EU Carbon Border Adjustment with the US Rejoining Paris: A Bit of a Game Changer

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Paper available here: https://www.dropbox.com/s/gvpb8belvh1uctt/gtap2021_CBA_paper.pdf?dl=0

Motivation 1/2

Global carbon price: global solution to a global problem

- Externality of economic activity on climate
- 3 problems
  - Non-cooperative behavior
  - Country-specific standards of living and discount rates
  - Developing countries' historic rights to emit

Paris Agreement: cooperative behavior and local solutions

- National Determined Contributions (NDCs) and national mechanisms
- International differences in carbon prices
  - Direct carbon leakages (imports)
  - Indirect carbon leakages (*via* energy markets)

Motivation 2/2

European Emission Trading Scheme (EU ETS)

- Implemented in 2005: "Cap and trade"
- Emissions of over 10 000 industrial installations
  (steel, cement, fossil-fuel-based electricity production, commercial aviation within the European Economic Area)
- Representing 40% of the EU emissions
- Share of auctioned emission quotas: 57%
- GHG emissions EU/World $< 10\%$ (3.6 Gt CO_2eq in 2020)

European Green Deal

- EU objective: -55% in 2030 wrt 1990, carbon neutrality 2050
- 16 Sept., 2020, U. von der Leyen: complete ETS with CBAM
- 10 March, 2021: Resolution by the European Parliament
- 14July, 2021: Proposal of regulation by EU commission

What we show

Impact of the CBAM on climate

- Necessary to enable the Green Deal higher ambition
- Reduces EU leakages and (slightly) global emissions
- Marginal compared to the US re-joining the Paris Agreement
- No incentive for other big players
- An element of a wider climate policy

Impact of the CBAM on the economy

- Increase in the carbon tax (despite second market)
- Level playing field only intra-EU for the sectors covered
- Competitiveness loss downstream

Literature

Beyond mechanisms at stake, extensive CGE litterature on

- Impacts: environment, economic, redistributive...
- Different policies: CBA (Babiker and Rutherford, 2005; Cezar and Grieco, 2021), CCBA (Weitzel et al., 2012; Antimiani et al., 2013; Manders and Veenendaal, 2008), compensatory tariffs (Böhringer et al., 2012; Böhringer et al., 2021), coalitions (Nordhaus, 2015)
- Under different institutional environments: Kyoto Protocol, EU ETS, Paris Agreement – with or w/o the US...
- Implementation cost of Paris under different CO_2 trading schemes (Böhringer et al., 2021)
- With different kind of models (Böhringer et al., 2021)

Tools used

MaGE

- Macro trajectory with 2040 horizon ▸ MaGE
- Demographics, female labor market participation, education, technological catch-up, energy efficiency, lifecycle, current account

MIRAGE-VA

- Global and sectoral CGE model, global value chains, GHGs (carbon dioxyde, methane, nitrous oxide, fluorinated gases)
  ▸ MIRAGE ▸ TFP energy
- Implicit techn. progr. – substit. K∼E and non-CO_2 ∼ conventional inputs
- MRIO table – *ImpactEcon* for GTAP 9.0-a
- Imperfect competition

Our assumptions (1/3)

1. What scope?
   - Sectors covered by ETS (incl. glass, paper and all chemistry)
   - ETS Sectors + downstream industries (pro-rata of ETS cons.)?
2. Which tax base (i.e. ref. emissions)?
   - ◇ Exporter ◇ World average ◇ EU
   - ◇ Direct emissions incl. energy ◇ Indirect emissions (elec.)
3. What kind of taxation?
   - Tariff
   - Tax
   - Emission quotas purchased by European importers
4. What allocation of the CBAM revenues?
   - General European budget
   - Only decarbonization projects
   - International transfer
5. Rebate of purchased ETS quotas to European exporters?
6. Free allocations of quotas to ETS industries?
7. SDT of imports from LDCs

Our assumptions (2/3)

In blue, the assumptions in our scenarios

1. What scope?
   - Sectors covered by ETS (incl. glass, paper and all chemistry)
   - ETS Sectors + downstream industries
2. Which tax base?
   - ◇ Exporter ◇ World average ◇ EU
   - ◇ Direct emissions incl. energy ◇ Indirect emissions (elec.)
3. What kind of compensation? No double taxation
   - Tariff
   - Tax
   - Emission quotas purchased by European importers
4. What allocation of the CBAM revenues?
   - General European budget
   - Only decarbonization projects
   - International transfer
5. Rebate to European exporters → with and without
6. Free allocation of quotas to ETS industries
7. SDT of imports from LDCs

Our assumptions (3/3)

- US in the Paris Agreement (baseline and scenarios)
- ETS in the EU
- Rapid obsolescence of installed equipment
- Incorporated technological progress
- Abatement of emissions limiting the increase of ETS price
- Unconditional NDCs (as of April 22, 2021: USA, UK, Jap., Can.)
- Shock: CBAM in 2023, horizon = 2040

$\Rightarrow$ CBAM: *one element* of an ambitious decarbonization policy

▸ Abatement & ETS prices

Simulated scenarios

1. 1st step: 2040 horizon projected by MaGE ▸ MaGE+MIRAGE
2. 2nd step: unconditional commitments (updated) taken in the Paris Ag. ▸ Paris Ag.
   - EU: two levels of carbon tax: ETS and rest of economy
   - Other countries with unconditional NDCs: one level of carbon tax
3. 3rd step: implementation of the CBAM scenarios

Table: Scenarios

Scen.	Scope	Emissions	Tax base	Rebate	SDT
S1	All ETS sect.	Direct	EU	No	Yes
S2	All ETS sect.	Direct	Exporter	No	Yes
S3	All ETS sect.	Direct + indirect	EU	No	Yes
S4	All ETS sect.	Direct	EU	Yes	Yes

Results (1/5)

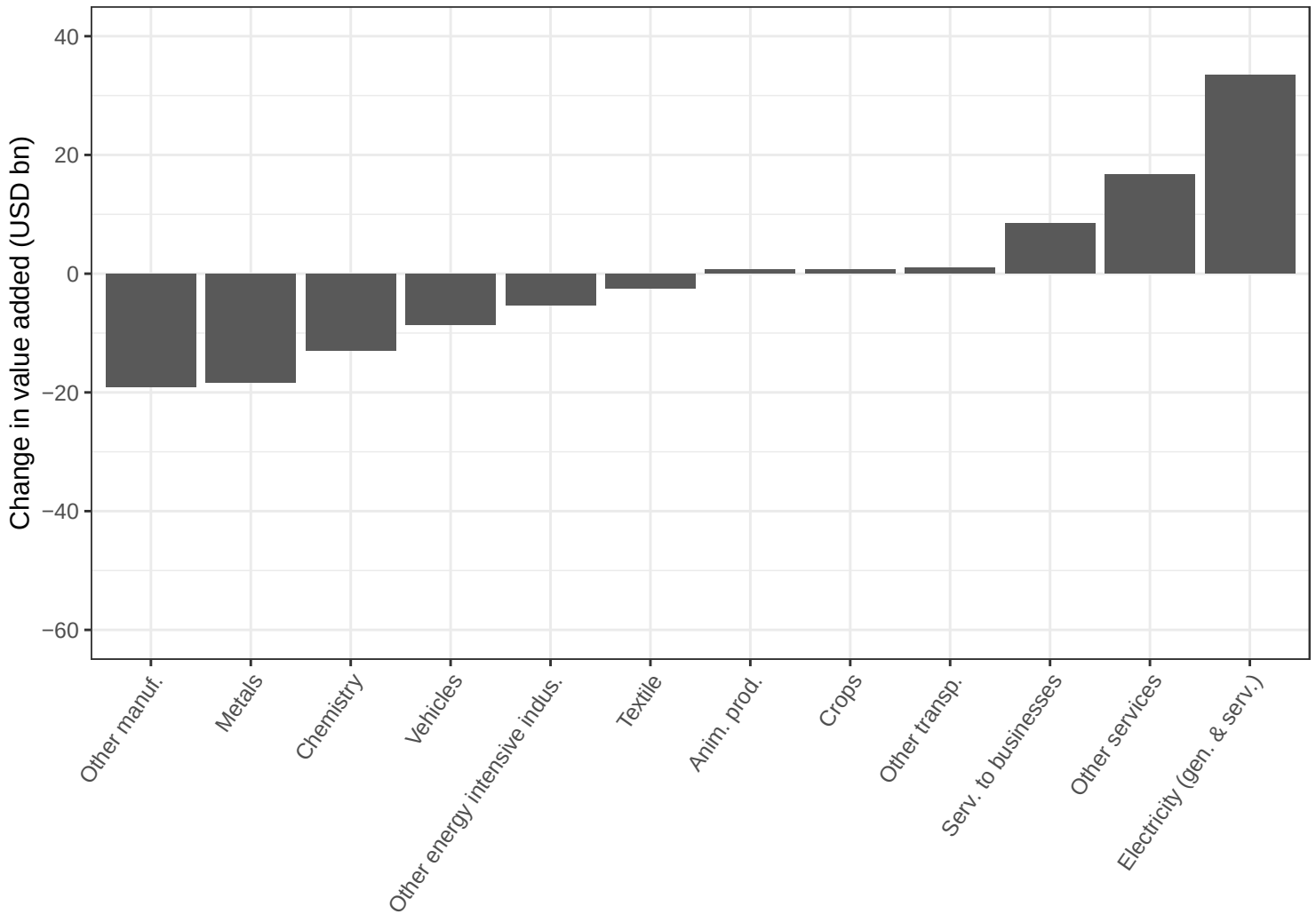
Table: Impact of the CBAM in EU (% change wrt to the reference scenario, in 2040)

	CBAM	+ ref. exp	+ Indir.emiss.	+ rebate
GDP	−0.63	−0.34	−0.52	−0.71
Exports				
Exports int. goods	−3.57	−3.65	−3.74	−1.26
Exports final goods	−2.65	−6.72	−3.87	−3.61
Imports				
Imports int. goods	−3.00	−6.81	−4.18	−2.35
Imports final goods	−1.60	−1.65	−1.64	−0.78
Carbon price ETS	22.10	29.46	24.02	28.67

Notes: relative changes in % compared to the baseline, in 2040, excl. price effect, excl. intra-EU, results in volume. US in the Paris agreement. International freight included. Source: MIRAGE-VA, calculations by the authors.

Results(2/5)

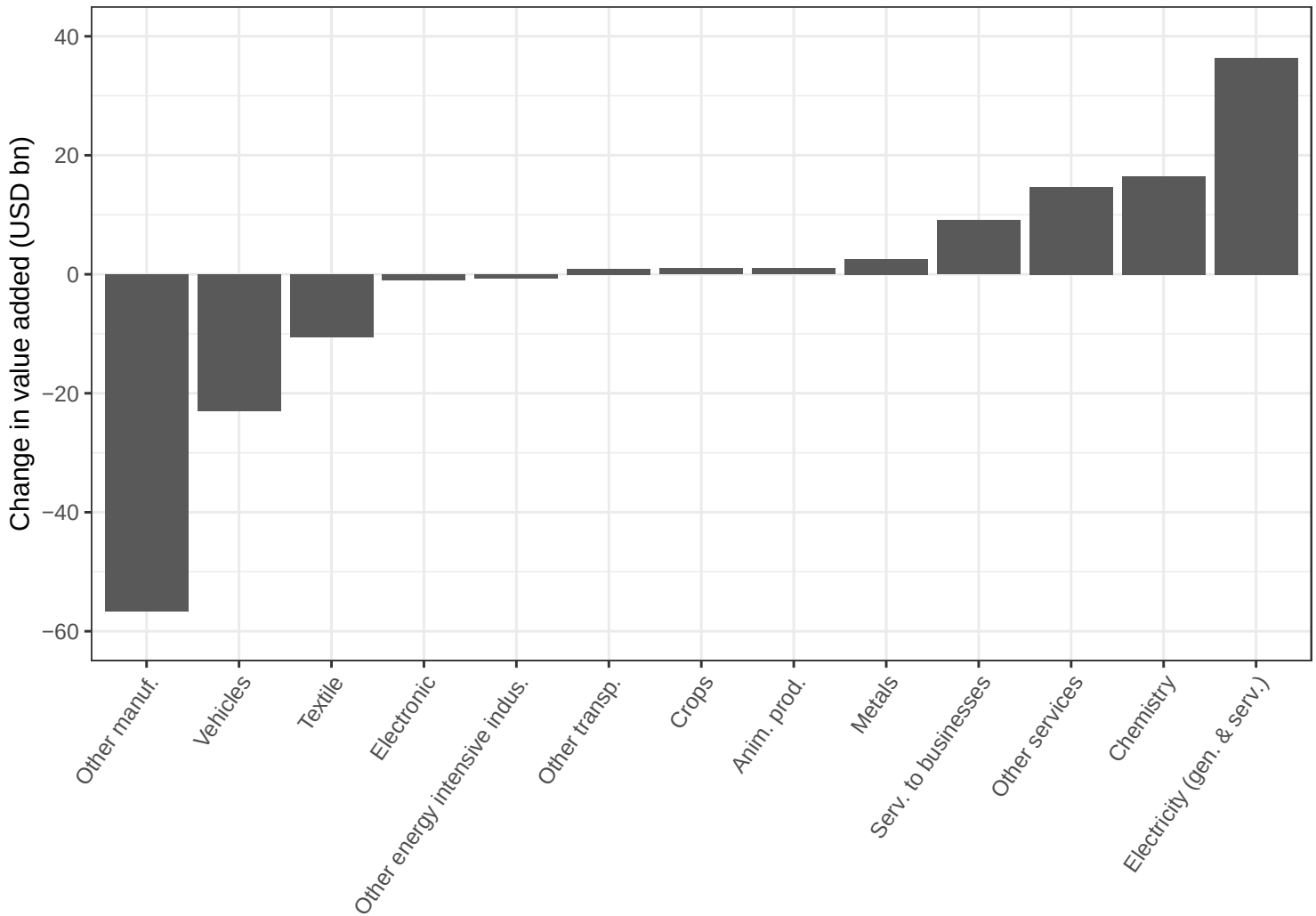
Figure: Impact of the CBAM on sectoral value added (*vs* baseline, in 2040)



Source: simulations with MIRAGE-VA, calculations by the authors (var.$>$ USD 500 Mn)

Results (3/5)

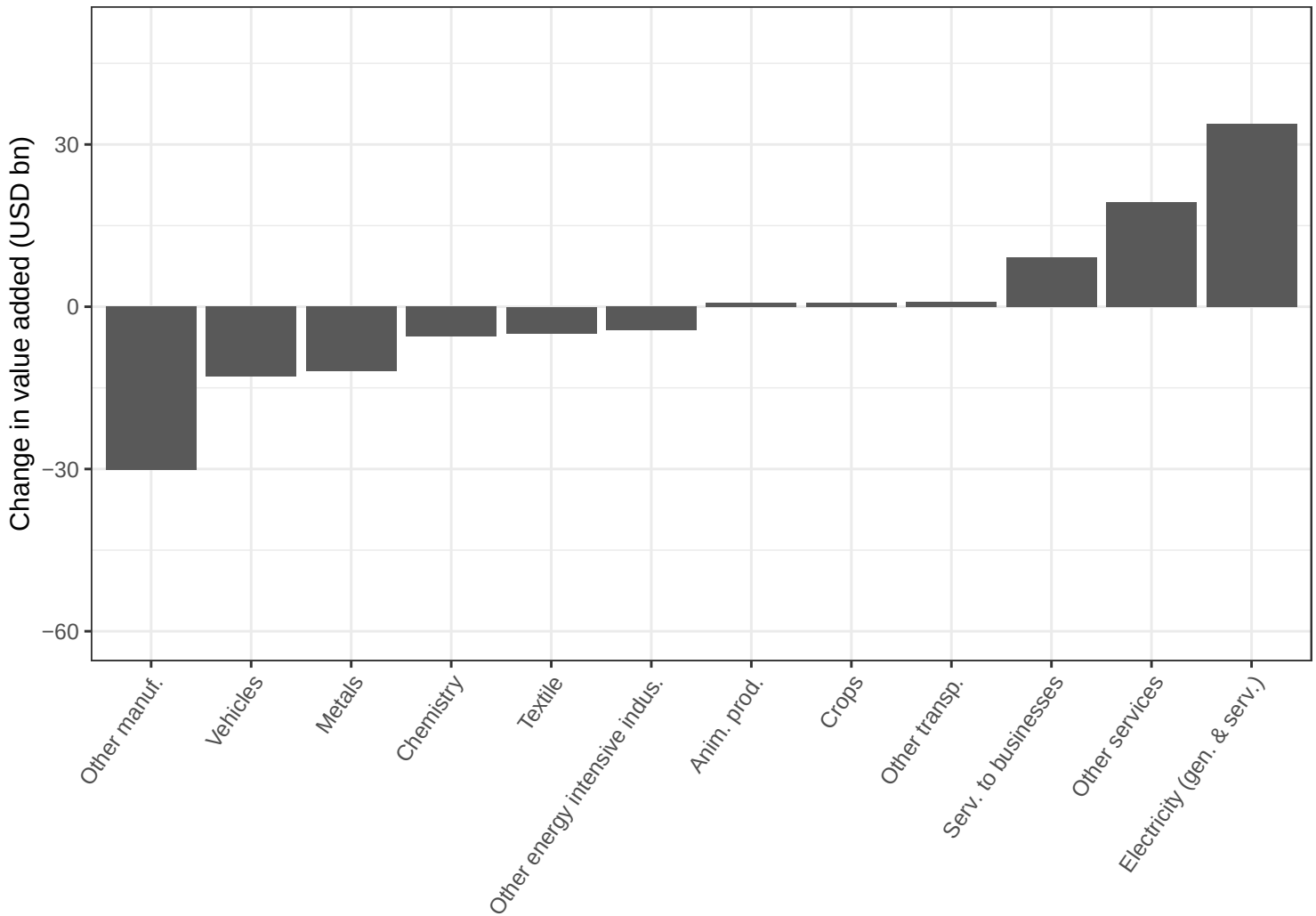
Figure: Impact of the CBAM *based on the emissions by the exporters* on sectoral value added (*vs* baseline, in 2040)



Source: simulations with MIRAGE-VA, calculations by the authors (var.$>$ USD 500 Mn)

Results (4/5)

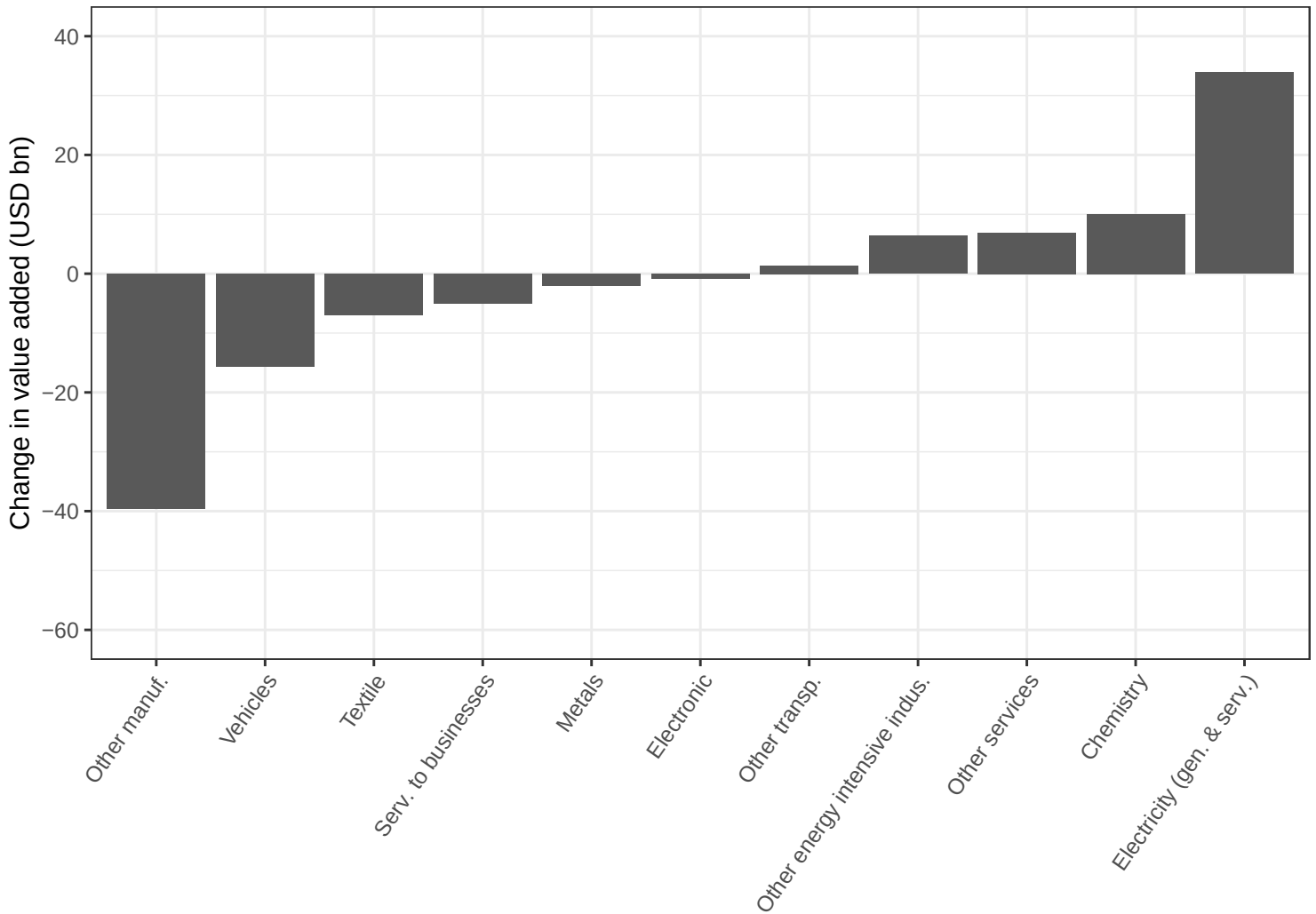
Figure: Impact of the CBAM *covering also indirect emissions* on sectoral value added (*vs* baseline, in 2040)



Source: simulations with MIRAGE-VA, calculations by the authors (var.$>$ USD 500 Mn)

Results (5/5)

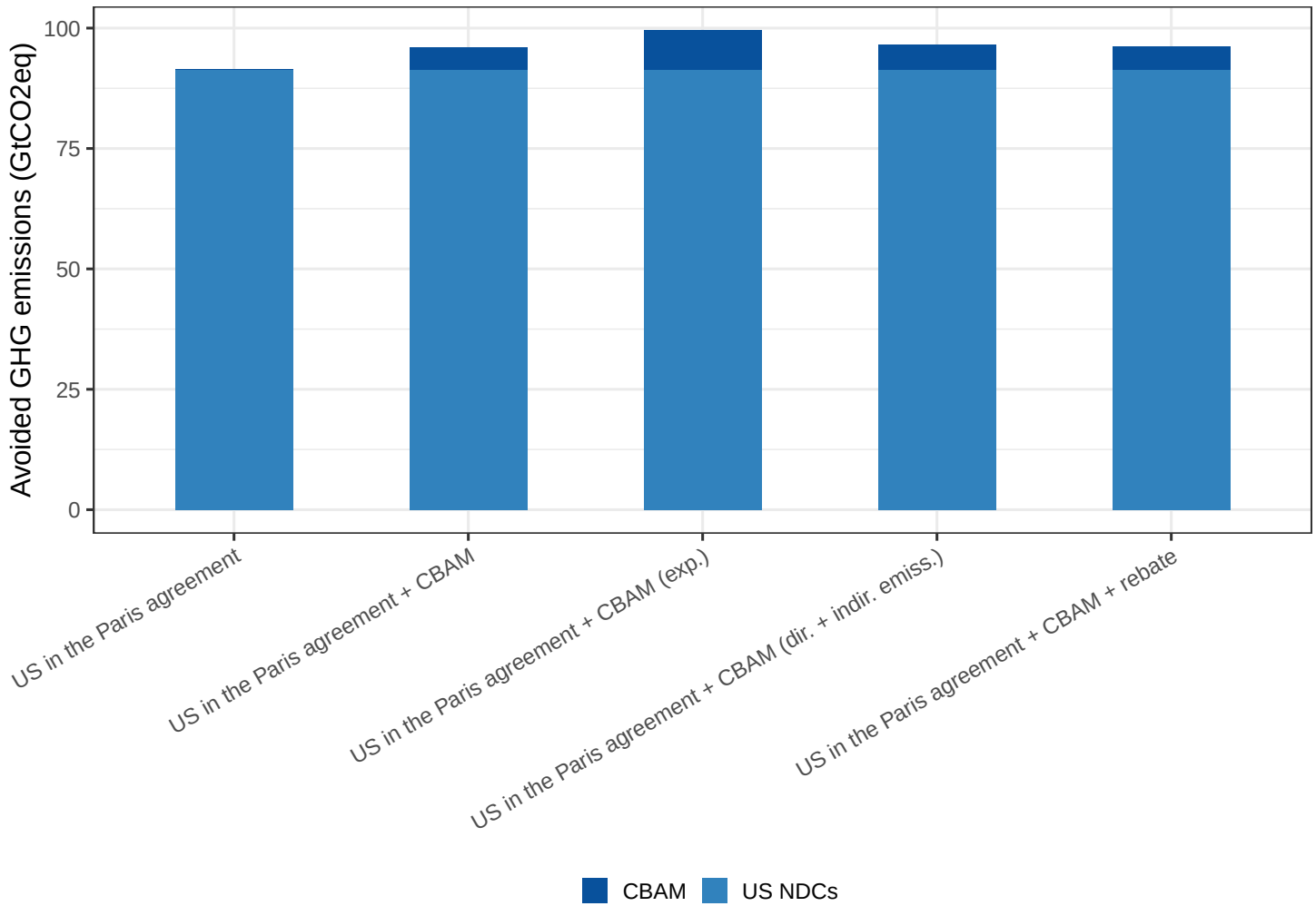
Figure: Impact of the CBAM *with rebate* on sectoral value added (*vs* baseline, in 2040)



Source: simulations with MIRAGE-VA, calculations by the authors (var.$>$ USD 500 Mn)

Discussion 1/3

Figure: Cumulated global GHG emissions *avoided*, 2023-2040



Source: MIRAGE-VA, author's calculations. Baseline: Paris *without* the US. International freight incl.

The return of the US avoids 91 Gt, CBAM avoids 5 Gt.

Discussion 2/3

Impact on leakages of EU policy:

- Leakage: 18 Gt cumulated 2023-40
- CBAM: -26%
- CBAM exporter reference emissions: -45%
- CBAM indirect emissions: -29%
- CBAM & rebate: -26%

Discussion 3/3

Work in progress:

- GTAP 10.1 MRIO
- Most recent baseline by MaGE
- Trade elasticities by Fontagné et al. (2019)
- Agenda

Conclusions

WTO constraints on CBAM:

- National and non-discriminating treatment
- Base
- Rebate
- Free allocations
- SDT

CBAM

- Increases price of ETS quotas in the 1st market *even if* importers buy them on the 2nd
- Reduces EU imports *and* exports (impact on prod. costs of downstream sectors)
- *per se* has a limited impact on climate but enables Green Deal ambition

The return of the US to Paris (and its new NDCs):

- Much greater impact on global emissions than CBAM
- Reduces the risk of retaliation (no double carbon taxation)

Merci

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GDP projection by MaGE

Production function with 3 prod. factors and 2 TFPs (van der Werf, Energy Econ., '08)

$$\max\left(Y - p_K K - p_L L - p_E E\right) \tag{1}$$

s.t.

$$Y = \left[\left(AK^{\alpha}L^{1-\alpha}\right)^{\frac{\sigma-1}{\sigma}} + \left(BE\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{2}$$

Energy demand from FOCs :

$$E = Y\frac{B^{\sigma-1}}{p_E^{\sigma}} \tag{3}$$

After substitution, projected GDP :

$$Y = \left[1 - \frac{B}{p_E}\right]^{\frac{\sigma}{1-\sigma}} AK^{\alpha}L^{1-\alpha} \tag{4}$$

$\alpha = 0.31$ (Mankiw, Romer & Weil, 1992)

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Energy productivity – From MaGE to MIRAGE

In MIRAGE-e, for sectors other than fossil fuels (coal, gas, oil – refined or not) :

$$E_{irt} = \alpha_E \frac{\tilde{B}_{irt}}{[A_{irt}]^{\sigma_{KE}-1}} KE_{irt} \left(\frac{P^{KE}_{irt}}{P^{E}_{irt}} \right)^{\sigma_{KE}}$$

with $\tilde{B}_{irt}$:

- fixed to 1 in the calibration and for the reference year,
- in the simulations, follows the dynamic path given by $\left[\tilde{B}_{irt} = \tilde{B}_{ir,t-1} \frac{B_{rt}}{B_{r,t-\mathbf{1}}}^{\sigma_{KE}-1} \right]$ where B is the energy productivity projected by MaGE

and A_{irt}: 3 TFP paths, depending on the sector (i)

- Services: dynamic path by Mage
- Manufacture: higher growth rate than in services, +2 p.p. per year
- Agriculture: specific estimation and projection, DEA approach.

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MIRAGE-e VA (1/3)

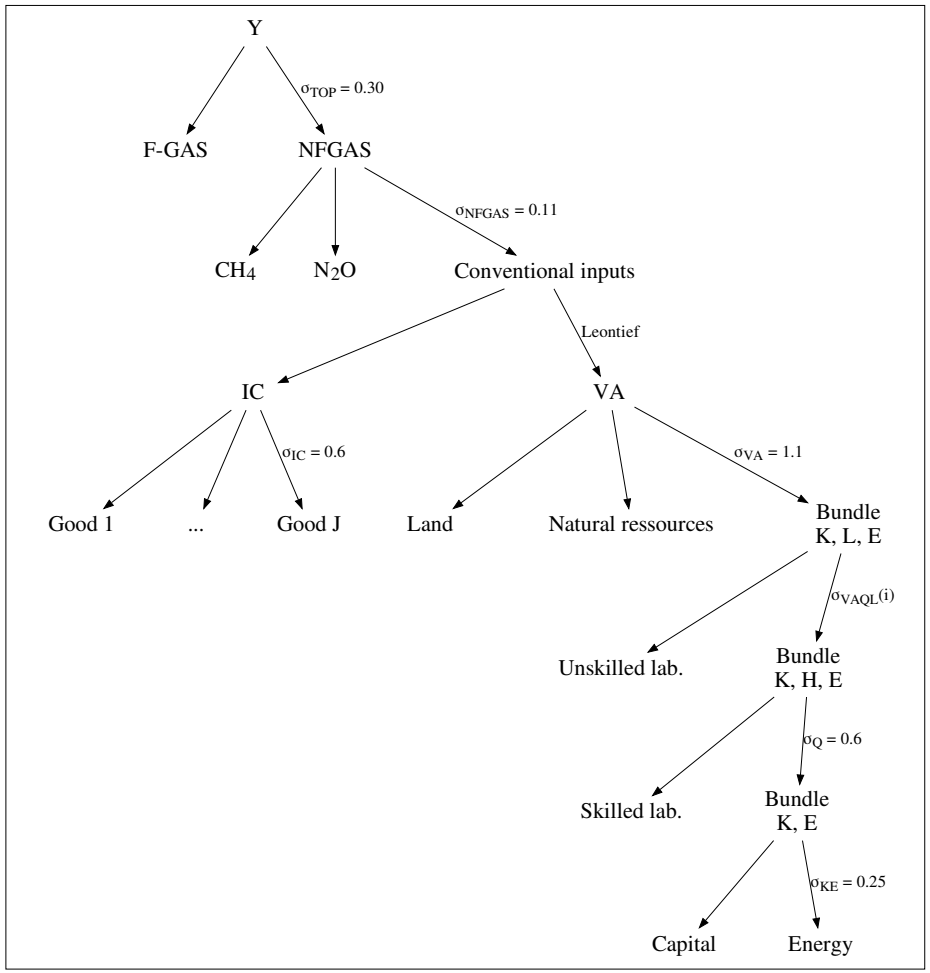
1. Multi-region, multi-sector;
2. Production
   - Oligopolistic competition (mark up) / perfect competition (representative firm) depending on the sectors;
   - Production combines:
     - 5 primary factors: unskilled, skilled, capital, land, natural resources
     - Energy
     - Intermediate consumptions
3. Demand
   - Consumption by a representative household, with LES-CES preferences
   - Trade: Armington assumption
   - Specific and differentiate representation of trade in intermediate consumptions and final goods

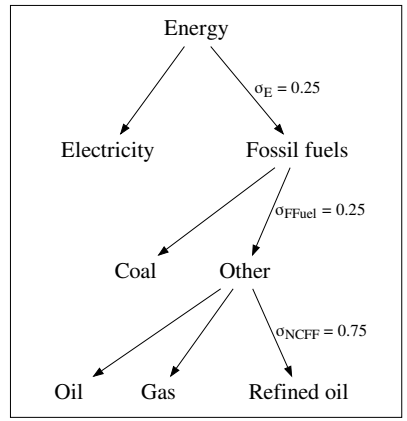
MIRAGE-e VA (2/3)

4. Environment
   - CO_2 emissions proportional to fossil energy consumption
   - Other GHGs (Nitrous oxide, methane and fluorinated gases) emitted during the production process, following (Hyman et al., 2003):
     - GHGs: by-products or production factors
     - Different prod. structures, by sector
   - Carbon tax for abatement
5. Recursive dynamics

MIRAGE-e VA (3/3)

Figure: Production structure – Industry (not ETS nor services)





cf. EPPA Model - Emission Prediction and Pol. Analysis (Hyman et al., 2003)

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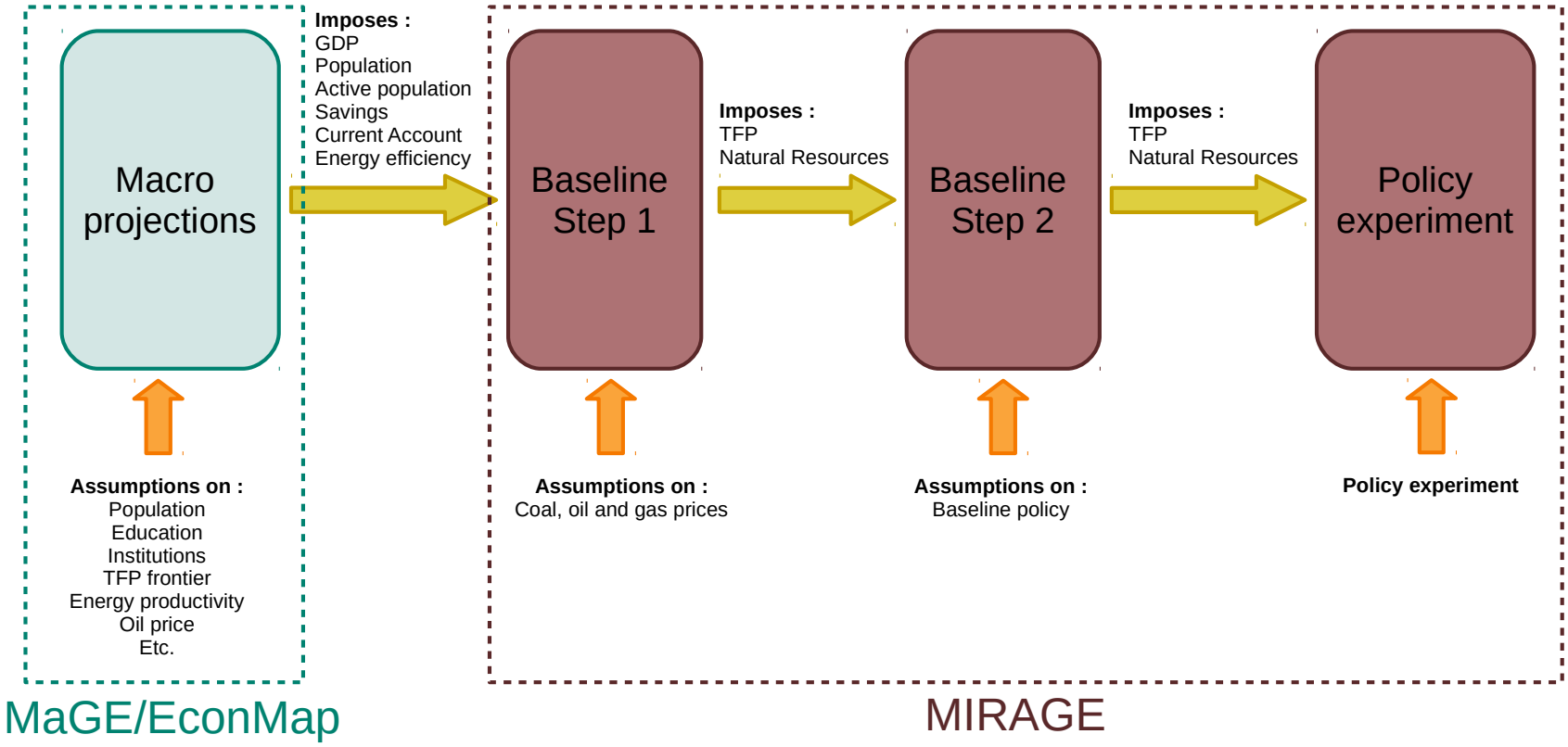
MaGE + MIRAGE



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Implementation of the Paris Agreement in MIRAGE

- Only unconditional commitments are taken into account (Absolute, BAU, intensity) $\Rightarrow$ GHG target, in Mt CO_2 eq
- Linear reduction between 2011 and the NDC's target year
- The price of GHG emissions (i.e. the carbon tax) is computed endogenously to reach the target
- No free allowances

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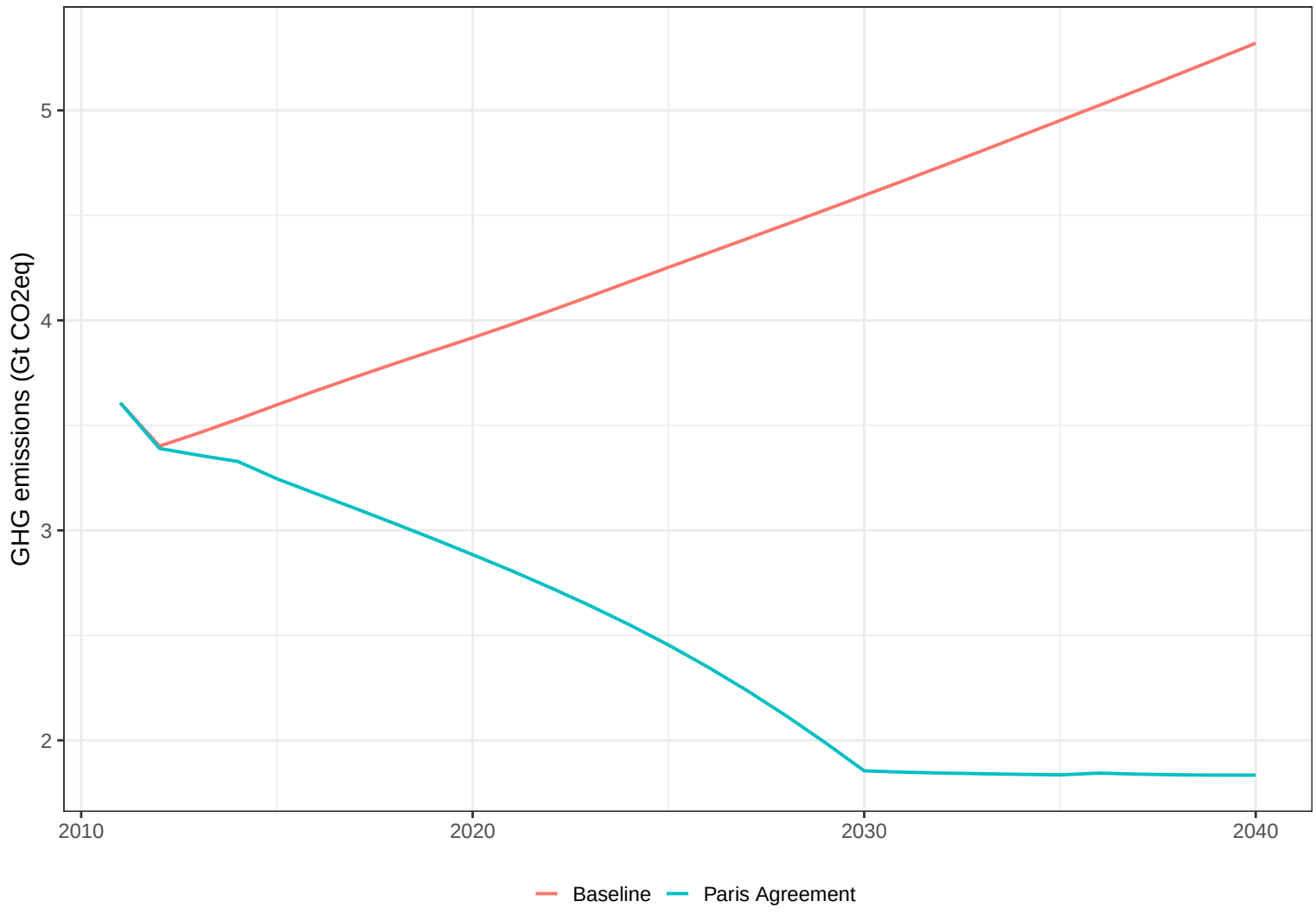
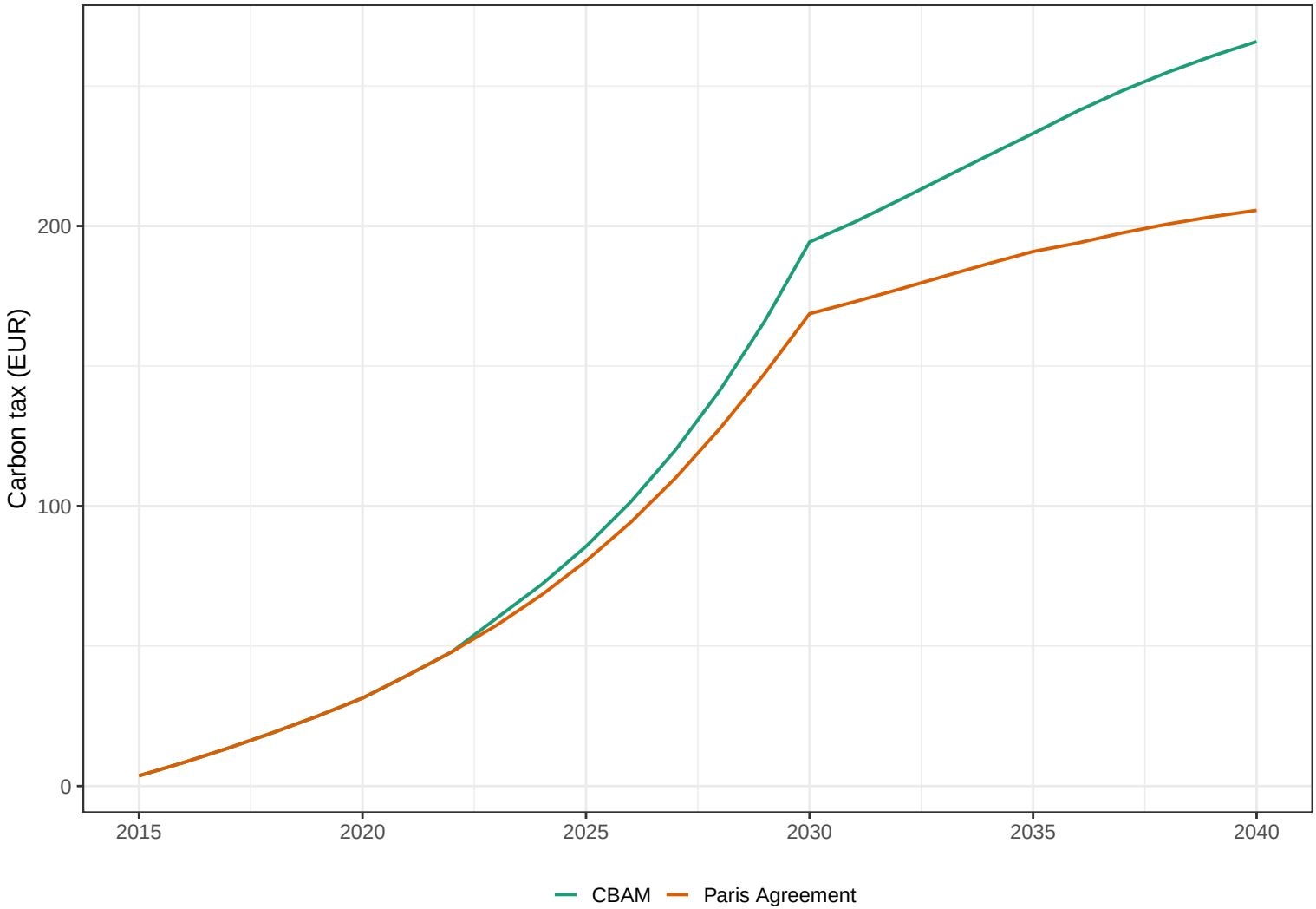
Abatement curves in MIRAGE and ETS prices (1/2)

Figure: EU emissions



Abatement curves in MIRAGE and ETS prices (2/2)

Figure: Prices of ETS quotas



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