

Environmental regulation and trade in second-hand vehicles. Evidence from EU trade

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Background and motivation

- Second-hand car market is vital for the new car industry
- Trade-offs in the international market:
 - Cheaper, better skill-matching (Navaretti et al., 2000)
 - Clerides (2008) Considerable welfare gains from trade in second-hand vehicles (import restrictions - Cyprus)
 - More energy efficient than obsolete capital goods (Davis and Kahn, 2010)
 - High maintenance costs (Sen, 1962)
 - Disincentive to development of domestic industry (Thomas (2003) and Pelletiere and Reinert (2004))
 - Can lead to overall increase in emissions (Davis and Kahn, 2010)
 - Developing countries as “junker graveyards”

Contribution and Existing literature

- Little evidence on the relationship between **environmental regulation** and the **international** market of used vehicles
- **Domestic market**: new fuel economy standards increase price of new vehicles, price of second-hand vehicles and postpone scrappage (Jacobsen and Benthem (2013) and Goulder et al. (2011))
- Gruenspecht effect (1982): tighter new standards increase aggregate emissions in the short-run (cars are hold for longer)
- Fuel prices: impact of expected future prices (consumer myopia?) (Busse, Knittel, and Zettelmeyer (2012), Langer and Miller (2012)).

Contribution and Existing literature

- **Environmental impact of international trade:**
 - Davis and Kahn (2010) Traded vehicles are lower-emitting per mile than stock of vehicles in importing country (US exports to Mexico)
 - Trade in second-hand cars reduces retirements rates and increases overall emissions (Davis and Kahn, 2010)
 - Bertinelli et al. (2010): impact of imports of second-hand durables (including vehicles) on the relationship between output and environmental quality.

This paper

Impact of environmental regulation on EU trade in second-hand vehicles

- **Emissions standards - ES**
 - Emission standards define the acceptable limits for exhaust emissions of **new** vehicles
 - Reflect restrictions on vehicles **in use** → low-emission zones (fees, traffic restrictions)
- **Fuel prices**
 - Affect **all** vehicles



Emission standards and the international market of second-hand cars

- Higher ES tend to reflect (i) higher fuel efficiency and/or (ii) lower carbon intensity.
 - They tend to raise the price of a new vehicles. Households hold their used cars for longer (Goulder et al. (2012), Jacobsen and Benthem (2013)). ↓ Supply
 - Consumers expectations about future fuel prices (Busse, Knittel, and Zettelmeyer (2012), Langer and Miller (2012)) ↑ Supply
- Higher ES imposes costs on old vehicles in use (e.g. Low Emission Zones, traffic restrictions).
 - Evidence of considerable increase in adoption of greener vehicles due to LEZ (Wolff, 2014). ↑ Supply
- Quality of second-hand cars for export?
- Distribution across importers? Rich vs poor countries

Empirical strategy

- 1 Impact of **domestic** Emission Standards (ES) on **exports supply** and **imports demand**:

$$y_{it}^u = \beta ES_{it} + \delta FP_{it} + \gamma X_{it} + d_t + u_i + \epsilon_{it} \quad (1)$$

- 2 Impact of **regulatory gaps** (ES^{GAP}) on **bilateral-trade**:

$$y_{ijt}^u = \beta_G ES_{ijt}^{GAP} + \delta_G FP_{ijt}^{GAP} + \gamma_G X_{ijt}^{GAP} + d_t + u_{ij} + \epsilon_{ijt} \quad (2)$$

Controls: GDP, GDP per capita, effective exchange rates, year fixed effects, country-specific time trend, domestic production of vehicles

Estimation: log-linear model and conditional fixed effects Poisson model

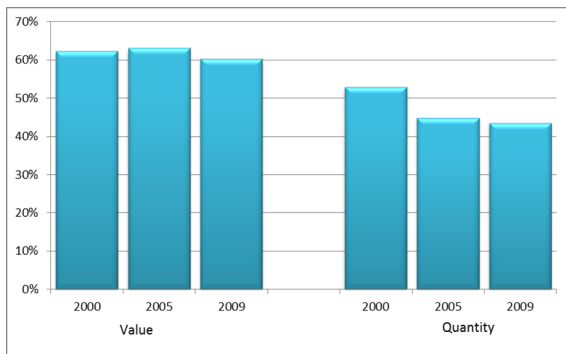
Trade data

- **Legal** exports of second-hand vehicles from the EU Comext database (8 digit)
 - EU trade between 1999 and 2009
 - Thresholds for reporting intra-EU trade varies across EU members
 - Distinction between new and used is possible mainly for passengers cars

Trade data - Within-EU trade

- About 60% of EU trade in second-hand cars is towards EU countries
- The largest European importers are Germany (17%), Poland (13%), Italy (11%), France (9%) and Bulgaria (6%).

Figure: Share of EU exports towards EU countries



Trade data - Extra-EU trade

Country	Quantity		Country	Value		Country	2009
	2005	2009		2005	2009		
Russia	12%	10%	Belarus	18%	8%	Norway	8%
Kazakhstan	10%	7%	Benin	10%	8%	Belarus	8%
Algeria	8%	6%	Kazakhstan	9%	6%	Switzerland	6%
Belarus	6%	6%	Nigeria	6%	6%	Russia	6%
Ukraine	5%	6%	Angola	4%	4%	Nigeria	4%
Nigeria	4%	4%	Serbia	3%	4%	Iraq	4%
Benin	3%	4%	Russia	3%	3%	Angola	3%
Croatia	3%	3%	Bosnia & Herz.	3%	3%	Serbia	3%
Niger	3%	3%	Libya	2%	3%	Saudi Arabia	3%
Togo	3%	3%	Ukraine	2%	3%	Kazakhstan	3%
Africa	41%	44%		28%			29%

Unit value by income groups

Income groups	2000	2005	2009
Low income	3,573	3,649	4,438
Lower middle income	4,625	5,640	6,648
Upper middle income	7,308	7,652	9,004
High income: nonOECD	8,825	11,558	12,857
High income: OECD	10,909	13,900	13,580

Data on environmental regulation

- Emission standards database obtained from Perkins and Neumayer (2012)
 - The stringency of emission standards is graded on a 0 to 5 scale. The reference point is EU standards.

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Cyprus	0	0	0	0	0	4	4	4	4	4	5
Estonia	0	0	0	0	0	0	4	4	4	4	5
Latvia	0	0	0	0	0	0	4	4	4	4	5
Lithuania	0	0	0	0	0	0	4	4	4	4	5
Malta	0	0	0	0	0	4	4	4	4	4	5
Romania	0	1	1	1	1	3	3	3	4	4	5
Bulgaria	1	1	1	1	1	3	3	3	4	4	5
Hungary	1	1	1	3	3	3	4	4	4	4	5
Slovenia	1	1	1	1	1	1	4	4	4	4	5
Poland	2	2	3	3	3	3	4	4	4	4	5
Austria	2	3	3	3	3	3	4	4	4	4	5
Belgium	2	3	3	3	3	3	4	4	4	4	5
Denmark	2	3	3	3	3	3	4	4	4	4	5
Finland	2	3	3	3	3	3	4	4	4	4	5
France	2	3	3	3	3	3	4	4	4	4	5
Germany	2	3	3	3	3	3	4	4	4	4	5
Greece	2	3	3	3	3	3	4	4	4	4	5
Ireland	2	3	3	3	3	3	4	4	4	4	5
Italy	2	3	3	3	3	3	4	4	4	4	5
Luxembourg	2	3	3	3	3	3	4	4	4	4	5
Netherlands	2	3	3	3	3	3	4	4	4	4	5
Portugal	2	3	3	3	3	3	4	4	4	4	5
Spain	2	3	3	3	3	3	4	4	4	4	5
Sweden	2	3	3	3	3	3	4	4	4	4	5

Emission standards

Table: Average regulatory gaps and standard deviations over the period 1999-2009

Exporters	Average Regulatory gap	Standard deviation	Exporters	Average Regulatory gap	Standard deviation
Austria	2.44	0.52	Latvia	0.75	1.80
Belgium	2.55	0.50	Lithuania	0.49	1.65
Bulgaria	1.38	0.91	Luxembourg	2.29	0.48
Czech Republic	2.35	0.50	Netherlands	2.54	0.50
Denmark	2.50	0.47	Poland	2.13	0.61
Estonia	0.71	1.89	Portugal	2.44	0.49
Finland	2.30	0.51	Romania	1.20	1.04
France	2.52	0.53	Slovakia	2.14	0.53
Germany	2.56	0.49	Slovenia	1.14	1.16
Greece	2.49	0.54	Spain	2.46	0.52
Hungary	1.71	1.01	Sweden	2.41	0.49
Ireland	2.35	0.61	United Kingdom	2.50	0.47
2.51	0.51				

Impact of domestic **ES** on exports of used vehicles

Dep. Variable:	Exports value	Quantity	Unit value
ES (exporter)	-0.11 (0.08)	0.13* (0.07)	-0.45*** (0.13)
Gasoline price (log)	-0.52 (1.12)	1.13 (0.78)	-0.02 (1.16)
GDP/capita (log)	7.10*** (2.22)	-5.65*** (1.16)	9.25** (4.12)
GDP (log)	-9.04*** (2.11)	4.94*** (1.34)	-12.77*** (4.17)
Vehicles production (log)	0.48* (0.24)	0.43* (0.23)	-0.38 (0.44)
REER (log)	-0.82 (1.31)	0.19 (0.94)	-0.33 (1.78)
Country fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Country time trend	Yes	Yes	Yes
Observations	263	260	260
Countries	25	25	25

Impact by income-group of importers

Dependent variable:	Impact of ES		
	Exports value	Quantity	Unit value
Low income	0.04 (0.11)	0.25** (0.11)	0.21 (0.14)
Lower middle income	0.07 (0.09)	0.19* (0.10)	0.01 (0.15)
Upper middle income	0.05 (0.09)	0.22** (0.09)	-0.25** (0.13)
High income non-OECD	-0.13 (0.10)	-0.04 (0.12)	-0.56*** (0.14)
High income OECD	-0.16* (0.09)	-0.05 (0.09)	-0.47*** (0.14)

Impact of **domestic ES** on **imports** of European used vehicles

Dep. Variable:	(1) Imports value	(2) Quantity	(3) Unit value	(4) Used/total ratio
ES (importer)	-0.14*** (0.05)	-0.14** (0.06)	-0.01 (0.04)	-0.03** (0.01)
Fuel price (log)	-0.02 (0.17)	-0.09 (0.18)	0.08 (0.12)	0.03 (0.03)
GDP/capita (log)	3.16*** (0.92)	3.09*** (0.92)	-0.00 (0.44)	0.04 (0.13)
GDP (log)	0.18 (0.17)	0.27 (0.18)	-0.10 (0.12)	-0.03 (0.03)
REER (log)	0.88*** (0.24)	0.75** (0.37)	0.12 (0.33)	0.06 (0.06)
Year FE	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Observations	1289	1289	1289	1289
Countries	128	128	128	128

Impact by income groups

Dependent variable:	(1) Quantity	(2) Unit value
Low and middle income	-0.12 (0.14)	-0.10 (0.07)
High income	-0.15*** (0.05)	0.04 (0.03)

Bilateral trade in second-hand cars and regulatory gap

Dep. Variable:	(1) Value	(2) Quantity	(3) Unit Value	(4) Used/total	(5) Quantity of new
ES (gap)	0.14*** (0.02)	0.16*** (0.02)	-0.02* (0.01)	0.01*** (0.00)	-0.05** (0.02)
Price (gap)	0.22*** (0.07)	0.27*** (0.07)	-0.06 (0.04)	-0.01 (0.01)	0.58*** (0.07)
GDP cap (gap)	-0.53*** (0.17)	-0.69*** (0.17)	0.11 (0.11)	-0.05** (0.02)	0.57*** (0.22)
GDP (gap)	-0.19*** (0.07)	-0.24*** (0.07)	0.05 (0.05)	0.00 (0.01)	-0.53*** (0.08)
REER (gap)	0.03 (0.10)	0.08 (0.10)	-0.06 (0.07)	0.03** (0.01)	-0.13 (0.13)
Pair fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	16530	16394	16387	13234	17118
Pairs	2389	2380	2379	1895	2317

Impact by income groups

	(1) Quantity	(2) Unit value	(3) Used/total
Low and middle income	0.17*** (0.04)	-0.02 (0.02)	0.051*** (0.000)
High income	0.15*** (0.02)	-0.02* (0.01)	0.013*** (0.004)

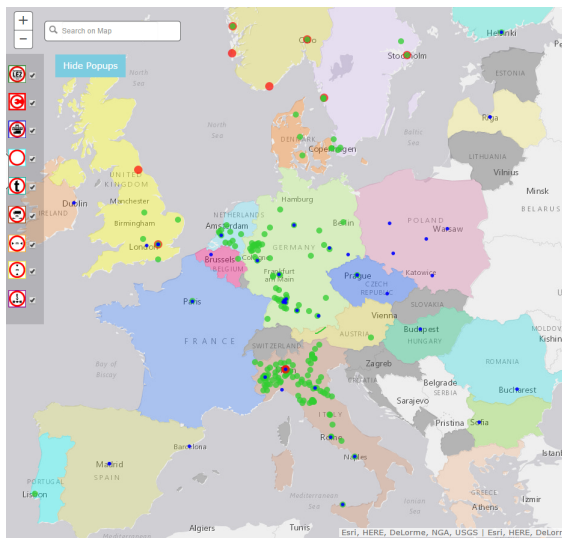
Conclusions and policy implications

- Environmental regulation (Emission standards) matters for trade in second-hand vehicles
- An increase in regulatory gaps between countries increases trade in second-hand vehicles:
 - A relative increase in ES in EU countries increases the supply of second-hand cars towards poorer countries
 - A relative decrease in ES in rich countries increases the demand for imported second-hand cars
- No evidence of increased legal “junkers dumping” in **poorer** countries but they do not benefit either from reduced regulatory gaps
- Potential concerns about decreasing quality of second-hand cars for **richer** importers if regulatory gap increases

References

- Bertinelli, L., E. Strobl, and B. Zou (2010). Polluting technologies and sustainable economic development. *International Journal of Global Environmental Issues* 10.
- Clerides, S. (2008, December). Gains from trade in used goods: Evidence from automobiles. *Journal of International Economics* 76(2), 322–336.
- Davis, L. W. and M. E. Kahn (2010). International trade in used vehicles: The environmental consequences of NAFTA. *American Economic Journal: Economic Policy* 2(4), 58–82.
- Navaretti, G. B., I. Soloaga, and W. Takacs (2000, January). Vintage technologies and skill constraints: Evidence from u.s. exports of new and used machines. *World Bank Economic Review* 14(1), 91–109.
- Pelletiere, D. and K. A. Reinert (2004, December). Used automobile protection and trade: Gravity and ordered probit analysis. *Empirical Economics* 29(4), 737–751.
- Sen, A. K. (1962). On the usefulness of used machines. *The Review of Economics and Statistics* 44(3), pp. 346–348.
- Thomas, V. M. (2003). Demand and dematerialization impacts of second-hand markets. *Journal of Industrial Ecology* 7(2), 65–78.

Low-emission zones and other restrictions in Europe



<http://www.urbanaccessregulations.eu/>