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Impact of the Mediterranean Sulfur Emission Control Area on trade and countries

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Data and Sustainable Navigation conference

Agenda

1. Introduction
2. Literature review
3. Methodology
4. Estimation results
5. Conclusions

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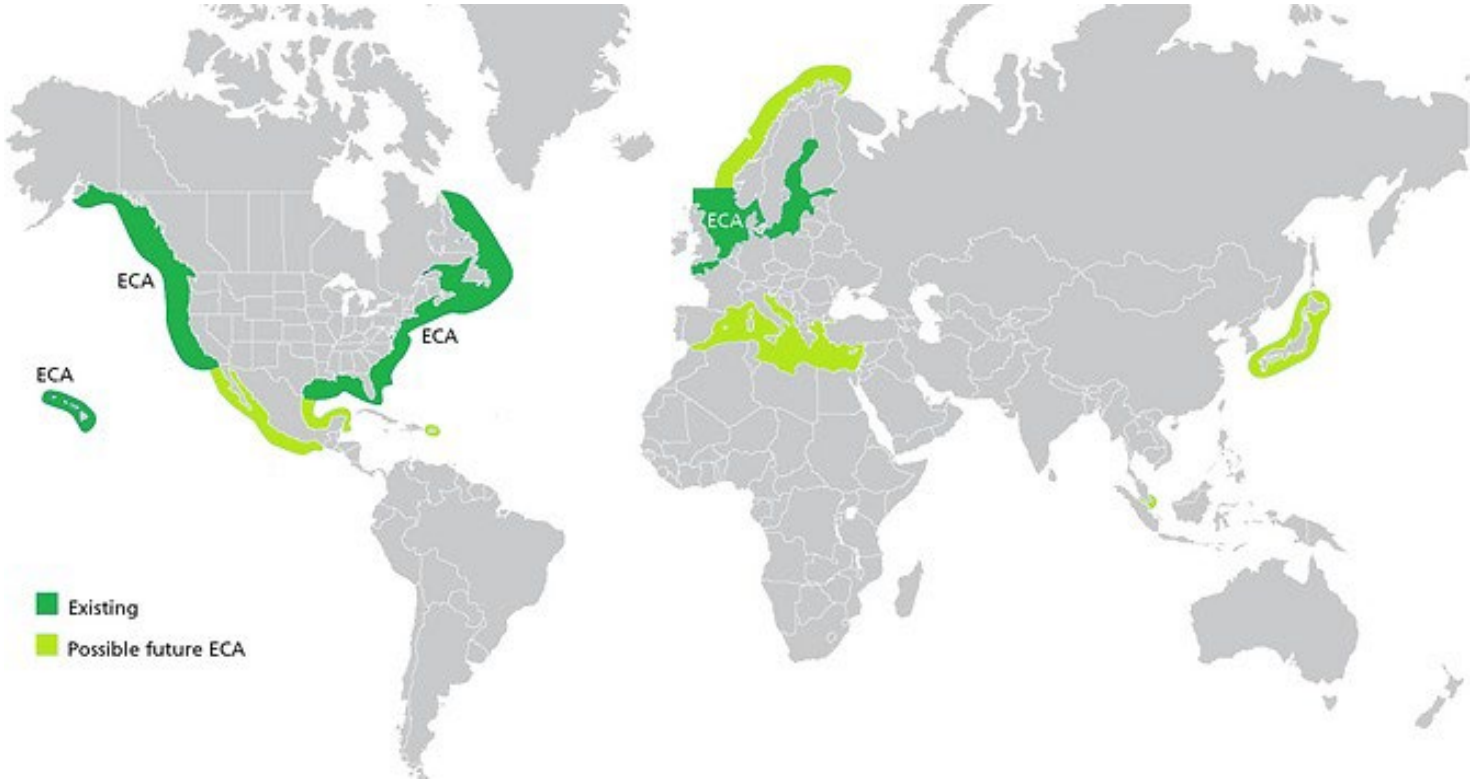
Introduction

1. SOx are amongst the most harmful exhausts of non-greenhouse gases. They affect mortality and morbidity, biodiversity and damage infrastructure though acid rain (EERA 2022).

2. Maritime Sulphur oxides (SOx) = approximatively 13% of SOx Worldwide emissions (Wan *et al*. 2016). According to Corbett et al. (2007) = 60,000 premature deaths globally can be associated to international shipping.

3. To limit SOx, the IMO sets a global Sulphur cap in international waters (since 2020, the limit is at 0.50%, against 3.5% previously). Lower limits can be imposed at a regional level in Sulfur Emission Control Areas (SECAs).



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4. The last agreement is for a Med SECA, agreed upon in 2022, following more that 15 years of negotiations amongst the 21 countries member of the Barcelona convention (see Thébault Guët *et al.* 2023).

5. A decisive step was the study by EERA (2019) on benefits: Med SECA could reduce emissions by 79% for Sox, 24% for PMs & it would prevent more than 1,100 premature deaths from lung cancer, cardiovascular diseases, and strokes per year, as well as more than 2,300 cases of asthma in children.

Problematic: Despite clear benefits, many areas in the World are still without SECA?

6. One reason = the uncertainty and the lack of studies on their economic impact that slows down negociations.

7. Contribution: There is the need for a framework to help assessing the impact of SECAs, at a disaggregated level (trade and country) and that could be easily replicated to other regions.

2. Literature review

1. For SECA regulations (Bloor et al. 2013), the transport costs were forecast to rise by 20-40% for SSS. A significant modal shift to trucks and rail is expected but as the differences in oil prices have been rather low, the effects of SECA on modal shift has been minimal (Katila et al., 2015). Similar findings for Notteboom (2006) and European Commission (2015).

2. For Baltic Sea SECA, Busk and Härmälä (2016) stress that Finnish export industries would be particularly impacted, by the increase in operating and investment costs. The industries with tight markets and low prices such as the paper and metal industry may particularly suffer (Kalli et al., 2013).

3. For Med SECA, the only study was by EERA (2022) = Med SECA will increase maritime transport costs (MTC) by approximatively 0.5-1%, and have a limited negative economic impact on trade, modal shift and countries.

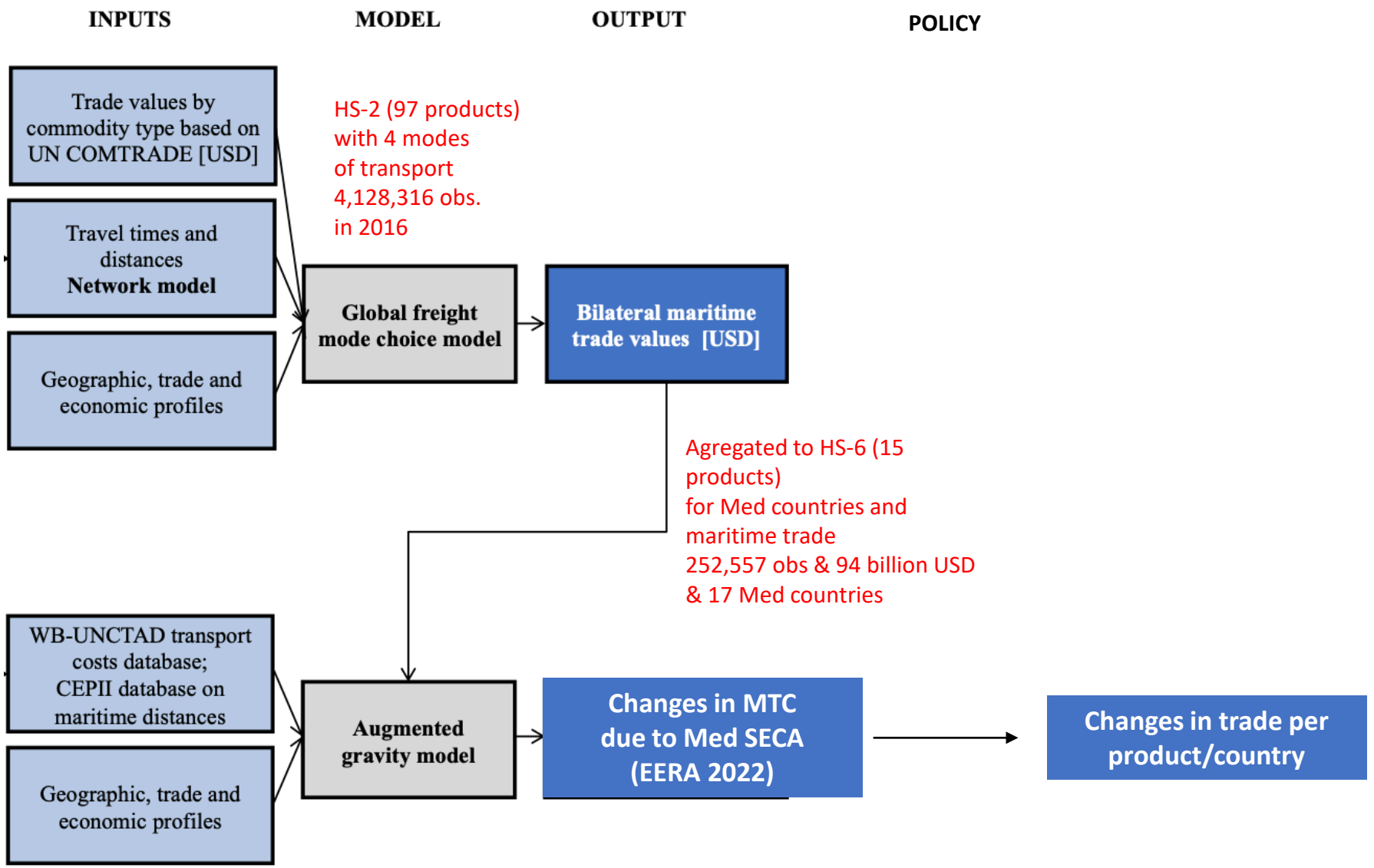
2. Mehodology

We put together a specific modelling framework that combined

1. a global freight mode choice model to estimate Med maritime bilateral trade = to countervail the lack of data, in the context of Med SECA.

2. an augmented gravity model to estimate the impact of MTC on trade = to estimate the impact on trade elasticity, in the context of Med SECA

2. Methodology



2. Mehodology: The global freight mode choice model

Our model estimates the probability (P) of choosing a particular mode k, for origin i, destination j, product group m, relative to all available alternatives.

$$\Psi_{i,j,m',k} = \hat{\beta}_{0,k} + \hat{\beta}_{1,m'} a_{i,j,k} + \hat{\beta}_{2,m'} b_{i,j,k} + \hat{\beta}_{3,k} D_{i,j}^{contig} + \hat{\beta}_{4,i} + \hat{\beta}_{5,j} \quad (1)$$

$$P_{i,j,m',k} = \frac{e^{\Psi_{i,j,m',k}}}{\sum_{k=1}^{K} e^{\Psi_{i,j,m',k}}} \quad (2)$$

where g' is an identifier of the HS 2-digits commodity group, Ψ is the choice utility, a is transport distance, b is transport time and D^{contig} is a dummy variable for the contiguity between origin and destination country. β_0 is an MOT-specific constant, β_1 is a transport distance coefficient, β_2 is a travel-time coefficient, β_3 is a contiguity coefficient. β_4 and β_5 are origin and destination fixed effects, respectively.

2. Mehodology: The augmented gravity model

The bilateral value of trade (in log) between country i and j for product m ($X_{ij,m}$) is then determined such that:

$$lnX_{ij,m} = \pi_i + \chi_j + \beta_1 lnDIST_{ij} + \beta_2 lnMTC_{ij,m} + \beta_3 CNTG_{ij} + \beta_4 LANG_{ij} + \beta_5 CLNY_{ij} + \beta_6 MOT_{ij} + \varepsilon_{ij} \qquad (4)$$

In equation (4), $lnX_{ij,m}$ is the logarithm of bilateral maritime trade flows (in value) from exporter i to importer j, β_0 is a constant term, $CNTG_{ij}$ is an indicator variable capturing the presence of contiguous borders between trading partners, $LANG_{ij}$ denotes a dummy variable for the existence of a common official language between trade partners, $CLNY_{ij}$ is an indicator for the presence of colonial ties between countries, and RTA_{ij} is the existence of Regional Trade Agreement. MOT_{ij} is the share value of maritime trade in the bilateral trade flow.

3. Estimation results from global freight model + World Bank MTC

Table 1. Descriptive statistics for Med trade

	Maritime Trade (M. USD	Bilateral flows)	Share maritime in trade (%)	Distance in nautical miles	% MTC in FOB value	MTC (in kg/1000 km)	Contiguous border (%)	Common Langage (%)
Export								
01. Animal and animal products	2 405	8 262	0,85	11 910	7,3	0,28	1.1	7.6
02. vegetable products	15 424	43 127	0,86	8 292	7,3	0,43	1.8	14.1
03. Foodstuffs	478	2 775	0,84	5 871	3,8	0,33	0.3	10.7
04. Mineral products	34 759	8 084	0,97	6 134	12,7	3,25	0.7	9.6
05. Chemicals & Allied Industries	15 810	50 179	0,70	9 765	5,6	27,98	0.8	9.2
06. Pastics/Rubbers	4 443	24 754	0,74	9 541	5,0	0,24	0.6	9.7
07. Raw Hides, Skins, Leathers & Furs	1 034	3 331	0,53	12 104	2,2	0,28	0.0	0.7
08. Wood & Wood Products	2 138	18 503	0,73	8 768	6,8	0,24	0.5	14.7
09. Textiles	3 498	31 323	0,71	7 866	3,2	0,52	1.8	8.1
10. Footwear/Headgear	104	1 581	0,57	5 031	3,7	1,24	2.6	7.6
11. Stones/Glass	2 851	14 937	0,65	8 625	7,1	9,22	1.2	9.2
12. Metals	10 868	41 005	0,82	8 337	5,5	0,21	1.5	9.5
13. Machinery/Electrical	380	1 971	0,56	11 315	3,5	1,40	0,0	17.6
14. Transportation	599	842	0,67	10 075	4,5	0,95	0,0	17.3
15. Miscellaneous	139	1 883	0,66	10 855	4,9	1,16	0,0	38.4
Total export	**94 930**	**252 557**	**0,84**	**7 960**	**8,21**	**6,28**	**3.4**	**10.3**

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3. Estimation results Gravity model – Trade elasticity to MTC

Annex B. PPML estimates for Exports, by product

Product	1	2	3	4	5	6	7	8	9	10
Log.MTC	-2.107***	-1.325***	-3.202***	-0.337***	-0.594***	-1.422***	-1.715***	-1.733***	-1.508***	-1.189***
	(-7.46)	(-13.03)	(-3.73)	(-2.70)	(-4.78)	(-7.17)	(-7.49)	(-8.02)	(-8.12)	(-4.69)
Log.dist	-0.805***	-0.708***	-3.335***	-0.430**	-0.290**	-0.904***	-0.432	-0.749***	-1.276***	-0.484***
	(-4.83)	(-6.56)	(-2.83)	(-1.97)	(-2.51)	(-6.27)	(-0.73)	(-3.89)	(-10.47)	(-3.51)
Contig.	2.022***	0.342	-0.612	1.425***	-0.567*	0.021	2.036	1.325***	0.577	-0.776
	(5.28)	(1.13)	(-0.79)	(3.15)	(-1.66)	(0.04)	(0.95)	(3.78)	(0.91)	(-1.08)
Lang.	0.518*	0.750***	-0.835	0.781*	0.015	0.384**	0.142	-0.039	-0.131	1.283***
	(1.67)	(3.91)	(-1.49)	(1.91)	(0.09)	(2.26)	(0.41)	(-0.22)	(-0.73)	(3.82)
MoT_{sea}	14.067***	2.883***	5.533***	7.805***	0.749	3.815***	-2.596*	4.028***	3.566***	7.283***
	(4.74)	(12.23)	(4.43)	(6.76)	(1.05)	(4.90)	(-1.89)	(7.42)	(7.54)	(4.79)
Constant	-9.834***	-3.485***	20.003**	-7.197***	-4.693***	-2.322	11.973**	-8.012***	-0.474	-7.340***
	(-3.24)	(-3.14)	(2.11)	(-3.34)	(-4.18)	(-1.52)	(2.12)	(-5.56)	(-0.34)	(-4.46)
Obs	**8 262**	**43 127**	**2 775**	**8 084**	**50 179**	**24 754**	**3 331**	**18 503**	**31 323**	**1 581**
R2	**0.452**	**0.072**	**0.804**	**0.222**	**0.164**	**0.312**	**0.848**	**0.391**	**0.293**	**0.763**

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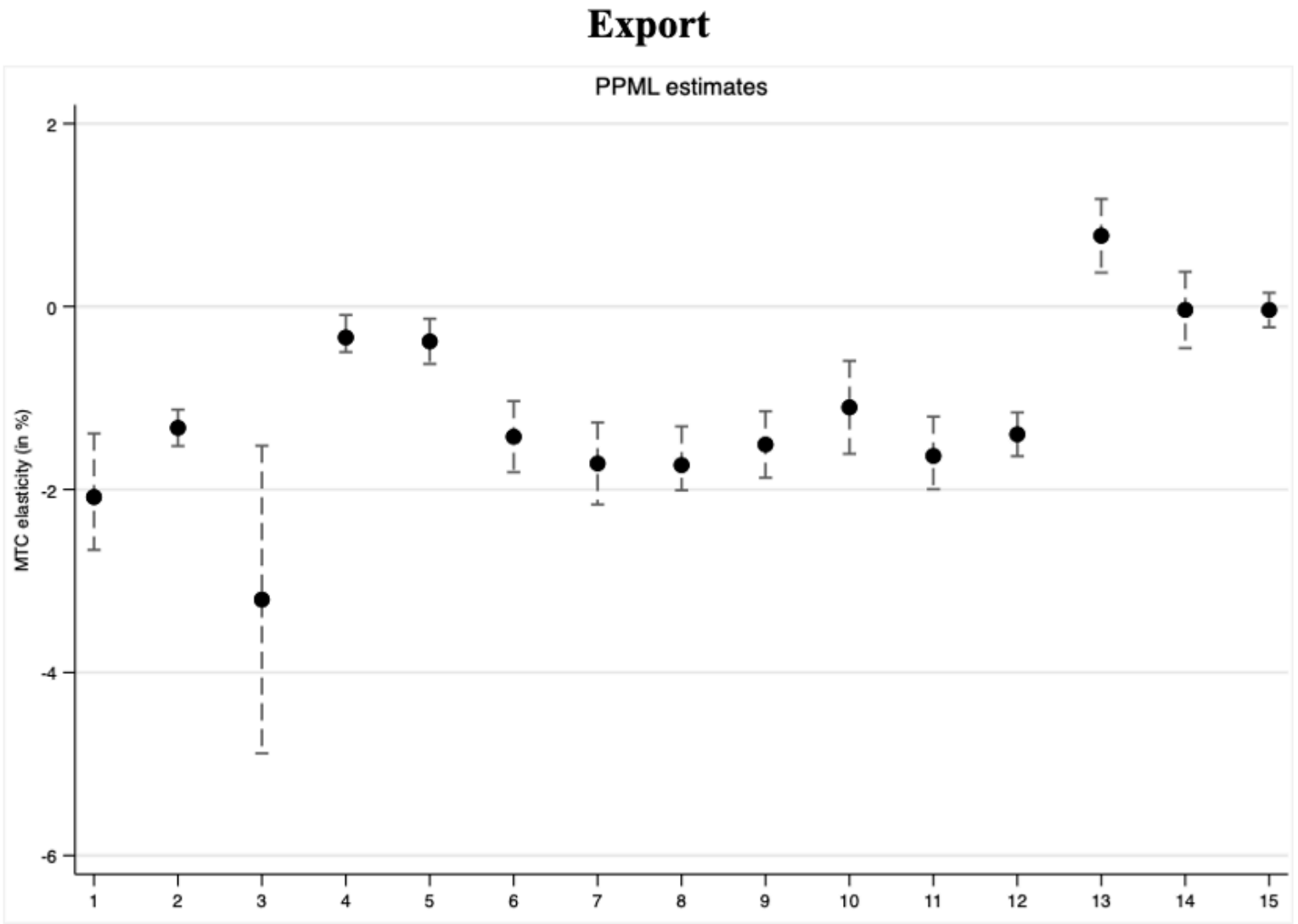
3. Estimation results Gravity model – Trade elasticity to MTC



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3. Estimation results – Simulation of Med SECA

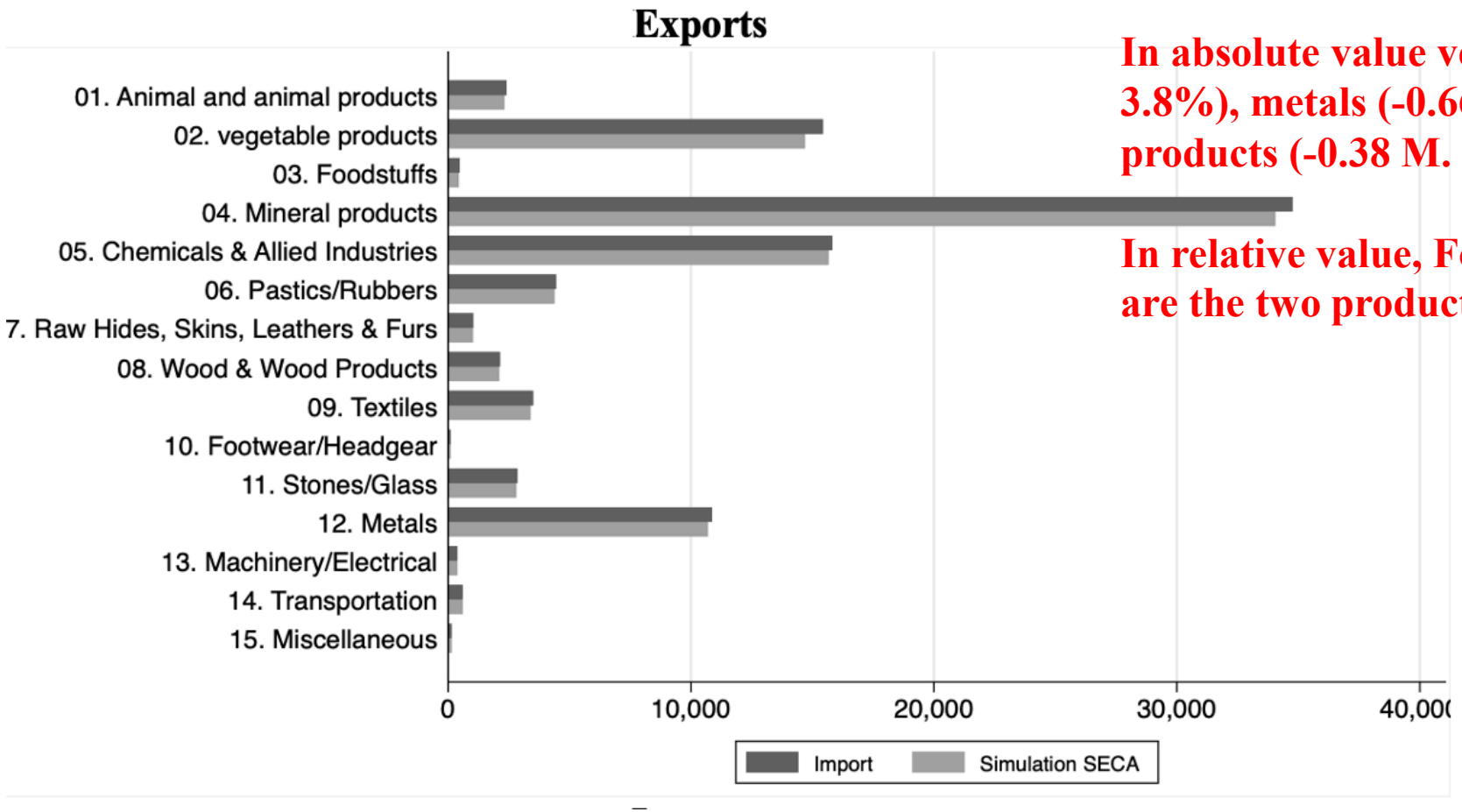
Table 2. Percentage change in MTC (USD per tonne-km) within ECA from higher fuel cost by commodity group and type of vessel

	Agriculture			Manufacturing			Raw material
	Combined	**Container**	**Clean Bulk**	**Combined**	**Container**	**Dirty bulk**	
Median	1.4%	1.4%	0.3%	0.5%	0.5%	0.9%	0.4%
Products #	1	2; 3	10*; 12	11; 12	7; 8; 9; 10; 13; 14; 15	5 6	4

* Only for Grain and Soybeans

Source: Derived by Authors from EERA (2022, Table 21 and Table 22).

3. Estimation results – Simulation Med SECA



Most impacted products (sum of import + export)

In absolute value vegetable products (-0.7 USD million or -3.8%), metals (-0.66 M. USD or -2.8%) and mineral products (-0.38 M. USD or -1.0%).

In relative value, Foodstuff (-6.5%) and footwear (-4.4%) are the two products that are the most impacted.

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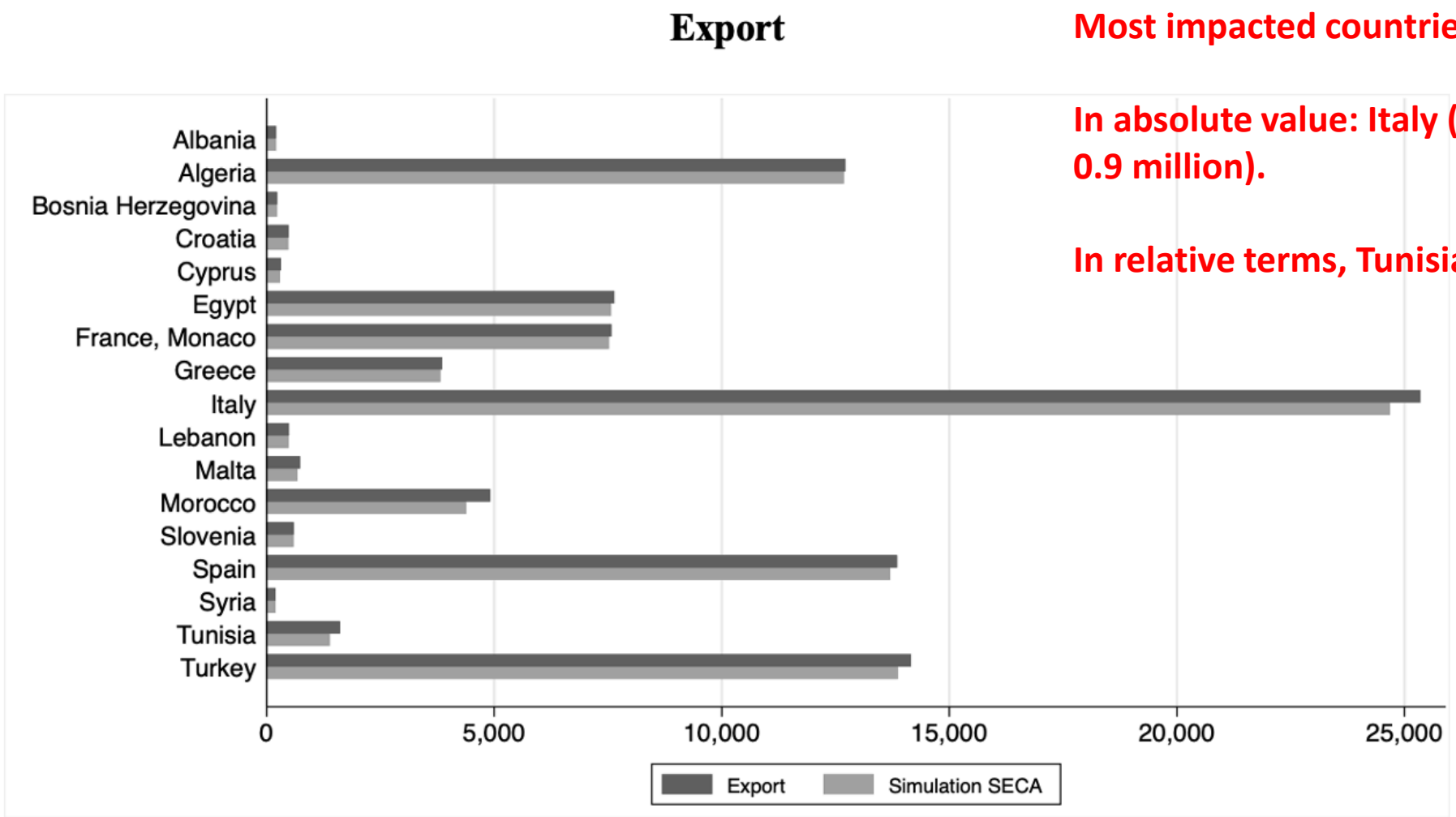
3. Estimation results – Simulation Med SECA



Most impacted countries (sum of import + export)

In absolute value: Italy (-1.1 million USD) and Morocco (-0.9 million).

In relative terms, Tunisia (-8.5%) and Morocco (-7.2%)

4. Conclusions/main limits

1. Augmented gravity model without substitution effect (modal split) elasticity i.e. potential losses may lead to import/export via other mode of transport not necessary loss of trade but loss in maritime trade due to the change in MTC.

2. Augmented gravity model estimated using data for 2016 (waiting for World Bank to release updated statistics on MTC - Fall 2023).

4. Conclusions/main advantages

3. Easier to apply than General Equilibrium Model – UNCTAD (2022) mentioned the need for alternative methods when assessing IMO short-term measures.

4. Other/new simulations can be easily replicated for specific products (Agricultural product/Worldwide), specific countries (for instance implications for trade/ports) or to assess other maritime regulations (global tax or impact of ETS) as long as they induce a change in Maritime Transport Cost.

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