EU in Search of a WTO-Compatible Carbon Border Adjustment Mechanism

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Motivation 1/4

Value chains factored into trade policy

- The structure of a tariff system and the effective protective rate (Corden, 1966)
  "*The theory of tariff structure (...) allows for the vertical relationships between tariff rates derived from the input-output relationships between products.*"
  - Protecting inputs is "deprotecting" the value added of the downstream sectors
  - Conversely, the rise in tariffs along the value chain is highly protective.
- Effective protection rate (Anderson, 1998)
  "*the uniform tariff which is equivalent to the actual differentiated tariff structure in its effect on the rents to residual claimants in a sector*"
- In practice: tariff escalation
  "*where an importing country protects its processing or manufacturing industry by setting lower duties on imports of raw materials and components, and higher duties on finished products.*" (WTO)

Motivation 2/4

Trade policy *disqualified* by value chains

- Protection and GVCs (Blanchard et al., 2016)
  "*GVCs already play an important role in shaping trade policy. Governments set lower tariffs and curb their use of temporary trade protection (particularly against China) where GVC linkages are strongest*"
- Trade war in presence of GVCs hurts domestic downstream producers (Bellora and Fontagné, 2020)
- Trade war impacts third countries through cumulative tariffs (Mao and Görg, 2020)

Motivation 3/4

Trade policy *justified* by value chains

- Distance between producer and consumer magnifies problems of information
  - Fundamental social rights in first or second-tier sub-contractors
  - Environmental footprint of intermediate inputs
  - Sanitary quality unobservable in final products
  - Voluntary standards or labelling not sufficient
- Subsidies, presence of SOEs and export restrictions on inputs distort competition
- Externalities of optimal decisions of individual firms (disruptions of value chains during Covid)
- Increasing gap between carbon content of consumption and national inventory

Motivation 4/4

The dilemna

- Uncoordinated climate policies justify action at the border
- GVCs increase the need for action (cumulative carbon content along the value chain)
- GVCs reduce the effectiveness of action
- Todays' talk addressing the specific case of the European proposal of a CBAM

Related literature

Beyond mechanisms at stake, extensive CGE literature on

- Impacts: environment, economic, redistributive...
- Different policies: CBA (Babiker and Rutherford, 2005; Lanzi et al., 2013; Cezar and Grieco, 2021), CCBA (Weitzel et al., 2012; Antimiani et al., 2013; Manders and Veenendaal, 2008), compensatory tariffs (Böhringer et al., 2012, 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., 2022)

What we do

Modeling of carbon pricing in presence of GVCs

- Carbon price transmitted throughout the value chain
  - $\Rightarrow$ MRIO
- Emissions are a dynamic issue
  - $\Rightarrow$ Dynamic path for the global economy
- Leakages result from GE mechanisms
  - Include GHGs in GE

Reference

- Fit for 55, ETS with FAs
- Paris Agreement:
  - Only the countries with a national carbon price in place by 2021 respect their NDCs
  - Specific treatment of China (carbon market July 2021)
  - Only unconditional NDCs updated COP26
- Shock: CBAM in 2026-35, replacing FAs, horizon 2040

What we show

Impact of the CBAM on climate

- Reduces leakages from EU policy
- Tension between efficiency of CBAM and WTO-compatibility

Impact of the CBAM on the EU economy

- Increase in the price of ETS quotas (despite second "market")
- In absence of rebate to exporters, level playing field for the sectors covered: only intra-EU
- CBAM + GVCs = competitiveness loss:
  - Baseline scenario detrimental to downstream sectors
  - The more so than the exporter's emissions reference is used
  - Also detrimental to ETS sectors (compared to FAs)
  - Rebate to exporters would not fully fix their competitiveness problem

Outline

- Policy background
- Modeling tools
- Scenarios
- Results
- Discussion
- Conclusion

Policy background 1/2

Paris Agreement

- National Determined Contributions (NDCs) and subsidiarity
- International differences in carbon prices and carbon leakage
- Neither coordinated nor enforceable (Nordhaus, 2021)

European Emission Trading Scheme (EU ETS)

- "Cap and trade", over 10 000 industrial installations
  (oil refin., steel, alu, metals, cement, glass, paper, bulk organic chem., electricity generation, commercial aviation within the Europ. Econ. Area)
- Representing 40% of the EU emissions
- Share of auctioned emission quotas: 57%
- CO2, nitrous oxyde, perfluorcarbons (alu prod.)

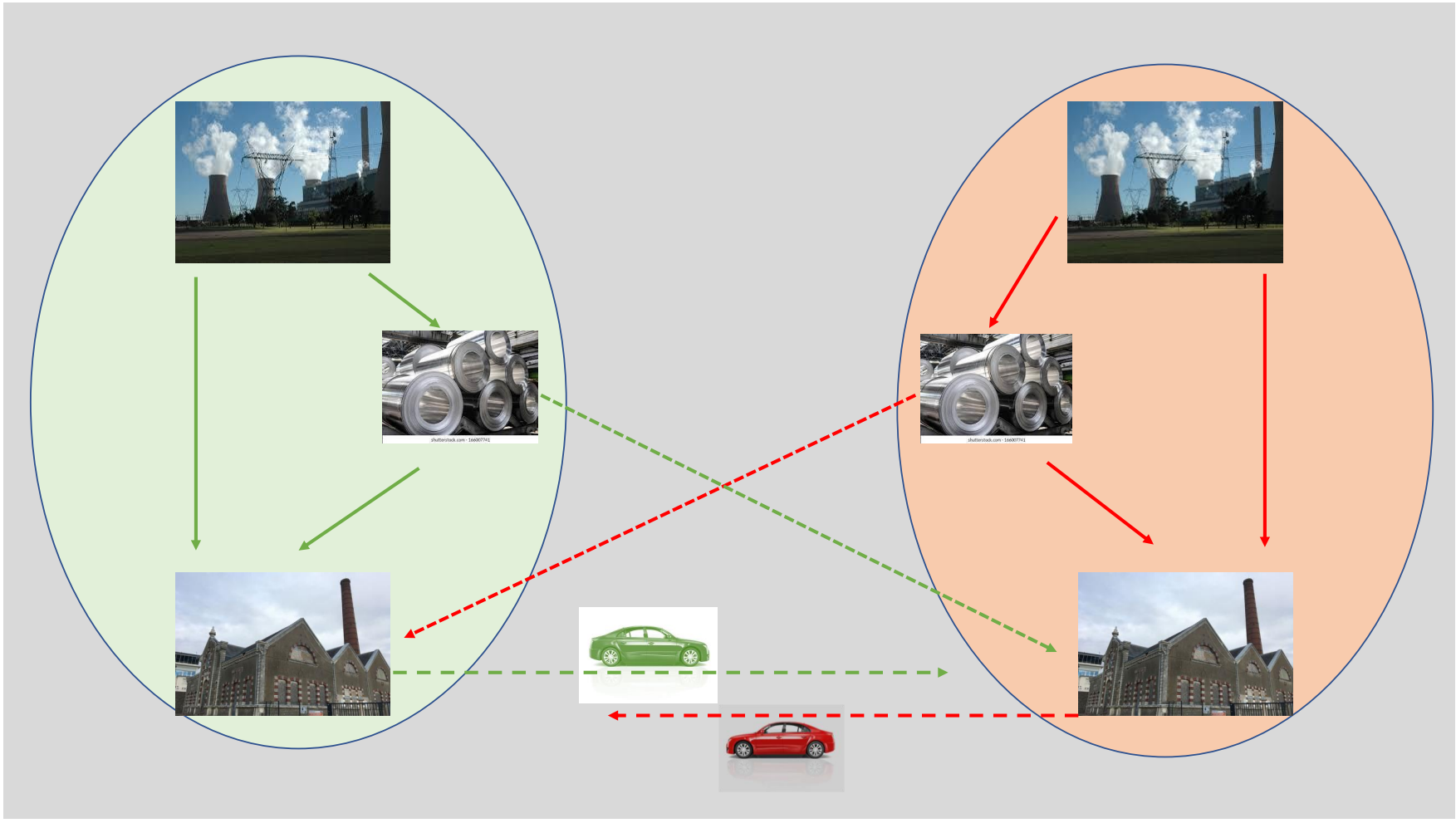
Policy background 2/2

European Green Deal

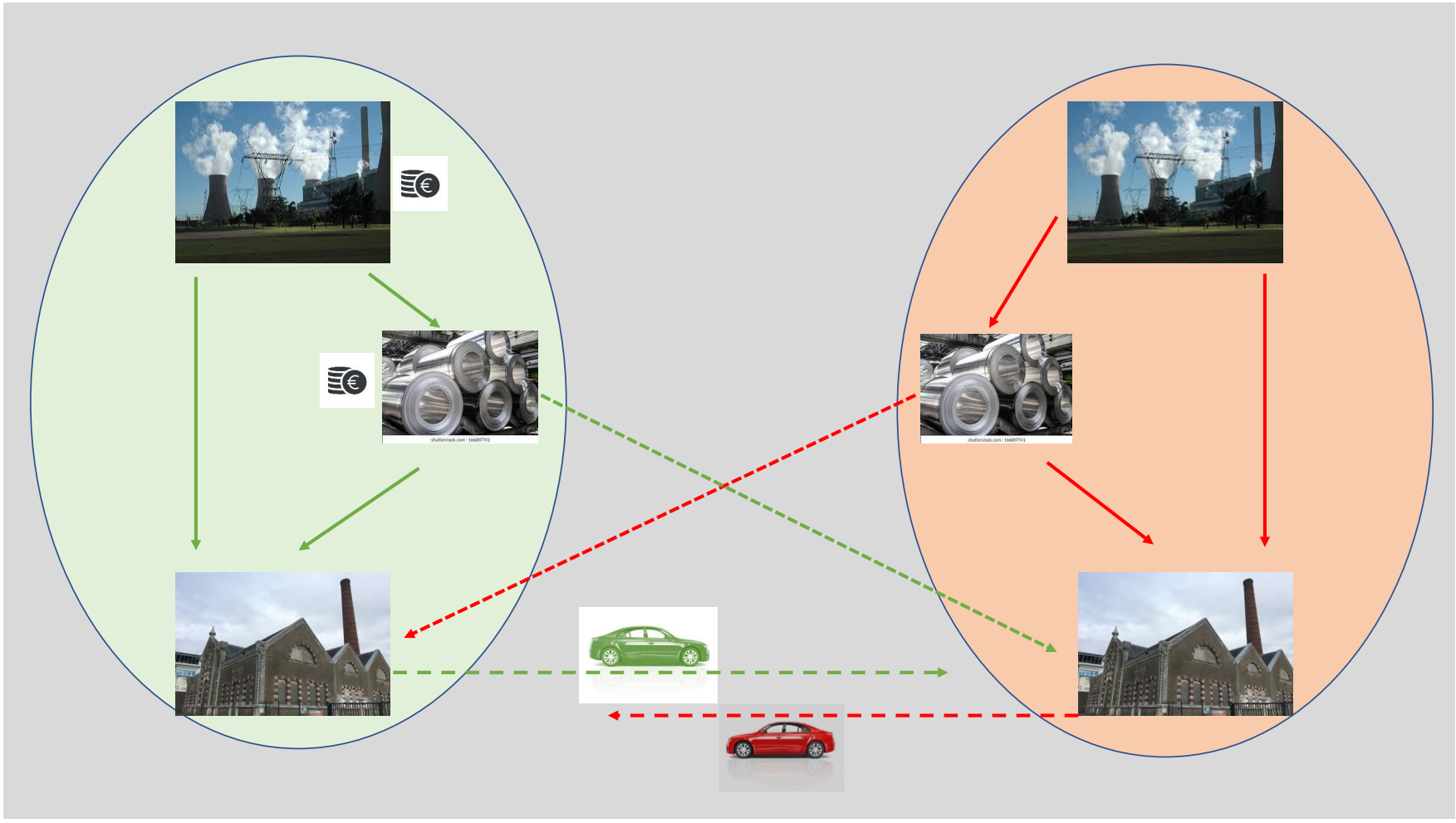
- −55% in 2030 wrt 1990 (init. NDC: −40%), C02 neutr. 2050
- 16 Sept., 2020, U. von der Leyen: Revise ETS, introduce CBAM
- 10 March, 2021: Resolution by the European Parliament
- 14 July, 2021: Proposal of a Regulation to implement a CBAM by the European Commission
- 15 March 2022: Proposal partially adopted by Council (pending: FAs, exporters rebate, Club)
- 8 June 2022: Vote by European Parliament on Fit for 55 (incl. CBAM)
- Competing projects
  - International carbon price floor (IMF)
  - Implicit prices of non-price instruments (OECD and WB)

A simple graphical exposition...

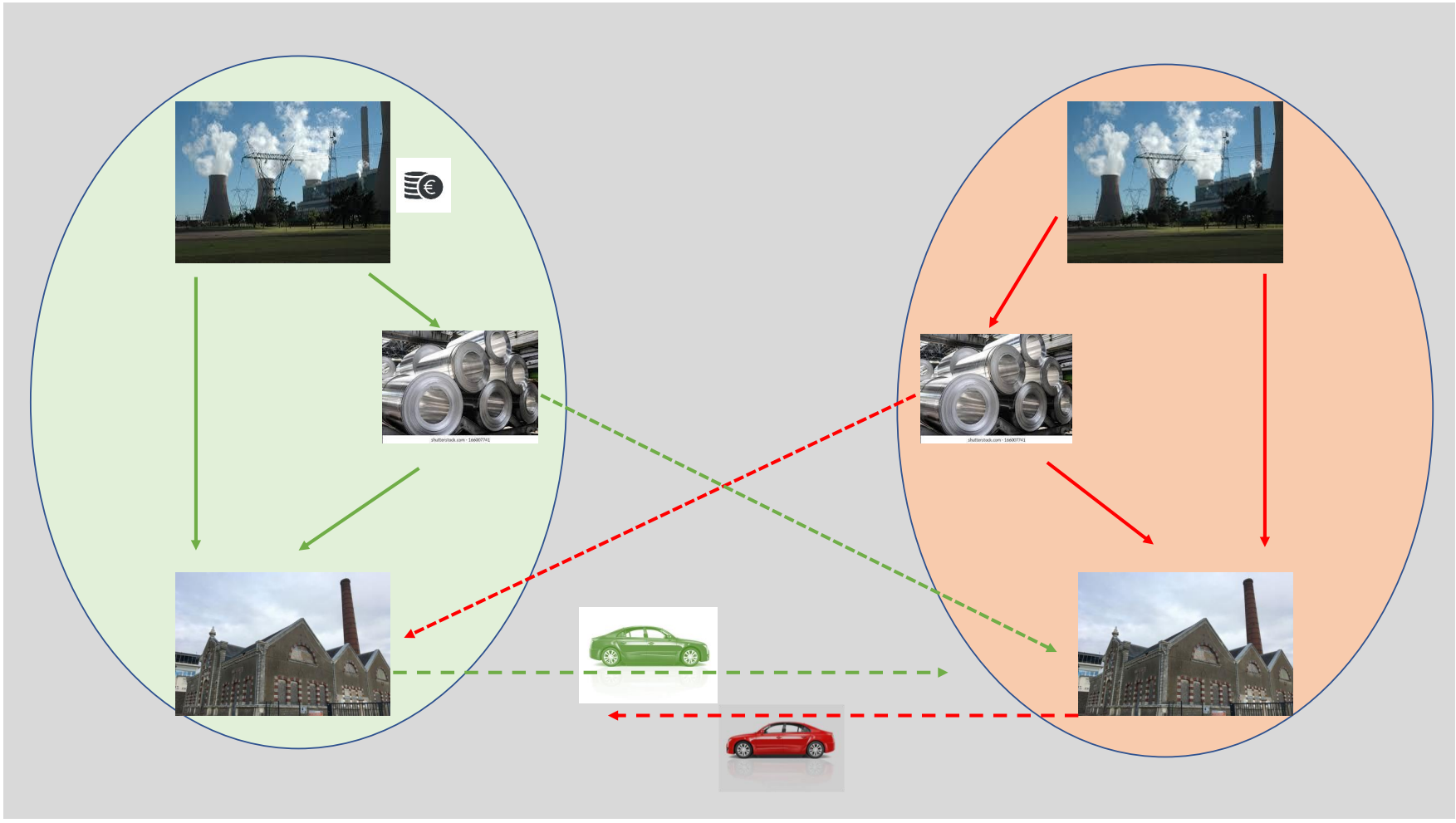
Value chain, no ETS, no FAs, no CBAM



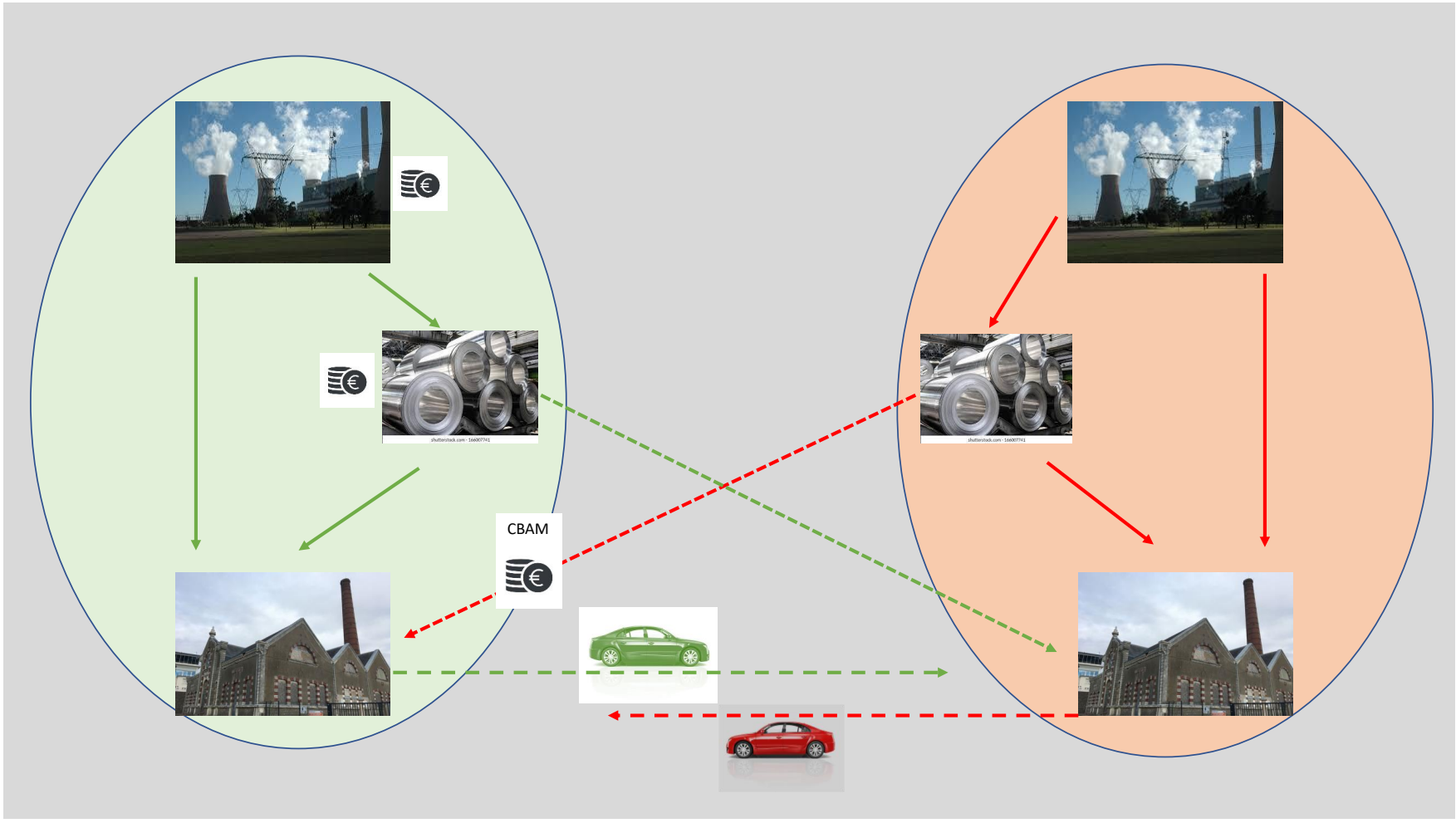
Value chain, ETS, no FAs, no CBAM



Value chain, ETS, FAs, no CBAM [Ref]



Value chain, ETS, CBAM, no FAs [S1/S2]



Modelling assumptions

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?
   - 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. Gradual phase out of FAs
7. SDT of imports from LDCs

Tools used 1/2

Data

- Database GTAP10.1, 2014 ref. year: 65 sect. 147 reg.
- GTAP MRIO
- Emission data from GTAP-E database and satellite data on non-CO2 emissions
- Macro baseline from MaGE rev. 3.1 (EconMap)

Tools used 2/2

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, GVCs, Imperfect competition, GHGs (carbon dioxyde, methane, nitrous oxide, fluorinated gases) ▸ MIRAGE ▸ TFP energy 23 sect. 28 reg.
- Baseline scenario *vs* shock
  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 + nat. carbon price: one level of carbon tax
  3. 3rd step: implementation of the CBAM scenarios

Simulated scenarios 1/2

Assumptions

- Rapid obsolescence of installed equipment
- Implicit techn. progr. – substit. K∼E and non-CO_2 ∼ conventional inputs
- → CBAM: *one element* of an ambitious decarbonization policy

Ref/scenarios

- Ref: Fit for 55, FAs, no CBAM
- S1 CBAM phased in, FAs phased out, ref. direct emissions EU
- S2 CBAM phased in, FAs phased out, ref. direct emissions exporter
- S3 = S2 + rebate to EU exporters

Simulated scenarios 2/2

Table: Scenarios

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

Environmental impact of the CBAM – Overview

Table: Focus on the environmental impact of the CBAM

	EU leakage (Gt CO_2 eq)	EU leakage rate (%)
Paris Ag., no FAs in EU ETS	20.7	76.1
Paris Ag., FAs in EU ETS (BLN)	14.6	53.7
Scenario 1	9.7	35.6
Scenario 2	8.6	31.5
Scenario 3	8.5	31.0

Note: cumulated emissions over the period 2021-2040.
Source: MIRAGE-VA, calculations by the authors.

The economic impact of the CBAM

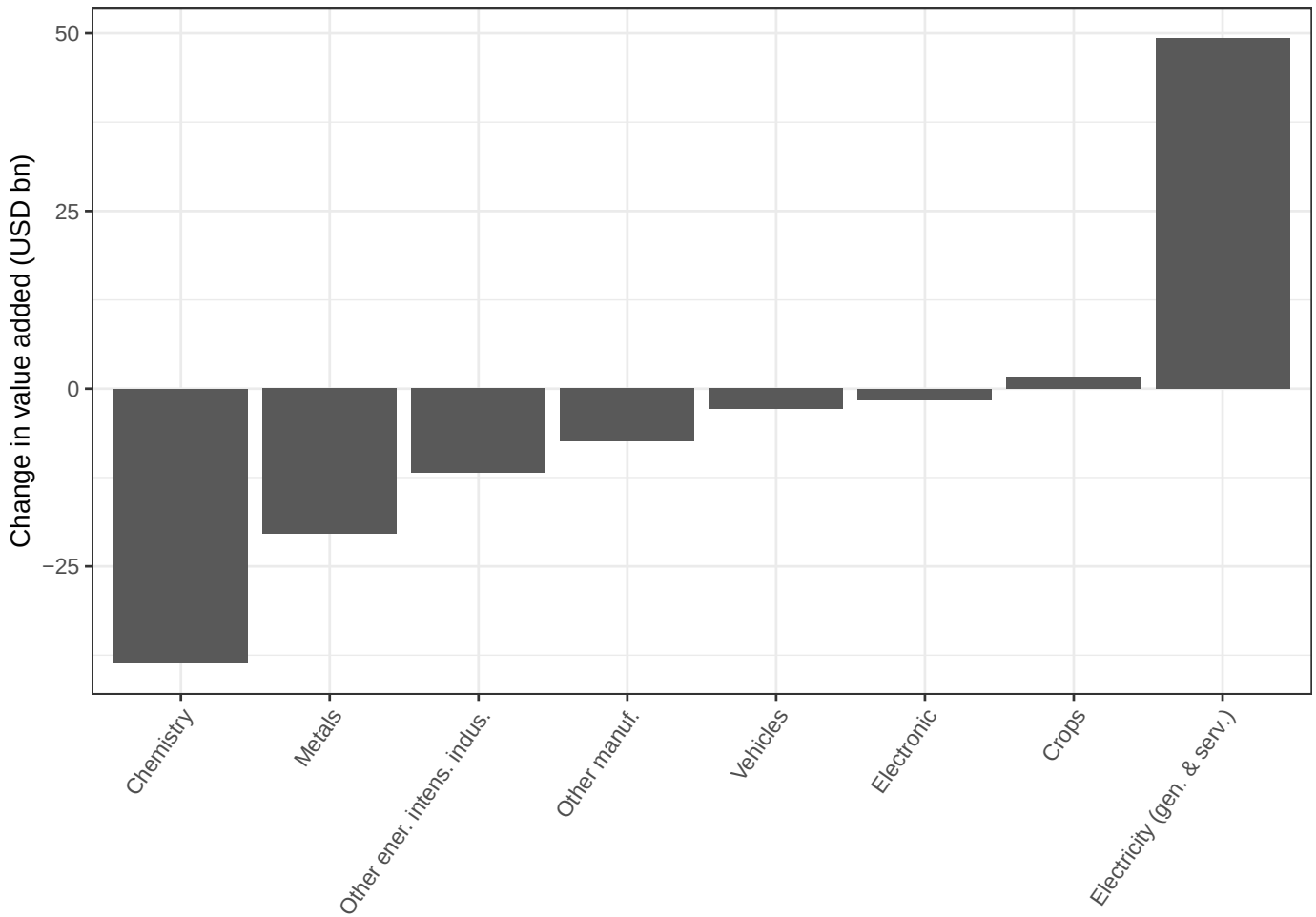
Table: Impact of the CBAM in EU

	CBAM (1)	+ ref. exp. (2)	+ ref. exp & rebate (3)
GDP	−1.2	−1.3	−1.3
Exports			
Exports int. goods	−6.3	−8.6	−6.6
Exports final goods	−2.6	−6.0	−6.4
Imports			
Imports int. goods	−3.6	−8.3	−7.4
Imports final goods	−2.7	−3.0	−1.5
Carbon price ETS	5.2	10.4	14.1

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

The impact of the CBAM on EU sectoral value added (1/2)

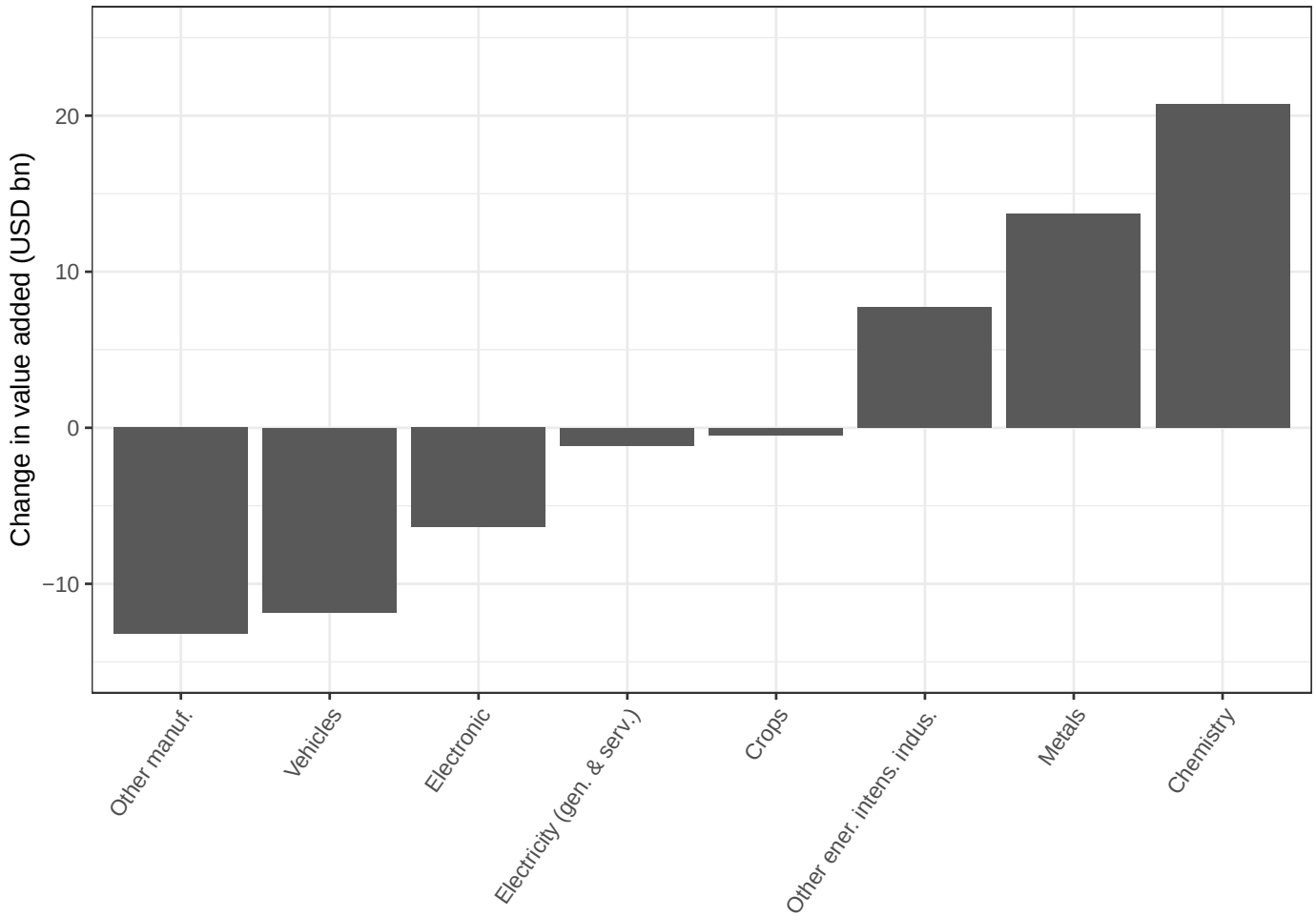
Figure: Impact of the CBAM on sectoral value added (S1 *vs* BLN, 2040).



Note: Sectors for which the absolute value of absolute variation is greater than USD 1.5 bn and the absolute value of relative variation is larger than 2 percent.

The impact of the CBAM on EU sectoral value added (2/2)

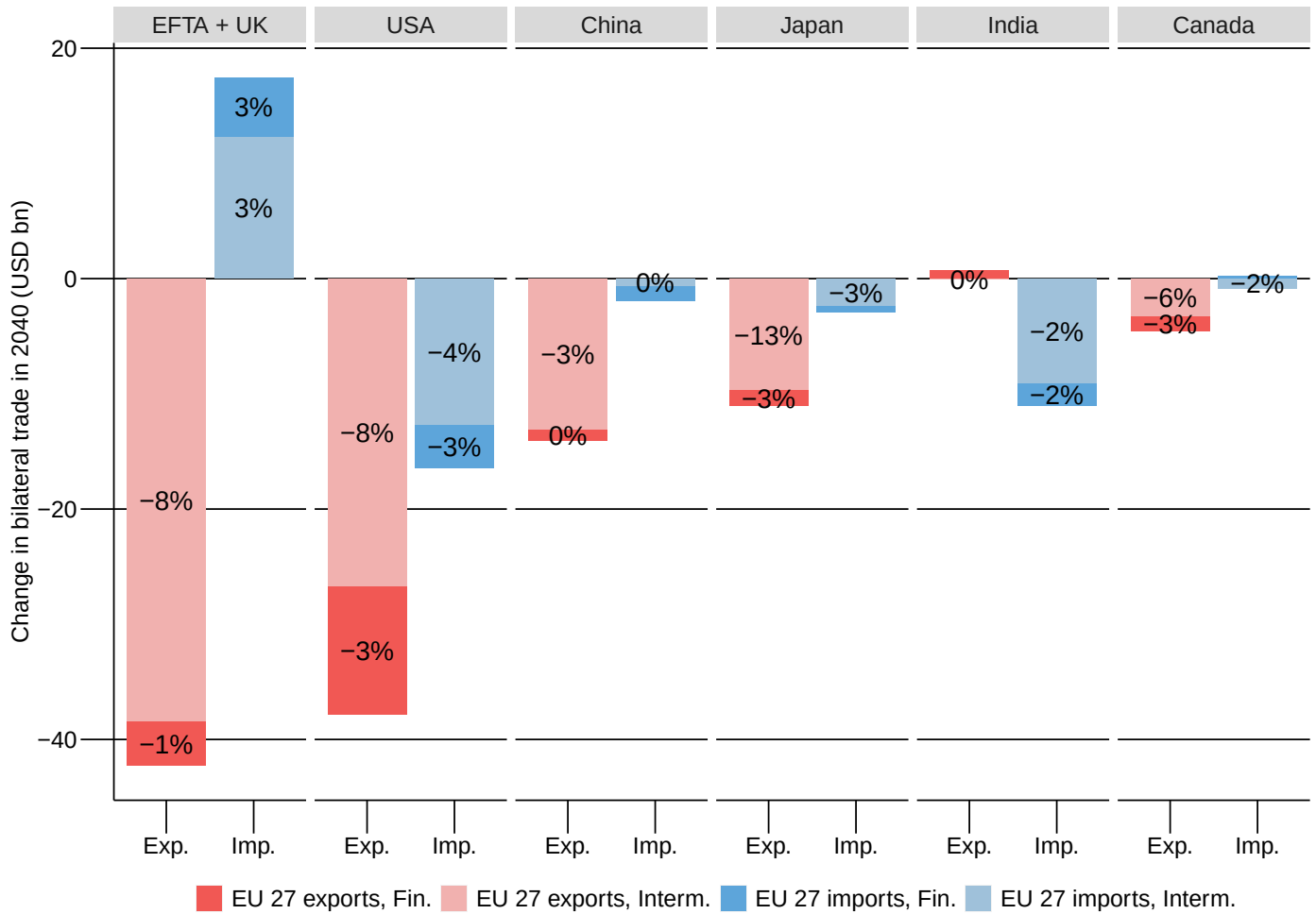
Figure: Impact of the CBAM *based on the emissions by the exporters and complemented with a rebate* on sectoral value added (S3 *vs* S1, 2040)



Note: Idem previous slide.

The impact of the CBAM on EU trade (1/2)

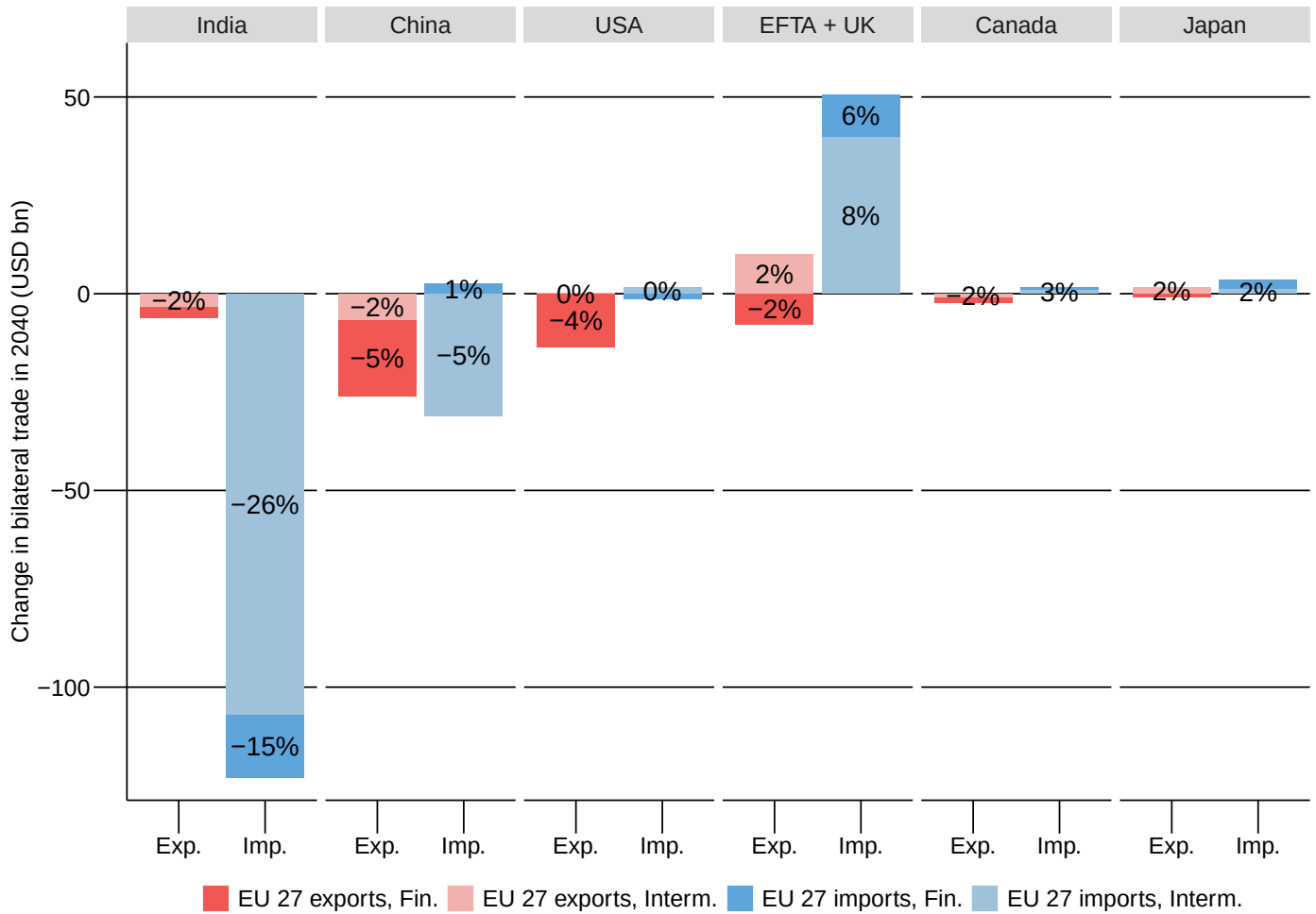
Figure: Impact of the CBAM on EU27 bilateral trade (S1 *vs* BLN, 2040).



Note: Values in constant USD of 2014. Trade in volume. Absolute and relative variations with respect to the baseline.

The economic impact on EU trade (2/2)

Figure: Impact of the CBAM on EU27 bilateral trade (S3 *vs S1*, 2040).



Note: Values in constant USD of 2014. Trade in volume. Absolute and relative variations with respect to the baseline.

Conclusions

1. GVCs increase the need for action (cumulative carbon content along the value chain)
2. EU leakages actually reduced with CBAM
3. GVCs reduce the effectiveness of action with CBAM:
   - Carbon price transmitted throughout the value chain
   - Price of ETS quotas increases in ETS and "second" markets
   - CBAM + GVCs = competitiveness loss
   - Decrease in EU imports *and* exports of intermediate and final products
   - Larger loss when foreign producers' emissions are used as reference
   - Rebate to exporters does not fully fix their competitiveness problem

THANK YOU

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GDP projection with MaGE

Production function with 3 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, the projected GDP is given by

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

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

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Energy efficiency – From MaGE to MIRAGE

In MIRAGE-e, for sectors other than those of fossil energies (coal, gas, refined oil and crude oil) :

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

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

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

and A_{irt}: 3 different TFP paths, according to the sector (i)

- Services: Mage projected path
- Industry: growth rate more rapid than in the services, +2 p.p. per year
- Agriculture: specific estimation and projection (DEA)

Back

MIRAGE-e VA (1/3)

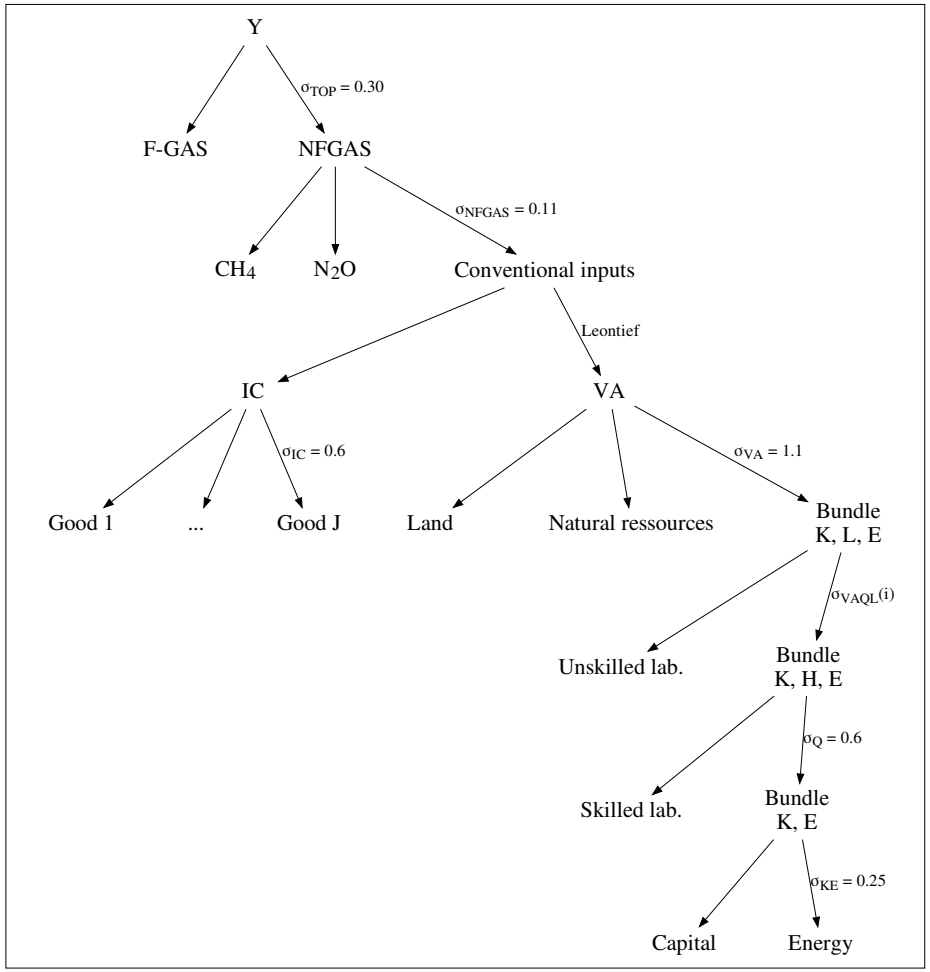
1. Multi-region, multi-sector;
2. Production
   - Oligopolistic competition (mark up) / perfect competition (representative firm) depending on the sectors;
   - Production combines:
     - 5 primary factors: unskilled, skilled, capital, land, natural resources
     - Energy
     - Intermediate consumptions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

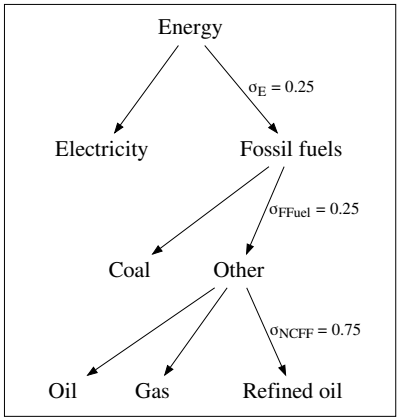
MIRAGE-e VA (2/3)

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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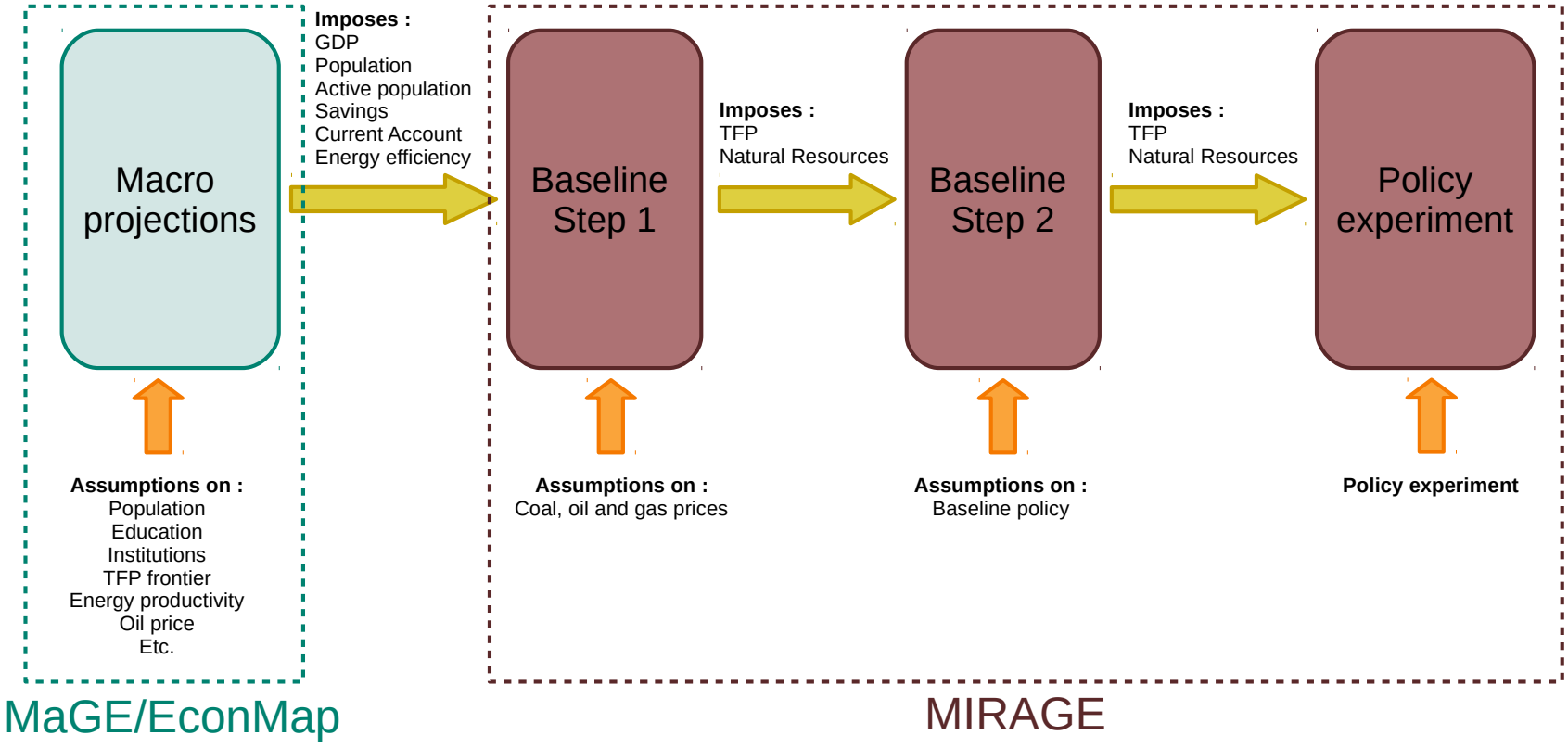
Pluging MaGE & MIRAGE



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Implementation of the Paris Agreement in MIRAGE (1/2)

- Only unconditional commitments are taken into account (Absolute, BAU, intensity) $\Rightarrow$ GHG target, in Mt CO_2 eq
- Only in countries with a national carbon price in place by 2020 (ARG, CAN, CHL, COL, ISL, JPN, KAZ, KOR, MEX, MNE, NZL, NOR, SGP, CHE, GBR UKR)
- Linear reduction between 2014 and the NDC's target year
- The price of GHG emissions (i.e. the carbon tax) is computed endogenously to reach the target
- FAs in the baseline, phased out gradually in scenarios

Implementation of the Paris Agreement in MIRAGE (2/2)

- 3 types of unconditional NDCs :
  - Absolute: target in tons of CO_2 eq;
  - BAU: reduction in relative terms wrt a reference situation established by the country itself;
  - Intensity: target in tons of CO_2 eq per dollar of GDP.
- What we impose in the model: total GHG emissions, by carbon market/region and by year.
- How are the 3 types of NDCs represented in the model?
  - Absolute: linear decrease btw the initial year and the target year to reach the targeted emissions ;
  - BAU: translated in an absolute target ;
  - Intensity: total GHG emissions endogenously computed based on the GDP in the simulations, given the targeted intensity.

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Leakages – How do we compute them ?

Leakage = additional emissions

- caused by the implementation of the EU policy
- occurring in regions other than the EU

$\Rightarrow$ How to compute these leakages ?

Comparison of the emissions from the World – EU btw :

- a scenario in which the EU does not implement the environmental policy
- a scenario in whcih the EU does implement the policy

More precisely:

- leakages from the Paris Agreement: 30 Gt
- change in these leakages with the CBAM in place: -30 % (S1)

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WTO compatibility 1/2

- EU tariffs are bound (GATT art. II): but additional tariff compensating for internal *tax* on like products authorized (art. II-2-a)
- EU shall not discriminate (GATT art. III): national treatment
- MFN treatment (GATT art.I): cannot discriminate between like products from different partners (implies no double taxation)
- Export subsidies prohibited: Agreement on Subsidies and Countervailing Measures Art. 3.1(a)

WTO compatibility 2/2

- Preamble GATT-94 add-on: "while allowing for the optimal use of the world's resources in accordance with the objective of sustainable development, seeking both to protect and preserve the environment"
- GATT Art. XX(b) "protect human, animal or plant life or health"
- GATT Art. XX(g) "conservation of exhaustible natural resources" if in conjunction with domestic restriction
- Art XX Chapo should not be a "disguised restriction on international trade"
- Art. 3.1(a) on subsidies authorizes rebate of a *tax* (e.g. VAT) to exporters
- Bottom line: an internal regulation (ETS) can only be adjusted at the border by an equivalent regulation imposed on imports

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