0.00711	0.15056	0.00091	0.00749	0.01489	0.01733	0.00109	0.08549	0.01595
	Tra	0.03804	0.00324	0.01304	0.01115	0.00269	0.01374	0.02732	0.04180	0.00259	0.11058	0.04336
	Elec	0.01806	0.00184	0.00578	0.00635	0.03758	0.01199	0.02385	0.03197	0.00207	0.06021	0.02212
	Cem	0.00049	0.00005	0.00017	0.00021	0.00004	0.06996	0.00409	0.00069	0.00004	0.00179	0.00073
	Mnr	0.00155	0.00016	0.00056	0.00067	0.00014	0.00694	0.14884	0.00225	0.00014	0.00581	0.00236
	Iro	0.00355	0.00042	0.00119	0.00150	0.00029	0.00171	0.00341	0.32824	0.00296	0.05220	0.00451
	Met	0.00191	0.00024	0.00065	0.00085	0.00016	0.00096	0.00191	0.02556	0.05725	0.03051	0.00246
	Con	0.00213	0.00015	0.00064	0.00055	0.00021	0.00066	0.00132	0.00376	0.00024	0.00597	0.00359
	Oth	0.05387	0.00437	0.01532	0.01280	0.00374	0.01950	0.03878	0.04356	0.00260	1.36876	0.05859
	Was	0.00337	0.00019	0.00088	0.00096	0.00019	0.00100	0.00199	0.04239	0.00290	0.01520	0.00347
	Ser	0.14122	0.00976	0.04509	0.03686	0.01113	0.04750	0.09447	0.12883	0.00770	0.40568	0.38491
Labor		0.05711	0.00523	0.02180	0.01978	0.00512	0.02667	0.05304	0.07282	0.00406	0.22186	0.11275
Capital		0.22356	0.01162	0.05618	0.03720	0.01454	0.05186	0.10313	0.14460	0.00818	0.40406	0.19074
Household		0.28068	0.01685	0.07798	0.05698	0.01966	0.07853	0.15617	0.21742	0.01225	0.62591	0.30350
Government		0.03297	0.00702	0.02071	0.01493	0.00396	0.01308	0.02601	0.05203	0.00314	0.25290	0.04333
Saving/Investment		0.08981	0.00539	0.02495	0.01823	0.00629	0.02513	0.04997	0.06957	0.00392	0.20028	0.09711
Rest of World		0.08135	0.03256	0.02335	0.08558	0.00804	0.02970	0.05905	0.16325	0.04844	0.60726	0.06092

Table G.21 Multiplier Analysis Results for All Sectors under 90% Difference in Demand Response Based on Free Allocation of Allowances in CP_2 Simulation

		Commodities										
	90%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.28735	0.00169	0.03193	0.00611	0.00185	0.00756	0.01503	0.02053	0.00117	0.07804	0.03141
	Min	0.00272	0.01379	0.00086	0.00122	0.00245	0.00437	0.00868	0.00733	0.00048	0.02270	0.00309
	Fod	0.04254	0.00181	0.07985	0.00632	0.00208	0.00843	0.01677	0.02322	0.00132	0.07016	0.03728
	Che	0.01464	0.00059	0.00365	0.07723	0.00047	0.00384	0.00764	0.00889	0.00056	0.04385	0.00818
	Tra	0.04222	0.00360	0.01447	0.01238	0.00298	0.01525	0.03032	0.04639	0.00287	0.12272	0.04812
	Elec	0.01989	0.00203	0.00637	0.00699	0.04138	0.01321	0.02626	0.03521	0.00228	0.06630	0.02436
	Cem	0.00051	0.00005	0.00018	0.00021	0.00005	0.07221	0.00422	0.00071	0.00005	0.00185	0.00076
	Mnr	0.00160	0.00017	0.00057	0.00069	0.00015	0.00717	0.15362	0.00232	0.00015	0.00599	0.00244
	Iro	0.00274	0.00033	0.00091	0.00116	0.00022	0.00132	0.00263	0.25296	0.00228	0.04023	0.00348
	Met	0.00046	0.00006	0.00016	0.00021	0.00004	0.00023	0.00046	0.00617	0.01382	0.00737	0.00059
	Con	0.00236	0.00016	0.00071	0.00061	0.00024	0.00073	0.00146	0.00416	0.00027	0.00661	0.00397
	Oth	0.03317	0.00269	0.00943	0.00788	0.00230	0.01201	0.02388	0.02682	0.00160	0.84267	0.03607
	Was	0.00256	0.00014	0.00067	0.00073	0.00014	0.00076	0.00151	0.03220	0.00220	0.01154	0.00263
	Ser	0.14847	0.01027	0.04741	0.03875	0.01170	0.04994	0.09932	0.13545	0.00809	0.42653	0.40469
Commodities	Agr	0.31689	0.00186	0.03521	0.00674	0.00204	0.00833	0.01657	0.02264	0.00129	0.08606	0.03464
	Min	0.01033	0.05231	0.00324	0.00461	0.00931	0.01655	0.03292	0.02778	0.00184	0.08609	0.01170
	Fod	0.05390	0.00229	0.10116	0.00800	0.00263	0.01068	0.02125	0.02942	0.00168	0.08889	0.04723
	Che	0.03211	0.00130	0.00800	0.16938	0.00102	0.00842	0.01675	0.01950	0.00123	0.09618	0.01794
	Tra	0.04280	0.00365	0.01467	0.01255	0.00302	0.01546	0.03074	0.04703	0.00291	0.12440	0.04878
	Elec	0.02032	0.00207	0.00651	0.00714	0.04227	0.01349	0.02683	0.03597	0.00233	0.06773	0.02489
	Cem	0.00055	0.00006	0.00019	0.00023	0.00005	0.07870	0.00460	0.00078	0.00005	0.00201	0.00083
	Mnr	0.00175	0.00018	0.00062	0.00076	0.00016	0.00781	0.16744	0.00253	0.00016	0.00653	0.00266
	Iro	0.00400	0.00048	0.00133	0.00169	0.00033	0.00193	0.00383	0.36927	0.00333	0.05873	0.00507
	Met	0.00215	0.00027	0.00073	0.00096	0.00018	0.00108	0.00215	0.02876	0.06440	0.03432	0.00277
	Con	0.00240	0.00016	0.00072	0.00062	0.00024	0.00075	0.00148	0.00423	0.00027	0.00672	0.00404
	Oth	0.06061	0.00492	0.01723	0.01439	0.00420	0.02194	0.04363	0.04901	0.00292	1.53985	0.06592
	Was	0.00379	0.00021	0.00099	0.00108	0.00021	0.00113	0.00224	0.04769	0.00326	0.01709	0.00390
	Ser	0.15887	0.01098	0.05073	0.04146	0.01252	0.05344	0.10628	0.14494	0.00866	0.45639	0.43302
Labor		0.06425	0.00589	0.02452	0.02225	0.00576	0.03000	0.05967	0.08192	0.00457	0.24959	0.12685
Capital		0.25151	0.01307	0.06321	0.04185	0.01635	0.05834	0.11602	0.16267	0.00921	0.45456	0.21458
Household		0.31576	0.01896	0.08773	0.06410	0.02211	0.08835	0.17569	0.24459	0.01378	0.70415	0.34143
Government		0.03710	0.00790	0.02330	0.01680	0.00446	0.01471	0.02926	0.05854	0.00354	0.28451	0.04874
Saving/Investment		0.10104	0.00607	0.02807	0.02051	0.00708	0.02827	0.05622	0.07826	0.00441	0.22531	0.10925
Rest of World		0.09152	0.03663	0.02627	0.09628	0.00905	0.03341	0.06643	0.18366	0.05449	0.68316	0.06853

Table G.22 Multiplier Analysis Results for All Sectors under 100% Difference in Demand Response Based on Free Allocation of Allowances in CP_2 Simulation

		Commodities										
	100%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.31928	0.00187	0.03548	0.00679	0.00205	0.00840	0.01669	0.02281	0.00130	0.08671	0.03490
	Min	0.00303	0.01533	0.00095	0.00135	0.00273	0.00485	0.00965	0.00814	0.00054	0.02522	0.00343
	Fod	0.04727	0.00201	0.08872	0.00702	0.00231	0.00937	0.01863	0.02580	0.00147	0.07796	0.04142
	Che	0.01627	0.00066	0.00405	0.08581	0.00052	0.00427	0.00848	0.00988	0.00062	0.04872	0.00909
	Tra	0.04691	0.00400	0.01608	0.01375	0.00331	0.01694	0.03369	0.05155	0.00319	0.13635	0.05346
	Elec	0.02210	0.00226	0.00708	0.00777	0.04597	0.01467	0.02918	0.03912	0.00253	0.07366	0.02707
	Cem	0.00056	0.00006	0.00020	0.00024	0.00005	0.08023	0.00469	0.00079	0.00005	0.00205	0.00084
	Mnr	0.00178	0.00018	0.00064	0.00077	0.00017	0.00796	0.17069	0.00258	0.00016	0.00666	0.00271
	Iro	0.00304	0.00036	0.00101	0.00129	0.00025	0.00147	0.00292	0.28106	0.00253	0.04470	0.00386
	Met	0.00051	0.00006	0.00017	0.00023	0.00004	0.00026	0.00051	0.00686	0.01536	0.00818	0.00066
	Con	0.00262	0.00018	0.00079	0.00067	0.00026	0.00081	0.00162	0.00462	0.00030	0.00734	0.00441
	Oth	0.03685	0.00299	0.01048	0.00875	0.00256	0.01334	0.02653	0.02980	0.00178	0.93630	0.04008
	Was	0.00284	0.00016	0.00074	0.00081	0.00016	0.00084	0.00168	0.03578	0.00244	0.01282	0.00292
	Ser	0.16497	0.01141	0.05268	0.04306	0.01300	0.05549	0.11036	0.15050	0.00899	0.47392	0.44965
Commodities	Agr	0.35211	0.00206	0.03913	0.00749	0.00227	0.00926	0.01841	0.02516	0.00143	0.09563	0.03849
	Min	0.01148	0.05812	0.00360	0.00512	0.01034	0.01839	0.03658	0.03087	0.00204	0.09565	0.01301
	Fod	0.05989	0.00255	0.11241	0.00889	0.00293	0.01187	0.02361	0.03269	0.00186	0.09877	0.05248
	Che	0.03568	0.00144	0.00888	0.18820	0.00113	0.00936	0.01861	0.02166	0.00137	0.10687	0.01994
	Tra	0.04755	0.00406	0.01630	0.01394	0.00336	0.01718	0.03416	0.05225	0.00323	0.13823	0.05420
	Elec	0.02258	0.00230	0.00723	0.00794	0.04697	0.01499	0.02981	0.03997	0.00258	0.07526	0.02765
	Cem	0.00061	0.00006	0.00022	0.00026	0.00006	0.08745	0.00512	0.00086	0.00005	0.00224	0.00092
	Mnr	0.00194	0.00020	0.00069	0.00084	0.00018	0.00868	0.18604	0.00281	0.00018	0.00726	0.00296
	Iro	0.00444	0.00053	0.00148	0.00188	0.00036	0.00214	0.00426	0.41030	0.00370	0.06525	0.00564
	Met	0.00239	0.00030	0.00081	0.00106	0.00020	0.00120	0.00239	0.03196	0.07156	0.03813	0.00308
	Con	0.00267	0.00018	0.00080	0.00069	0.00027	0.00083	0.00165	0.00469	0.00030	0.00746	0.00449
	Oth	0.06734	0.00547	0.01915	0.01599	0.00467	0.02438	0.04848	0.05446	0.00325	1.71095	0.07324
	Was	0.00421	0.00024	0.00110	0.00120	0.00024	0.00125	0.00249	0.05299	0.00362	0.01899	0.00433
	Ser	0.17652	0.01220	0.05637	0.04607	0.01391	0.05938	0.11808	0.16104	0.00962	0.50710	0.48113
Labor		0.07139	0.00654	0.02724	0.02472	0.00640	0.03334	0.06630	0.09102	0.00508	0.27732	0.14094
Capital		0.27945	0.01452	0.07023	0.04650	0.01817	0.06482	0.12891	0.18075	0.01023	0.50507	0.23843
Household		0.35084	0.02106	0.09747	0.07122	0.02457	0.09816	0.19521	0.27177	0.01531	0.78239	0.37937
Government		0.04122	0.00878	0.02589	0.01866	0.00495	0.01635	0.03251	0.06504	0.00393	0.31612	0.05416
Saving/Investment		0.11226	0.00674	0.03119	0.02279	0.00786	0.03141	0.06246	0.08696	0.00490	0.25035	0.12139
Rest of World		0.10168	0.04070	0.02919	0.10698	0.01005	0.03712	0.07382	0.20406	0.06055	0.75907	0.07615

G.3 CP_3 Simulation

Table G.23 Sectoral Carbon Costs Under Difference in Demand Response Based on Free Allocation of Allowances for CP_3 Simulation

	Carbon Costs (€ billion) under Different Elasticies for CP_3 Simulation									
	10%	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
Agr	0.036	0.071	0.107	0.143	0.179	0.214	0.250	0.286	0.321	0.357
Min	0.008	0.016	0.024	0.031	0.039	0.047	0.055	0.063	0.071	0.079
Fod	0.012	0.024	0.036	0.048	0.060	0.072	0.085	0.097	0.109	0.121
Che	0.021	0.042	0.062	0.083	0.104	0.125	0.145	0.166	0.187	0.208
Elec	0.003	0.006	0.010	0.013	0.016	0.019	0.022	0.026	0.029	0.032
Cem	0.012	0.024	0.036	0.048	0.059	0.071	0.083	0.095	0.107	0.119
Mnr	0.024	0.047	0.071	0.095	0.118	0.142	0.165	0.189	0.213	0.236
Iro	0.050	0.100	0.150	0.199	0.249	0.299	0.349	0.399	0.449	0.498
Met	0.010	0.019	0.029	0.039	0.049	0.058	0.068	0.078	0.087	0.097
Con	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oth	0.186	0.371	0.557	0.742	0.928	1.113	1.299	1.484	1.670	1.856
Ser	0.035	0.070	0.106	0.141	0.176	0.211	0.247	0.282	0.317	0.352

Table G.24 Multiplier Analysis Results for All Sectors under 10% Difference in Demand Response Based on Free Allocation of Allowances in CP_3 Simulation

		Commodities										
	10%	**Agr**	**Min**	**Fod**	**Che**	**Elec**	**Cem**	**Mnr**	**Iro**	**Met**	**Oth**	**Ser**
Activities	**Agr**	0.04470	0.00026	0.00497	0.00095	0.00029	0.00118	0.00234	0.00319	0.00018	0.01214	0.00489
	Min	0.00042	0.00215	0.00013	0.00019	0.00038	0.00068	0.00135	0.00114	0.00008	0.00353	0.00048
	Fod	0.00662	0.00028	0.01242	0.00098	0.00032	0.00131	0.00261	0.00361	0.00021	0.01091	0.00580
	Che	0.00228	0.00009	0.00057	0.01201	0.00007	0.00060	0.00119	0.00138	0.00009	0.00682	0.00127
	Tra	0.00657	0.00056	0.00225	0.00193	0.00046	0.00237	0.00472	0.00722	0.00045	0.01909	0.00748
	Elec	0.00309	0.00032	0.00099	0.00109	0.00644	0.00205	0.00409	0.00548	0.00035	0.01031	0.00379
	Cem	0.00008	0.00001	0.00003	0.00003	0.00001	0.01123	0.00066	0.00011	0.00001	0.00029	0.00012
	Mnr	0.00025	0.00003	0.00009	0.00011	0.00002	0.00111	0.02390	0.00036	0.00002	0.00093	0.00038
	Iro	0.00043	0.00005	0.00014	0.00018	0.00003	0.00021	0.00041	0.03935	0.00035	0.00626	0.00054
	Met	0.00007	0.00001	0.00002	0.00003	0.00001	0.00004	0.00007	0.00096	0.00215	0.00115	0.00009
	Con	0.00037	0.00003	0.00011	0.00009	0.00004	0.00011	0.00023	0.00065	0.00004	0.00103	0.00062
	Oth	0.00516	0.00042	0.00147	0.00123	0.00036	0.00187	0.00371	0.00417	0.00025	0.13107	0.00561
	Was	0.00040	0.00002	0.00010	0.00011	0.00002	0.00012	0.00024	0.00501	0.00034	0.00180	0.00041
	Ser	0.02309	0.00160	0.00737	0.00603	0.00182	0.00777	0.01545	0.02107	0.00126	0.06634	0.06295
Commodities	**Agr**	0.04929	0.00029	0.00548	0.00105	0.00032	0.00130	0.00258	0.00352	0.00020	0.01339	0.00539
	Min	0.00161	0.00814	0.00050	0.00072	0.00145	0.00257	0.00512	0.00432	0.00029	0.01339	0.00182
	Fod	0.00838	0.00036	0.01574	0.00125	0.00041	0.00166	0.00330	0.00458	0.00026	0.01383	0.00735
	Che	0.00500	0.00020	0.00124	0.02635	0.00016	0.00131	0.00260	0.00303	0.00019	0.01496	0.00279
	Tra	0.00666	0.00057	0.00228	0.00195	0.00047	0.00240	0.00478	0.00731	0.00045	0.01935	0.00759
	Elec	0.00316	0.00032	0.00101	0.00111	0.00658	0.00210	0.00417	0.00560	0.00036	0.01054	0.00387
	Cem	0.00009	0.00001	0.00003	0.00004	0.00001	0.01224	0.00072	0.00012	0.00001	0.00031	0.00013
	Mnr	0.00027	0.00003	0.00010	0.00012	0.00003	0.00121	0.02604	0.00039	0.00003	0.00102	0.00041
	Iro	0.00062	0.00007	0.00021	0.00026	0.00005	0.00030	0.00060	0.05744	0.00052	0.00913	0.00079
	Met	0.00033	0.00004	0.00011	0.00015	0.00003	0.00017	0.00033	0.00447	0.01002	0.00534	0.00043
	Con	0.00037	0.00003	0.00011	0.00010	0.00004	0.00012	0.00023	0.00066	0.00004	0.00104	0.00063
	Oth	0.00943	0.00077	0.00268	0.00224	0.00065	0.00341	0.00679	0.00762	0.00045	0.23951	0.01025
	Was	0.00059	0.00003	0.00015	0.00017	0.00003	0.00018	0.00035	0.00742	0.00051	0.00266	0.00061
	Ser	0.02471	0.00171	0.00789	0.00645	0.00195	0.00831	0.01653	0.02254	0.00135	0.07099	0.06735
Labor		0.00999	0.00092	0.00381	0.00346	0.00090	0.00467	0.00928	0.01274	0.00071	0.03882	0.01973
Capital		0.03912	0.00203	0.00983	0.00651	0.00254	0.00907	0.01805	0.02530	0.00143	0.07070	0.03338
Household		0.04911	0.00295	0.01365	0.00997	0.00344	0.01374	0.02733	0.03804	0.00214	0.10953	0.05311
Government		0.00577	0.00123	0.00362	0.00261	0.00069	0.00229	0.00455	0.00911	0.00055	0.04425	0.00758
Saving/Investment		0.01572	0.00094	0.00437	0.00319	0.00110	0.00440	0.00874	0.01217	0.00069	0.03505	0.01699
Rest of World		0.01423	0.00570	0.00409	0.01498	0.00141	0.00520	0.01033	0.02857	0.00848	0.10626	0.01066

Table G.25 Multiplier Analysis Results for All Sectors under 20% Difference in Demand Response Based on Free Allocation of Allowances in CP_3 Simulation

	20%	Commodities									
		Agr	Min	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.08939	0.00052	0.00190	0.00058	0.00235	0.00467	0.00639	0.00036	0.02428	0.00977
	Min	0.00085	0.00429	0.00038	0.00076	0.00136	0.00270	0.00228	0.00015	0.00706	0.00096
	Fod	0.01323	0.00056	0.00197	0.00065	0.00262	0.00522	0.00722	0.00041	0.02183	0.01160
	Che	0.00455	0.00018	0.02402	0.00014	0.00119	0.00238	0.00277	0.00017	0.01364	0.00254
	Tra	0.01313	0.00112	0.00385	0.00093	0.00474	0.00943	0.01443	0.00089	0.03818	0.01497
	Elec	0.00619	0.00063	0.00217	0.01287	0.00411	0.00817	0.01095	0.00071	0.02062	0.00758
	Cem	0.00016	0.00002	0.00007	0.00001	0.02246	0.00131	0.00022	0.00001	0.00057	0.00024
	Mnr	0.00050	0.00005	0.00022	0.00005	0.00223	0.04779	0.00072	0.00005	0.00186	0.00076
	Iro	0.00085	0.00010	0.00036	0.00007	0.00041	0.00082	0.07869	0.00071	0.01251	0.00108
	Met	0.00014	0.00002	0.00006	0.00001	0.00007	0.00014	0.00192	0.00430	0.00229	0.00018
	Con	0.00073	0.00005	0.00019	0.00007	0.00023	0.00045	0.00129	0.00008	0.00206	0.00124
	Oth	0.01032	0.00084	0.00245	0.00072	0.00373	0.00743	0.00834	0.00050	0.26214	0.01122
	Was	0.00080	0.00005	0.00023	0.00004	0.00024	0.00047	0.01002	0.00068	0.00359	0.00082
	Ser	0.04619	0.00319	0.01205	0.00364	0.01554	0.03090	0.04214	0.00252	0.13269	0.12589
Commodities	Agr	0.09858	0.00058	0.00210	0.00063	0.00259	0.00515	0.00704	0.00040	0.02677	0.01078
	Min	0.00321	0.01627	0.00143	0.00289	0.00515	0.01024	0.00864	0.00057	0.02678	0.00364
	Fod	0.01677	0.00071	0.00249	0.00082	0.00332	0.00661	0.00915	0.00052	0.02765	0.01469
	Che	0.00999	0.00040	0.05269	0.00032	0.00262	0.00521	0.00607	0.00038	0.02992	0.00558
	Tra	0.01331	0.00114	0.00390	0.00094	0.00481	0.00956	0.01463	0.00091	0.03870	0.01517
	Elec	0.00632	0.00065	0.00222	0.01315	0.00420	0.00835	0.01119	0.00072	0.02107	0.00774
	Cem	0.00017	0.00002	0.00007	0.00002	0.02448	0.00143	0.00024	0.00002	0.00063	0.00026
	Mnr	0.00054	0.00006	0.00024	0.00005	0.00243	0.05209	0.00079	0.00005	0.00203	0.00083
	Iro	0.00124	0.00015	0.00053	0.00010	0.00060	0.00119	0.11487	0.00104	0.01827	0.00158
	Met	0.00067	0.00008	0.00030	0.00006	0.00034	0.00067	0.00895	0.02003	0.01068	0.00086
	Con	0.00075	0.00005	0.00019	0.00008	0.00023	0.00046	0.00131	0.00009	0.00209	0.00126
	Oth	0.01885	0.00153	0.00448	0.00131	0.00683	0.01357	0.01525	0.00091	0.47902	0.02051
	Was	0.00118	0.00007	0.00034	0.00007	0.00035	0.00070	0.01484	0.00101	0.00532	0.00121
	Ser	0.04942	0.00342	0.01290	0.00389	0.01662	0.03306	0.04509	0.00269	0.14198	0.13471
Labor		0.01999	0.00183	0.00692	0.00179	0.00933	0.01856	0.02548	0.00142	0.07764	0.03946
Capital		0.07824	0.00407	0.01302	0.00509	0.01815	0.03609	0.05061	0.00286	0.14141	0.06675
Household		0.09823	0.00590	0.01994	0.00688	0.02748	0.05465	0.07609	0.00429	0.21905	0.10621
Government		0.01154	0.00246	0.00523	0.00139	0.00458	0.00910	0.01821	0.00110	0.08851	0.01516
Saving/Investment		0.03143	0.00189	0.00638	0.00220	0.00879	0.01749	0.02435	0.00137	0.07009	0.03399
Rest of World		0.02847	0.01140	0.02995	0.00281	0.01039	0.02067	0.05713	0.01695	0.21252	0.02132

Table G.26 Multiplier Analysis Results for All Sectors under 30% Difference in Demand Response Based on Free Allocation of Allowances in CP_3 Simulation

	30%	Commodities										
		Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.13409	0.00079	0.01490	0.00285	0.00086	0.00353	0.00701	0.00958	0.00054	0.03642	0.01466
	Min	0.00127	0.00644	0.00040	0.00057	0.00115	0.00204	0.00405	0.00342	0.00023	0.01059	0.00144
	Fod	0.01985	0.00084	0.03726	0.00295	0.00097	0.00393	0.00782	0.01084	0.00062	0.03274	0.01740
	Che	0.00683	0.00028	0.00170	0.03604	0.00022	0.00179	0.00356	0.00415	0.00026	0.02046	0.00382
	Tra	0.01970	0.00168	0.00675	0.00578	0.00139	0.00712	0.01415	0.02165	0.00134	0.05726	0.02245
	Elec	0.00928	0.00095	0.00297	0.00326	0.01931	0.00616	0.01226	0.01643	0.00106	0.03094	0.01137
	Cem	0.00024	0.00002	0.00008	0.00010	0.00002	0.03370	0.00197	0.00033	0.00002	0.00086	0.00035
	Mnr	0.00075	0.00008	0.00027	0.00032	0.00007	0.00334	0.07169	0.00108	0.00007	0.00280	0.00114
	Iro	0.00128	0.00015	0.00043	0.00054	0.00010	0.00062	0.00123	0.11804	0.00106	0.01877	0.00162
	Met	0.00022	0.00003	0.00007	0.00010	0.00002	0.00011	0.00022	0.00288	0.00645	0.00344	0.00028
	Con	0.00110	0.00008	0.00033	0.00028	0.00011	0.00034	0.00068	0.00194	0.00013	0.00308	0.00185
	Oth	0.01548	0.00126	0.00440	0.00368	0.00107	0.00560	0.01114	0.01251	0.00075	0.39321	0.01683
	Was	0.00119	0.00007	0.00031	0.00034	0.00007	0.00035	0.00071	0.01502	0.00103	0.00539	0.00123
	Ser	0.06928	0.00479	0.02212	0.01808	0.00546	0.02331	0.04635	0.06321	0.00378	0.19903	0.18884
Commodities	Agr	0.14787	0.00087	0.01643	0.00314	0.00095	0.00389	0.00773	0.01056	0.00060	0.04016	0.01617
	Min	0.00482	0.02441	0.00151	0.00215	0.00434	0.00772	0.01536	0.01296	0.00086	0.04017	0.00546
	Fod	0.02515	0.00107	0.04721	0.00374	0.00123	0.00499	0.00991	0.01373	0.00078	0.04148	0.02204
	Che	0.01499	0.00061	0.00373	0.07904	0.00048	0.00393	0.00781	0.00910	0.00057	0.04488	0.00837
	Tra	0.01997	0.00170	0.00685	0.00585	0.00141	0.00721	0.01434	0.02194	0.00136	0.05805	0.02276
	Elec	0.00948	0.00097	0.00304	0.00333	0.01973	0.00630	0.01252	0.01679	0.00108	0.03161	0.01161
	Cem	0.00026	0.00003	0.00009	0.00011	0.00002	0.03673	0.00215	0.00036	0.00002	0.00094	0.00039
	Mnr	0.00081	0.00008	0.00029	0.00035	0.00008	0.00364	0.07813	0.00118	0.00008	0.00305	0.00124
	Iro	0.00187	0.00022	0.00062	0.00079	0.00015	0.00090	0.00179	0.17231	0.00155	0.02740	0.00237
	Met	0.00100	0.00013	0.00034	0.00045	0.00008	0.00050	0.00100	0.01342	0.03005	0.01601	0.00129
	Con	0.00112	0.00008	0.00034	0.00029	0.00011	0.00035	0.00069	0.00197	0.00013	0.00313	0.00188
	Oth	0.02828	0.00230	0.00804	0.00672	0.00196	0.01024	0.02036	0.02287	0.00136	0.71853	0.03076
	Was	0.00177	0.00010	0.00046	0.00051	0.00010	0.00053	0.00104	0.02225	0.00152	0.00798	0.00182
	Ser	0.07413	0.00513	0.02367	0.01935	0.00584	0.02494	0.04959	0.06763	0.00404	0.21296	0.20206
Labor		0.02998	0.00275	0.01144	0.01038	0.00269	0.01400	0.02784	0.03823	0.00213	0.11646	0.05919
Capital		0.11736	0.00610	0.02949	0.01953	0.00763	0.02722	0.05414	0.07591	0.00430	0.21211	0.10013
Household		0.14734	0.00885	0.04094	0.02991	0.01032	0.04122	0.08198	0.11413	0.00643	0.32858	0.15932
Government		0.01731	0.00369	0.01087	0.00784	0.00208	0.00687	0.01365	0.02732	0.00165	0.13276	0.02274
Saving/Investment		0.04715	0.00283	0.01310	0.00957	0.00330	0.01319	0.02623	0.03652	0.00206	0.10514	0.05098
Rest of World		0.04270	0.01709	0.01226	0.04493	0.00422	0.01559	0.03100	0.08570	0.02543	0.31878	0.03198

Table G.27 Multiplier Analysis Results for All Sectors under 40% Difference in Demand Response Based on Free Allocation of Allowances in CP_3 Simulation

		Commodities										
	40%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.17878	0.00105	0.01987	0.00380	0.00115	0.00470	0.00935	0.01277	0.00073	0.04855	0.01954
	Min	0.00169	0.00858	0.00053	0.00076	0.00153	0.00272	0.00540	0.00456	0.00030	0.01412	0.00192
	Fod	0.02647	0.00113	0.04968	0.00393	0.00129	0.00525	0.01043	0.01445	0.00082	0.04365	0.02319
	Che	0.00911	0.00037	0.00227	0.04805	0.00029	0.00239	0.00475	0.00553	0.00035	0.02728	0.00509
	Tra	0.02627	0.00224	0.00901	0.00770	0.00185	0.00949	0.01887	0.02886	0.00179	0.07635	0.02994
	Elec	0.01237	0.00126	0.00396	0.00435	0.02574	0.00822	0.01634	0.02191	0.00142	0.04125	0.01516
	Cem	0.00032	0.00003	0.00011	0.00013	0.00003	0.04493	0.00263	0.00044	0.00003	0.00115	0.00047
	Mnr	0.00100	0.00010	0.00036	0.00043	0.00009	0.00446	0.09558	0.00144	0.00009	0.00373	0.00152
	Iro	0.00170	0.00020	0.00057	0.00072	0.00014	0.00082	0.00163	0.15738	0.00142	0.02503	0.00216
	Met	0.00029	0.00004	0.00010	0.00013	0.00002	0.00014	0.00029	0.00384	0.00860	0.00458	0.00037
	Con	0.00147	0.00010	0.00044	0.00038	0.00015	0.00046	0.00091	0.00259	0.00017	0.00411	0.00247
	Oth	0.02064	0.00168	0.00587	0.00490	0.00143	0.00747	0.01485	0.01669	0.00100	0.52428	0.02244
	Was	0.00159	0.00009	0.00042	0.00045	0.00009	0.00047	0.00094	0.02003	0.00137	0.00718	0.00164
	Ser	0.09237	0.00639	0.02950	0.02411	0.00728	0.03107	0.06179	0.08427	0.00503	0.26537	0.25178
Commodities	Agr	0.19716	0.00116	0.02191	0.00419	0.00127	0.00518	0.01031	0.01409	0.00080	0.05355	0.02155
	Min	0.00643	0.03254	0.00202	0.00287	0.00579	0.01030	0.02048	0.01728	0.00114	0.05356	0.00728
	Fod	0.03354	0.00143	0.06294	0.00498	0.00164	0.00665	0.01322	0.01831	0.00104	0.05531	0.02938
	Che	0.01998	0.00081	0.00497	0.10538	0.00064	0.00524	0.01042	0.01213	0.00077	0.05984	0.01116
	Tra	0.02663	0.00227	0.00913	0.00781	0.00188	0.00962	0.01913	0.02926	0.00181	0.07740	0.03035
	Elec	0.01264	0.00129	0.00405	0.00444	0.02630	0.00839	0.01669	0.02238	0.00145	0.04214	0.01548
	Cem	0.00034	0.00003	0.00012	0.00014	0.00003	0.04897	0.00286	0.00048	0.00003	0.00125	0.00051
	Mnr	0.00109	0.00011	0.00039	0.00047	0.00010	0.00486	0.10418	0.00157	0.00010	0.00406	0.00165
	Iro	0.00249	0.00030	0.00083	0.00105	0.00020	0.00120	0.00239	0.22975	0.00207	0.03654	0.00316
	Met	0.00134	0.00017	0.00045	0.00060	0.00011	0.00067	0.00134	0.01789	0.04007	0.02135	0.00172
	Con	0.00149	0.00010	0.00045	0.00038	0.00015	0.00046	0.00092	0.00263	0.00017	0.00418	0.00251
	Oth	0.03771	0.00306	0.01072	0.00896	0.00262	0.01365	0.02715	0.03049	0.00182	0.95804	0.04101
	Was	0.00236	0.00013	0.00062	0.00067	0.00013	0.00070	0.00139	0.02967	0.00203	0.01064	0.00243
	Ser	0.09884	0.00683	0.03156	0.02580	0.00779	0.03325	0.06612	0.09017	0.00539	0.28395	0.26941
Labor		0.03998	0.00366	0.01526	0.01384	0.00358	0.01867	0.03712	0.05097	0.00285	0.15529	0.07892
Capital		0.15648	0.00813	0.03932	0.02604	0.01017	0.03630	0.07218	0.10121	0.00573	0.28281	0.13351
Household		0.19646	0.01179	0.05458	0.03988	0.01376	0.05497	0.10931	0.15218	0.00857	0.43810	0.21243
Government		0.02308	0.00492	0.01450	0.01045	0.00277	0.00915	0.01820	0.03642	0.00220	0.17701	0.03033
Saving/Investment		0.06286	0.00377	0.01746	0.01276	0.00440	0.01759	0.03498	0.04869	0.00274	0.14018	0.06797
Rest of World		0.05694	0.02279	0.01634	0.05990	0.00563	0.02078	0.04133	0.11427	0.03390	0.42504	0.04264

Table G.28 Multiplier Analysis Results for All Sectors under 50% Difference in Demand Response Based on Free Allocation of Allowances in CP_3 Simulation

		Commodities										
	50%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.22348	0.00131	0.02483	0.00475	0.00144	0.00588	0.01169	0.01597	0.00091	0.06069	0.02443
	Min	0.00212	0.01073	0.00067	0.00095	0.00191	0.00340	0.00675	0.00570	0.00038	0.01766	0.00240
	Fod	0.03309	0.00141	0.06210	0.00491	0.00162	0.00656	0.01304	0.01806	0.00103	0.05457	0.02899
	Che	0.01139	0.00046	0.00284	0.06006	0.00036	0.00299	0.00594	0.00691	0.00044	0.03410	0.00636
	Tra	0.03283	0.00280	0.01126	0.00963	0.00232	0.01186	0.02358	0.03608	0.00223	0.09544	0.03742
	Elec	0.01547	0.00158	0.00495	0.00544	0.03218	0.01027	0.02043	0.02738	0.00177	0.05156	0.01894
	Cem	0.00039	0.00004	0.00014	0.00016	0.00004	0.05616	0.00329	0.00055	0.00004	0.00144	0.00059
	Mnr	0.00125	0.00013	0.00045	0.00054	0.00012	0.00557	0.11948	0.00180	0.00012	0.00466	0.00190
	Iro	0.00213	0.00025	0.00071	0.00090	0.00017	0.00103	0.00204	0.19673	0.00177	0.03129	0.00270
	Met	0.00036	0.00005	0.00012	0.00016	0.00003	0.00018	0.00036	0.00480	0.01075	0.00573	0.00046
	Con	0.00184	0.00013	0.00055	0.00047	0.00018	0.00057	0.00113	0.00323	0.00021	0.00514	0.00309
	Oth	0.02579	0.00209	0.00733	0.00613	0.00179	0.00934	0.01857	0.02086	0.00124	0.65535	0.02805
	Was	0.00199	0.00011	0.00052	0.00057	0.00011	0.00059	0.00118	0.02504	0.00171	0.00898	0.00205
	Ser	0.11547	0.00798	0.03687	0.03014	0.00910	0.03884	0.07724	0.10534	0.00629	0.33171	0.31473
Commodities	Agr	0.24645	0.00145	0.02739	0.00524	0.00159	0.00648	0.01289	0.01761	0.00100	0.06693	0.02694
	Min	0.00803	0.04068	0.00252	0.00359	0.00724	0.01287	0.02560	0.02161	0.00143	0.06695	0.00910
	Fod	0.04192	0.00178	0.07868	0.00623	0.00205	0.00831	0.01652	0.02288	0.00130	0.06913	0.03673
	Che	0.02498	0.00101	0.00622	0.13173	0.00079	0.00655	0.01302	0.01516	0.00096	0.07480	0.01395
	Tra	0.03328	0.00284	0.01141	0.00976	0.00235	0.01202	0.02391	0.03657	0.00226	0.09675	0.03793
	Elec	0.01580	0.00161	0.00506	0.00556	0.03288	0.01049	0.02087	0.02798	0.00181	0.05268	0.01935
	Cem	0.00043	0.00004	0.00015	0.00018	0.00004	0.06121	0.00358	0.00060	0.00004	0.00156	0.00064
	Mnr	0.00136	0.00014	0.00049	0.00059	0.00013	0.00607	0.13022	0.00197	0.00013	0.00508	0.00207
	Iro	0.00311	0.00037	0.00104	0.00131	0.00026	0.00150	0.00298	0.28718	0.00259	0.04567	0.00395
	Met	0.00167	0.00021	0.00057	0.00074	0.00014	0.00084	0.00167	0.02237	0.05009	0.02669	0.00215
	Con	0.00187	0.00013	0.00056	0.00048	0.00019	0.00058	0.00115	0.00329	0.00021	0.00522	0.00314
	Oth	0.04713	0.00383	0.01340	0.01119	0.00327	0.01706	0.03393	0.03812	0.00227	1.19755	0.05126
	Was	0.00295	0.00017	0.00077	0.00084	0.00017	0.00088	0.00174	0.03709	0.00253	0.01329	0.00303
	Ser	0.12355	0.00854	0.03945	0.03225	0.00974	0.04156	0.08265	0.11272	0.00673	0.35494	0.33676
Labor		0.04997	0.00458	0.01907	0.01730	0.00448	0.02333	0.04640	0.06371	0.00356	0.19411	0.09865
Capital		0.19560	0.01017	0.04916	0.03255	0.01272	0.04537	0.09023	0.12651	0.00716	0.35352	0.16688
Household		0.24557	0.01474	0.06823	0.04985	0.01720	0.06871	0.13663	0.19022	0.01072	0.54763	0.26553
Government		0.02885	0.00615	0.01812	0.01306	0.00347	0.01144	0.02275	0.04553	0.00275	0.22127	0.03791
Saving/Investment		0.07858	0.00472	0.02183	0.01595	0.00550	0.02198	0.04372	0.06087	0.00343	0.17523	0.08497
Rest of World		0.07117	0.02849	0.02043	0.07488	0.00704	0.02598	0.05167	0.14283	0.04238	0.53130	0.05330

Table G.29 Multiplier Analysis Results for All Sectors under 60% Difference in Demand Response Based on Free Allocation of Allowances in CP_3 Simulation

		Commodities										
	60%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.26817	0.00157	0.02980	0.00570	0.00173	0.00705	0.01402	0.01916	0.00109	0.07283	0.02932
	Min	0.00254	0.01287	0.00080	0.00113	0.00229	0.00407	0.00810	0.00684	0.00045	0.02119	0.00288
	Fod	0.03970	0.00169	0.07452	0.00590	0.00194	0.00787	0.01565	0.02167	0.00123	0.06548	0.03479
	Che	0.01366	0.00055	0.00340	0.07207	0.00043	0.00358	0.00713	0.00830	0.00052	0.04092	0.00763
	Tra	0.03940	0.00336	0.01351	0.01155	0.00278	0.01423	0.02830	0.04329	0.00268	0.11453	0.04491
	Elec	0.01856	0.00189	0.00594	0.00652	0.03861	0.01233	0.02451	0.03286	0.00212	0.06187	0.02273
	Cem	0.00047	0.00005	0.00017	0.00020	0.00004	0.06739	0.00394	0.00066	0.00004	0.00172	0.00071
	Mnr	0.00149	0.00016	0.00053	0.00065	0.00014	0.00669	0.14337	0.00217	0.00014	0.00559	0.00228
	Iro	0.00256	0.00031	0.00085	0.00108	0.00021	0.00123	0.00245	0.23607	0.00213	0.03754	0.00324
	Met	0.00043	0.00005	0.00015	0.00019	0.00004	0.00022	0.00043	0.00576	0.01290	0.00687	0.00055
	Con	0.00220	0.00015	0.00066	0.00057	0.00022	0.00068	0.00136	0.00388	0.00025	0.00617	0.00371
	Oth	0.03095	0.00251	0.00880	0.00735	0.00215	0.01120	0.02228	0.02503	0.00149	0.78642	0.03366
	Was	0.00239	0.00014	0.00062	0.00068	0.00013	0.00071	0.00141	0.03005	0.00205	0.01077	0.00246
	Ser	0.13856	0.00958	0.04425	0.03616	0.01092	0.04661	0.09269	0.12641	0.00755	0.39806	0.37767
Commodities	Agr	0.29574	0.00173	0.03286	0.00629	0.00190	0.00778	0.01546	0.02113	0.00120	0.08032	0.03233
	Min	0.00964	0.04881	0.00303	0.00430	0.00868	0.01545	0.03072	0.02593	0.00172	0.08034	0.01092
	Fod	0.05030	0.00214	0.09441	0.00747	0.00246	0.00997	0.01983	0.02746	0.00156	0.08296	0.04408
	Che	0.02997	0.00121	0.00746	0.15808	0.00095	0.00786	0.01563	0.01820	0.00115	0.08976	0.01674
	Tra	0.03994	0.00341	0.01369	0.01171	0.00282	0.01443	0.02869	0.04389	0.00272	0.11610	0.04552
	Elec	0.01896	0.00194	0.00607	0.00667	0.03945	0.01259	0.02504	0.03357	0.00217	0.06321	0.02323
	Cem	0.00052	0.00005	0.00018	0.00022	0.00005	0.07345	0.00430	0.00072	0.00005	0.00188	0.00077
	Mnr	0.00163	0.00017	0.00058	0.00071	0.00015	0.00729	0.15626	0.00236	0.00015	0.00610	0.00248
	Iro	0.00373	0.00045	0.00124	0.00158	0.00031	0.00180	0.00358	0.34462	0.00311	0.05481	0.00473
	Met	0.00201	0.00025	0.00068	0.00089	0.00017	0.00101	0.00201	0.02684	0.06010	0.03203	0.00258
	Con	0.00224	0.00015	0.00067	0.00058	0.00023	0.00070	0.00138	0.00394	0.00026	0.00627	0.00377
	Oth	0.05656	0.00459	0.01608	0.01343	0.00392	0.02048	0.04072	0.04574	0.00273	1.43707	0.06152
	Was	0.00354	0.00020	0.00092	0.00101	0.00020	0.00105	0.00209	0.04451	0.00304	0.01595	0.00364
	Ser	0.14826	0.01025	0.04734	0.03870	0.01168	0.04987	0.09918	0.13526	0.00808	0.42593	0.40412
Labor		0.05996	0.00549	0.02288	0.02076	0.00538	0.02800	0.05569	0.07645	0.00427	0.23293	0.11838
Capital		0.23472	0.01220	0.05899	0.03906	0.01526	0.05445	0.10827	0.15182	0.00859	0.42422	0.20026
Household		0.29468	0.01769	0.08187	0.05982	0.02064	0.08245	0.16396	0.22827	0.01286	0.65715	0.31864
Government		0.03462	0.00737	0.02175	0.01568	0.00416	0.01373	0.02731	0.05463	0.00330	0.26552	0.04549
Saving/Investment		0.09429	0.00566	0.02620	0.01914	0.00660	0.02638	0.05246	0.07304	0.00411	0.21027	0.10196
Rest of World		0.08541	0.03419	0.02452	0.08985	0.00844	0.03118	0.06200	0.17140	0.05086	0.63756	0.06396

Table G.30 Multiplier Analysis Results for All Sectors under 70% Difference in Demand Response Based on Free Allocation of Allowances in CP_3 Simulation

		Commodities										
	70%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.31287	0.00183	0.03477	0.00665	0.00201	0.00823	0.01636	0.02235	0.00127	0.08497	0.03420
	Min	0.00297	0.01502	0.00093	0.00132	0.00267	0.00475	0.00945	0.00798	0.00053	0.02472	0.00336
	Fod	0.04632	0.00197	0.08694	0.00688	0.00226	0.00918	0.01826	0.02528	0.00144	0.07639	0.04059
	Che	0.01594	0.00064	0.00397	0.08408	0.00051	0.00418	0.00831	0.00968	0.00061	0.04775	0.00891
	Tra	0.04597	0.00392	0.01576	0.01348	0.00325	0.01660	0.03302	0.05051	0.00313	0.13361	0.05239
	Elec	0.02166	0.00221	0.00693	0.00761	0.04505	0.01438	0.02860	0.03833	0.00248	0.07218	0.02652
	Cem	0.00055	0.00006	0.00019	0.00023	0.00005	0.07862	0.00460	0.00077	0.00005	0.00201	0.00083
	Mnr	0.00174	0.00018	0.00062	0.00076	0.00016	0.00780	0.16727	0.00253	0.00016	0.00652	0.00266
	Iro	0.00298	0.00036	0.00099	0.00126	0.00024	0.00144	0.00286	0.27542	0.00248	0.04380	0.00378
	Met	0.00050	0.00006	0.00017	0.00022	0.00004	0.00025	0.00050	0.00672	0.01505	0.00802	0.00065
	Con	0.00257	0.00018	0.00077	0.00066	0.00026	0.00080	0.00159	0.00453	0.00029	0.00719	0.00432
	Oth	0.03611	0.00293	0.01027	0.00858	0.00250	0.01307	0.02600	0.02920	0.00174	0.91749	0.03928
	Was	0.00279	0.00016	0.00073	0.00080	0.00016	0.00083	0.00165	0.03506	0.00239	0.01257	0.00287
	Ser	0.16166	0.01118	0.05162	0.04219	0.01274	0.05438	0.10814	0.14748	0.00881	0.46440	0.44062
Commodities	Agr	0.34503	0.00202	0.03834	0.00733	0.00222	0.00907	0.01804	0.02465	0.00140	0.09371	0.03772
	Min	0.01125	0.05695	0.00353	0.00502	0.01013	0.01802	0.03584	0.03025	0.00200	0.09373	0.01274
	Fod	0.05869	0.00250	0.11015	0.00872	0.00287	0.01163	0.02313	0.03203	0.00182	0.09678	0.05142
	Che	0.03497	0.00141	0.00871	0.18442	0.00111	0.00917	0.01823	0.02123	0.00134	0.10472	0.01953
	Tra	0.04660	0.00397	0.01598	0.01366	0.00329	0.01683	0.03347	0.05120	0.00317	0.13545	0.05311
	Elec	0.02212	0.00226	0.00709	0.00778	0.04603	0.01469	0.02922	0.03917	0.00253	0.07375	0.02710
	Cem	0.00060	0.00006	0.00021	0.00025	0.00006	0.08569	0.00501	0.00084	0.00005	0.00219	0.00090
	Mnr	0.00190	0.00020	0.00068	0.00082	0.00018	0.00850	0.18231	0.00275	0.00018	0.00711	0.00290
	Iro	0.00435	0.00052	0.00145	0.00184	0.00036	0.00210	0.00418	0.40206	0.00363	0.06394	0.00552
	Met	0.00234	0.00029	0.00079	0.00104	0.00020	0.00118	0.00234	0.03131	0.07012	0.03737	0.00301
	Con	0.00261	0.00018	0.00078	0.00067	0.00026	0.00081	0.00161	0.00460	0.00030	0.00731	0.00440
	Oth	0.06599	0.00536	0.01876	0.01567	0.00458	0.02389	0.04750	0.05336	0.00318	1.67658	0.07177
	Was	0.00413	0.00023	0.00108	0.00118	0.00023	0.00123	0.00244	0.05192	0.00355	0.01861	0.00424
	Ser	0.17297	0.01196	0.05523	0.04515	0.01363	0.05819	0.11571	0.15780	0.00943	0.49691	0.47147
Labor		0.06996	0.00641	0.02670	0.02422	0.00627	0.03267	0.06497	0.08919	0.00498	0.27175	0.13811
Capital		0.27384	0.01423	0.06882	0.04557	0.01780	0.06352	0.12632	0.17712	0.01002	0.49493	0.23364
Household		0.34380	0.02064	0.09552	0.06979	0.02408	0.09619	0.19129	0.26631	0.01500	0.76668	0.37175
Government		0.04039	0.00860	0.02537	0.01829	0.00485	0.01602	0.03186	0.06374	0.00385	0.30977	0.05307
Saving/Investment		0.11001	0.00660	0.03056	0.02233	0.00770	0.03078	0.06121	0.08521	0.00480	0.24532	0.11895
Rest of World		0.09964	0.03988	0.02860	0.10483	0.00985	0.03637	0.07233	0.19996	0.05933	0.74382	0.07462

Table G.31 Multiplier Analysis Results for All Sectors under 80% Difference in Demand Response Based on Free Allocation of Allowances in CP_3 Simulation

		Commodities										
	80%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.35756	0.00210	0.03973	0.00760	0.00230	0.00940	0.01870	0.02555	0.00145	0.09711	0.03909
	Min	0.00339	0.01716	0.00106	0.00151	0.00305	0.00543	0.01080	0.00912	0.00060	0.02825	0.00384
	Fod	0.05294	0.00225	0.09936	0.00786	0.00259	0.01049	0.02087	0.02890	0.00165	0.08730	0.04639
	Che	0.01822	0.00074	0.00454	0.09610	0.00058	0.00478	0.00950	0.01106	0.00070	0.05457	0.01018
	Tra	0.05253	0.00448	0.01801	0.01540	0.00371	0.01897	0.03773	0.05773	0.00357	0.15270	0.05987
	Elec	0.02475	0.00253	0.00793	0.00870	0.05149	0.01643	0.03268	0.04381	0.00283	0.08249	0.03031
	Cem	0.00063	0.00006	0.00022	0.00026	0.00006	0.08985	0.00526	0.00089	0.00006	0.00230	0.00094
	Mnr	0.00199	0.00021	0.00071	0.00086	0.00019	0.00892	0.19116	0.00289	0.00018	0.00746	0.00304
	Iro	0.00341	0.00041	0.00114	0.00144	0.00028	0.00164	0.00327	0.31476	0.00284	0.05006	0.00432
	Met	0.00057	0.00007	0.00019	0.00026	0.00005	0.00029	0.00057	0.00768	0.01720	0.00917	0.00074
	Con	0.00294	0.00020	0.00088	0.00076	0.00030	0.00091	0.00181	0.00517	0.00034	0.00822	0.00494
	Oth	0.04127	0.00335	0.01174	0.00980	0.00286	0.01494	0.02971	0.03337	0.00199	1.04856	0.04489
	Was	0.00319	0.00018	0.00083	0.00091	0.00018	0.00095	0.00188	0.04006	0.00274	0.01436	0.00328
	Ser	0.18475	0.01277	0.05899	0.04822	0.01456	0.06215	0.12359	0.16855	0.01007	0.53074	0.50357
Commodities	Agr	0.39432	0.00231	0.04382	0.00838	0.00254	0.01037	0.02062	0.02817	0.00160	0.10709	0.04311
	Min	0.01285	0.06508	0.00404	0.00574	0.01158	0.02060	0.04096	0.03457	0.00229	0.10712	0.01456
	Fod	0.06707	0.00285	0.12588	0.00996	0.00328	0.01329	0.02644	0.03661	0.00209	0.11061	0.05877
	Che	0.03996	0.00162	0.00995	0.21077	0.00127	0.01048	0.02084	0.02426	0.00153	0.11968	0.02233
	Tra	0.05325	0.00454	0.01826	0.01561	0.00376	0.01923	0.03825	0.05852	0.00362	0.15480	0.06070
	Elec	0.02528	0.00258	0.00810	0.00889	0.05260	0.01679	0.03339	0.04476	0.00289	0.08428	0.03097
	Cem	0.00069	0.00007	0.00024	0.00029	0.00006	0.09793	0.00573	0.00097	0.00006	0.00250	0.00103
	Mnr	0.00217	0.00023	0.00078	0.00094	0.00020	0.00972	0.20835	0.00315	0.00020	0.00813	0.00331
	Iro	0.00498	0.00059	0.00166	0.00210	0.00041	0.00240	0.00477	0.45950	0.00414	0.07308	0.00631
	Met	0.00268	0.00034	0.00091	0.00119	0.00022	0.00135	0.00268	0.03579	0.08014	0.04270	0.00345
	Con	0.00299	0.00020	0.00090	0.00077	0.00030	0.00093	0.00184	0.00526	0.00034	0.00836	0.00502
	Oth	0.07542	0.00612	0.02145	0.01791	0.00523	0.02730	0.05429	0.06098	0.00364	1.91609	0.08202
	Was	0.00472	0.00027	0.00123	0.00135	0.00026	0.00140	0.00279	0.05934	0.00405	0.02127	0.00485
	Ser	0.19768	0.01367	0.06313	0.05159	0.01558	0.06650	0.13224	0.18035	0.01077	0.56790	0.53882
Labor		0.07995	0.00732	0.03051	0.02768	0.00717	0.03734	0.07425	0.10193	0.00569	0.31057	0.15784
Capital		0.31296	0.01627	0.07865	0.05207	0.02035	0.07260	0.14437	0.20242	0.01146	0.56563	0.26701
Household		0.39291	0.02359	0.10916	0.07976	0.02752	0.10993	0.21861	0.30436	0.01715	0.87620	0.42486
Government		0.04616	0.00983	0.02900	0.02090	0.00555	0.01831	0.03641	0.07284	0.00440	0.35402	0.06065
Saving/Investment		0.12572	0.00755	0.03493	0.02552	0.00880	0.03518	0.06995	0.09739	0.00549	0.28036	0.13594
Rest of World		0.11388	0.04558	0.03269	0.11980	0.01126	0.04157	0.08267	0.22853	0.06781	0.85008	0.08528

Table G.32 Multiplier Analysis Results for All Sectors under 90% Difference in Demand Response Based on Free Allocation of Allowances in CP_3 Simulation

		Commodities										
	90%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.40226	0.00236	0.04470	0.00855	0.00259	0.01058	0.02103	0.02874	0.00163	0.10925	0.04398
	Min	0.00381	0.01931	0.00120	0.00170	0.00344	0.00611	0.01215	0.01026	0.00068	0.03178	0.00432
	Fod	0.05956	0.00253	0.11178	0.00884	0.00291	0.01180	0.02347	0.03251	0.00185	0.09822	0.05219
	Che	0.02050	0.00083	0.00510	0.10811	0.00065	0.00537	0.01069	0.01244	0.00079	0.06139	0.01145
	Tra	0.05910	0.00504	0.02026	0.01733	0.00417	0.02135	0.04245	0.06494	0.00402	0.17179	0.06736
	Elec	0.02784	0.00284	0.00892	0.00979	0.05792	0.01849	0.03677	0.04929	0.00319	0.09281	0.03410
	Cem	0.00071	0.00007	0.00025	0.00030	0.00007	0.10109	0.00591	0.00100	0.00006	0.00258	0.00106
	Mnr	0.00224	0.00023	0.00080	0.00097	0.00021	0.01003	0.21506	0.00325	0.00021	0.00839	0.00342
	Iro	0.00383	0.00046	0.00128	0.00162	0.00031	0.00185	0.00368	0.35411	0.00319	0.05632	0.00486
	Met	0.00065	0.00008	0.00022	0.00029	0.00005	0.00032	0.00065	0.00864	0.01935	0.01031	0.00083
	Con	0.00330	0.00023	0.00099	0.00085	0.00033	0.00103	0.00204	0.00582	0.00038	0.00925	0.00556
	Oth	0.04643	0.00377	0.01320	0.01103	0.00322	0.01681	0.03342	0.03754	0.00224	1.17963	0.05050
	Was	0.00358	0.00020	0.00094	0.00102	0.00020	0.00106	0.00212	0.04507	0.00308	0.01616	0.00368
	Ser	0.20784	0.01437	0.06637	0.05425	0.01638	0.06992	0.13904	0.18962	0.01133	0.59709	0.56651
Commodities	Agr	0.44361	0.00260	0.04929	0.00943	0.00286	0.01166	0.02320	0.03169	0.00180	0.12048	0.04850
	Min	0.01446	0.07322	0.00454	0.00645	0.01303	0.02317	0.04609	0.03889	0.00257	0.12051	0.01639
	Fod	0.07546	0.00321	0.14162	0.01121	0.00369	0.01496	0.02974	0.04119	0.00235	0.12444	0.06612
	Che	0.04496	0.00182	0.01119	0.23711	0.00143	0.01179	0.02344	0.02729	0.00172	0.13464	0.02512
	Tra	0.05991	0.00511	0.02054	0.01756	0.00423	0.02164	0.04303	0.06583	0.00407	0.17415	0.06828
	Elec	0.02845	0.00290	0.00911	0.01000	0.05918	0.01889	0.03756	0.05036	0.00325	0.09482	0.03484
	Cem	0.00077	0.00008	0.00027	0.00032	0.00007	0.11018	0.00645	0.00109	0.00007	0.00282	0.00116
	Mnr	0.00244	0.00025	0.00087	0.00106	0.00023	0.01093	0.23440	0.00354	0.00023	0.00914	0.00372
	Iro	0.00560	0.00067	0.00187	0.00236	0.00046	0.00270	0.00537	0.51693	0.00466	0.08221	0.00710
	Met	0.00301	0.00038	0.00102	0.00134	0.00025	0.00151	0.00301	0.04026	0.09015	0.04804	0.00388
	Con	0.00336	0.00023	0.00101	0.00086	0.00034	0.00104	0.00208	0.00592	0.00038	0.00940	0.00565
	Oth	0.08484	0.00689	0.02413	0.02015	0.00589	0.03071	0.06108	0.06861	0.00409	2.15560	0.09227
	Was	0.00531	0.00030	0.00139	0.00152	0.00030	0.00158	0.00313	0.06676	0.00456	0.02393	0.00546
	Ser	0.22239	0.01538	0.07102	0.05804	0.01753	0.07481	0.14877	0.20289	0.01212	0.63889	0.60618
Labor		0.08994	0.00824	0.03433	0.03115	0.00806	0.04200	0.08353	0.11468	0.00640	0.34939	0.17757
Capital		0.35208	0.01830	0.08848	0.05858	0.02289	0.08167	0.16241	0.22772	0.01289	0.63633	0.30039
Household		0.44202	0.02654	0.12281	0.08973	0.03096	0.12367	0.24594	0.34240	0.01929	0.98573	0.47796
Government		0.05193	0.01106	0.03262	0.02351	0.00624	0.02060	0.04096	0.08195	0.00495	0.39828	0.06823
Saving/Investment		0.14144	0.00849	0.03930	0.02871	0.00990	0.03957	0.07870	0.10956	0.00617	0.31541	0.15294
Rest of World		0.12811	0.05128	0.03678	0.13478	0.01267	0.04677	0.09300	0.25710	0.07628	0.95634	0.09594

Table G.33 Multiplier Analysis Results for All Sectors under 100% Difference in Demand Response Based on Free Allocation of Allowances in CP_3 Simulation

		Commodities										
	100%	Agr	Min	Fod	Che	Elec	Cem	Mnr	Iro	Met	Oth	Ser
Activities	Agr	0.44695	0.00262	0.04967	0.00950	0.00288	0.01175	0.02337	0.03193	0.00182	0.12139	0.04886
	Min	0.00424	0.02145	0.00133	0.00189	0.00382	0.00679	0.01350	0.01140	0.00075	0.03531	0.00480
	Fod	0.06617	0.00281	0.12420	0.00983	0.00323	0.01312	0.02608	0.03612	0.00206	0.10913	0.05798
	Che	0.02277	0.00092	0.00567	0.12012	0.00072	0.00597	0.01188	0.01383	0.00087	0.06821	0.01272
	Tra	0.06567	0.00560	0.02251	0.01925	0.00464	0.02372	0.04717	0.07216	0.00447	0.19088	0.07484
	Elec	0.03094	0.00316	0.00991	0.01087	0.06436	0.02054	0.04085	0.05476	0.00354	0.10312	0.03789
	Cem	0.00079	0.00008	0.00028	0.00033	0.00007	0.11232	0.00657	0.00111	0.00007	0.00287	0.00118
	Mnr	0.00249	0.00026	0.00089	0.00108	0.00023	0.01115	0.23895	0.00361	0.00023	0.00932	0.00380
	Iro	0.00426	0.00051	0.00142	0.00180	0.00035	0.00205	0.00409	0.39345	0.00355	0.06257	0.00541
	Met	0.00072	0.00009	0.00024	0.00032	0.00006	0.00036	0.00072	0.00960	0.02150	0.01146	0.00092
	Con	0.00367	0.00025	0.00110	0.00094	0.00037	0.00114	0.00227	0.00646	0.00042	0.01028	0.00618
	Oth	0.05159	0.00419	0.01467	0.01225	0.00358	0.01867	0.03714	0.04172	0.00249	1.31070	0.05611
	Was	0.00398	0.00023	0.00104	0.00114	0.00022	0.00118	0.00235	0.05008	0.00342	0.01795	0.00409
	Ser	0.23094	0.01597	0.07374	0.06027	0.01820	0.07768	0.15449	0.21068	0.01258	0.66343	0.62946
Commodities	Agr	0.49290	0.00289	0.05477	0.01048	0.00317	0.01296	0.02577	0.03522	0.00200	0.13387	0.05389
	Min	0.01607	0.08136	0.00505	0.00717	0.01447	0.02575	0.05121	0.04321	0.00286	0.13390	0.01821
	Fod	0.08384	0.00357	0.15735	0.01245	0.00410	0.01662	0.03305	0.04576	0.00261	0.13826	0.07346
	Che	0.04995	0.00202	0.01244	0.26346	0.00159	0.01310	0.02605	0.03033	0.00191	0.14960	0.02791
	Tra	0.06657	0.00568	0.02282	0.01951	0.00470	0.02404	0.04781	0.07315	0.00453	0.19350	0.07587
	Elec	0.03161	0.00323	0.01012	0.01111	0.06575	0.02099	0.04174	0.05595	0.00362	0.10535	0.03871
	Cem	0.00086	0.00009	0.00030	0.00036	0.00008	0.12242	0.00716	0.00121	0.00008	0.00313	0.00128
	Mnr	0.00271	0.00028	0.00097	0.00118	0.00025	0.01215	0.26044	0.00393	0.00025	0.01016	0.00414
	Iro	0.00622	0.00074	0.00207	0.00263	0.00051	0.00300	0.00596	0.57437	0.00518	0.09135	0.00789
	Met	0.00334	0.00042	0.00113	0.00149	0.00028	0.00168	0.00335	0.04473	0.10017	0.05338	0.00431
	Con	0.00373	0.00025	0.00112	0.00096	0.00038	0.00116	0.00231	0.00657	0.00043	0.01045	0.00628
	Oth	0.09427	0.00766	0.02681	0.02239	0.00654	0.03413	0.06786	0.07623	0.00455	2.39511	0.10253
	Was	0.00590	0.00033	0.00154	0.00168	0.00033	0.00175	0.00348	0.07418	0.00507	0.02659	0.00606
	Ser	0.24710	0.01709	0.07891	0.06449	0.01947	0.08312	0.16530	0.22543	0.01347	0.70988	0.67353
Labor		0.09994	0.00915	0.03814	0.03461	0.00896	0.04667	0.09281	0.12742	0.00711	0.38822	0.19730
Capital		0.39120	0.02033	0.09831	0.06509	0.02543	0.09074	0.18046	0.25303	0.01432	0.70704	0.33377
Household		0.49114	0.02949	0.13645	0.09970	0.03439	0.13741	0.27327	0.38044	0.02143	1.09525	0.53107
Government		0.05770	0.01229	0.03625	0.02613	0.00693	0.02288	0.04551	0.09105	0.00550	0.44253	0.07582
Saving/Investment		0.15715	0.00944	0.04366	0.03190	0.01101	0.04397	0.08744	0.12173	0.00686	0.35046	0.16993
Rest of World		0.14235	0.05698	0.04086	0.14975	0.01407	0.05196	0.10333	0.28566	0.08476	1.06260	0.10660