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How effective is carbon pricing?

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Harnessing Finance for Climate, May 23 2023

Carbon tax initiatives

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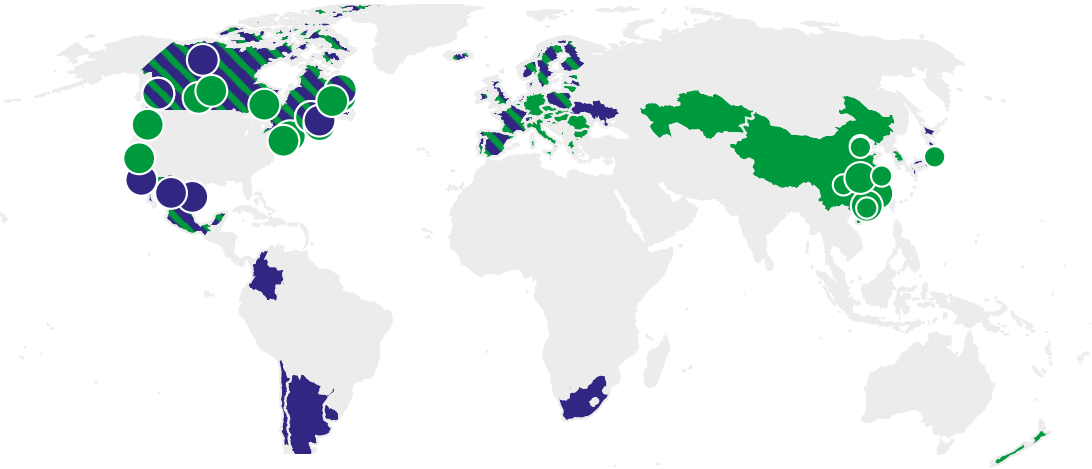
Name	*Type*	*Coverage*	*Year implemented*
Finland carbon tax	Carbon tax	National	1990
Poland carbon tax	Carbon tax	National	1990
Sweden carbon tax	**Carbon tax**	**National**	**1991**
Norway carbon tax	Carbon tax	National	1991
Denmark carbon tax	Carbon tax	National	1992
Slovenia carbon tax	Carbon tax	National	1996
Estonia carbon tax	Carbon tax	National	2000
Latvia carbon tax	Carbon tax	National	2004
EU ETS	**ETS**	**Regional**	**2005**
Alberta TIER	ETS	Subnational	2007
BC carbon tax	Carbon tax	Subnational	2008
Liechtenstein carbon tax	Carbon tax	National	2008
New Zealand ETS	ETS	National	2008
Switzerland ETS	ETS	National	2008
Switzerland carbon tax	Carbon tax	National	2008
RGGI (Eastern US states)	ETS	Subnational	2009
Iceland carbon tax	Carbon tax	National	2010
Ireland carbon tax	Carbon tax	National	2010
Tokyo CaT	ETS	Subnational	2010
Saitama ETS	ETS	Subnational	2011
Ukraine carbon tax	Carbon tax	National	2011
Australia CPM (abolished)	ETS	National	2012
California CaT	ETS	Subnational	2012
Japan carbon tax	Carbon tax	National	2012



KEY STATISTICS FOR 2022 ON INITIATIVE(S) IMPLEMENTED

70 Carbon pricing initiatives selected

47 National jurisdictions are covered by the initiatives selected

36 Subnational jurisdictions are covered by the initiatives selected

In 2022, these initiatives would cover **11.86 $GtCO_2e$**, representing **23.17%** of global GHG emissions

Does carbon pricing work?

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- Existing schemes are far from theoretical 1st best
  - Regional, not global
    - CO2 has same effect on climate regardless of where it is emitted
  - Tax rates are too low (Nordhaus, Stern, Golosov et al)
  - Taxes do not cover all CO_2 emissions and differ across emitters (exemptions etc)
  - Taxes are not revenue-neutral
    - Can reduce firms' financial capacity to invest in abatement

→Do they have any effect on emissions?

- Several papers estimate effects around introduction of carbon pricing scheme
  - Mostly aggregate/sector-level, some on microdata
  - Mixed results across methodologies and schemes (Rafaty et al, 2021)

- Mixed results maybe not surprising:
  - Carbon price varies substantially across schemes and time
  - Effect depends on on technology, price elasticity of demand, cost of funds, and time to adapt

  → Change in emissions depends on tax level, time to adjust, & differs across sectors / firms

The Swedish carbon tax

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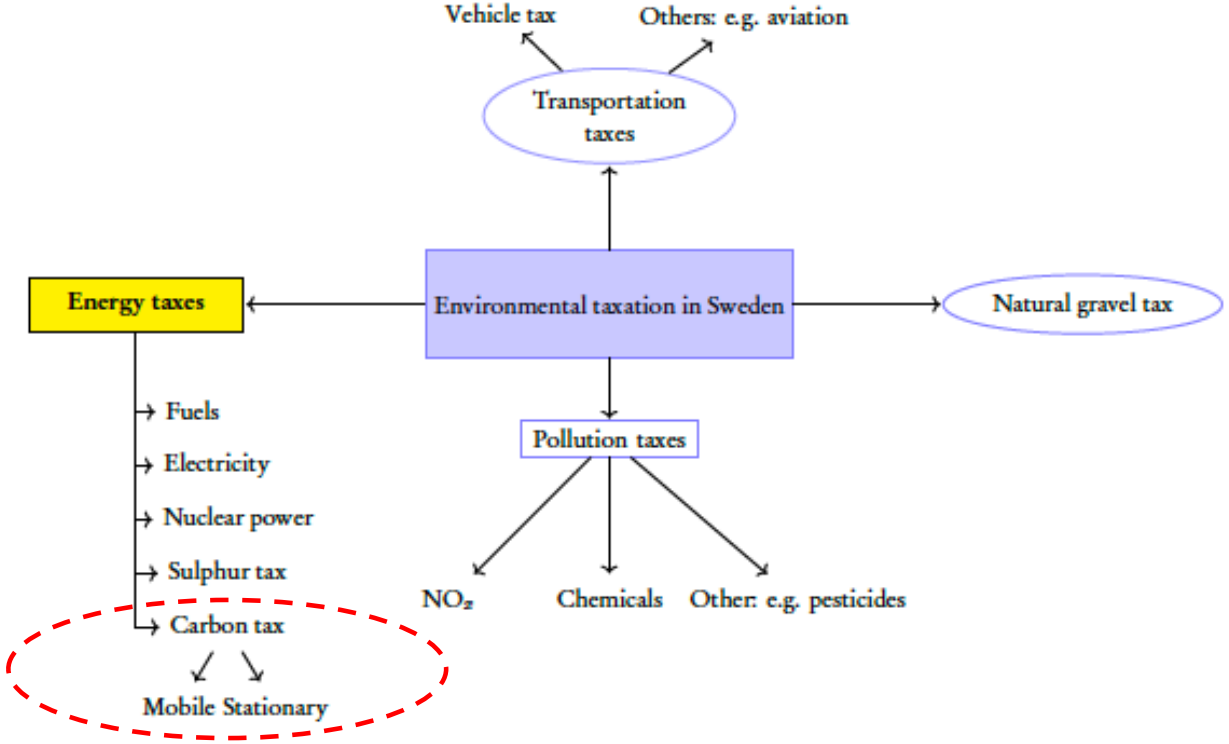
Figure 1.1: Environmental taxation system in Sweden



The Swedish carbon tax

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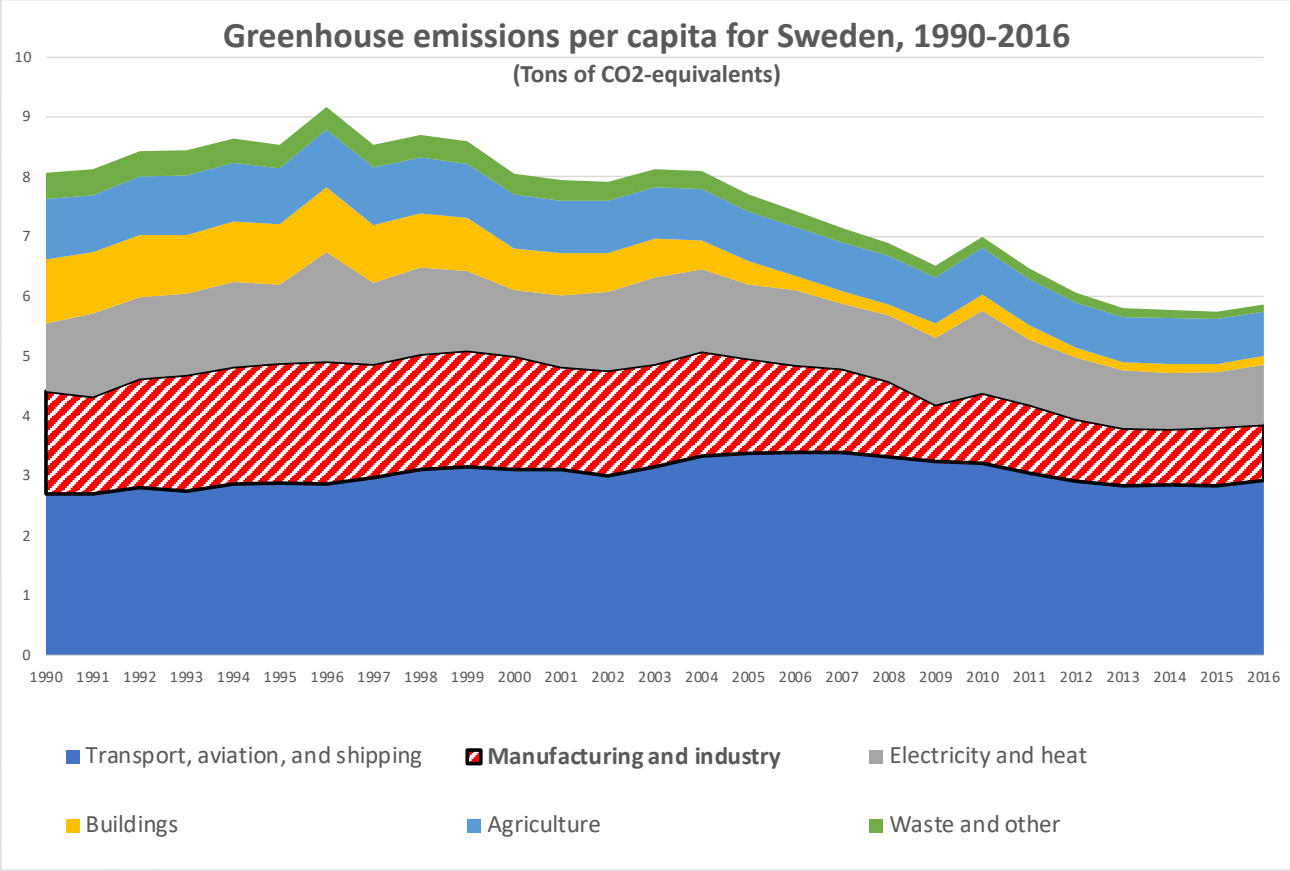

Source: Our World In Data

In addition to manufacturing, domestic transport and electricity and heat were also subject to CO2-taxation

Transport emissions

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Andersson (AEJEP 2019):

- Compare Swedish emissions to synthetic control
- CO2 emissions from transports fell by 11%, with the largest share being due to carbon taxes alone.
  - Carbon tax elasticity 3x larger than price elasticity of gasoline

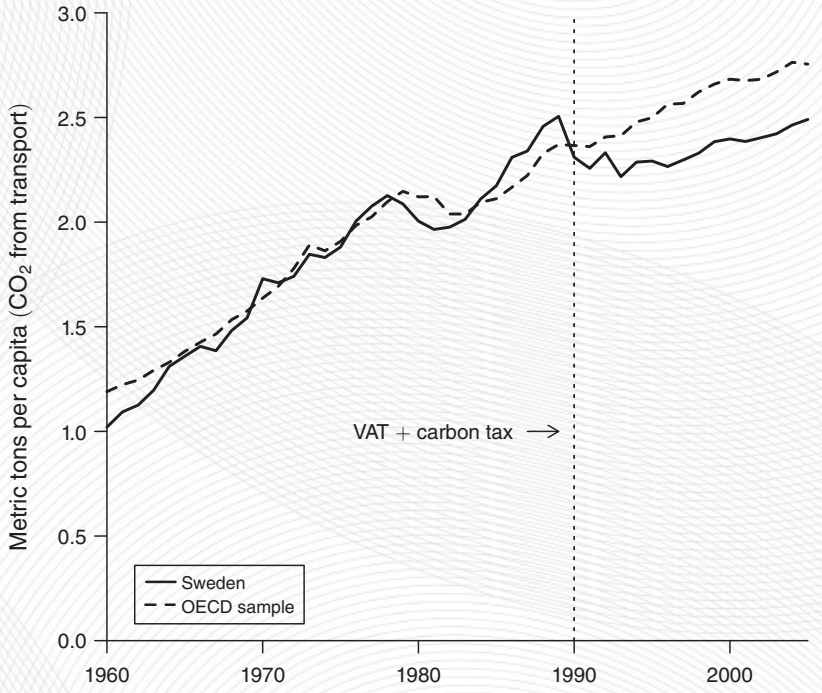

FIGURE 3. PATH PLOT OF PER CAPITA CO_2 EMISSIONS FROM TRANSPORT DURING 1960–2005: SWEDEN VERSUS THE OECD AVERAGE OF MY 14 DONOR COUNTRIES

Manufacturing emissions
(Martinsson, Sajtos, Strömberg, Thomann, 2023)

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Figure 4: Distribution of sales in the Swedish manufacturing sector (1990-2015)

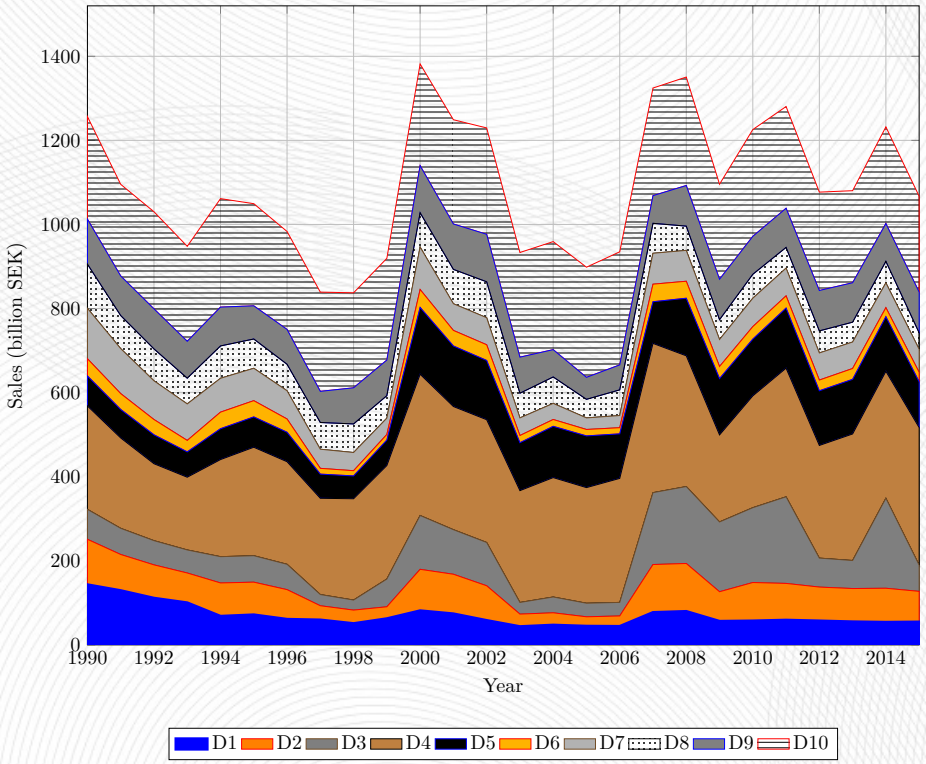

Figure 4 reports the distribution of PPI-adjusted sales in the Swedish manufacturing sector. The sample is divided into ten deciles based on the firms' carbon intensity (i.e. CO_2 emissions over sales) in 1990.

Figure 3: Distribution of CO_2 emissions from Swedish manufacturing (1990-2015)

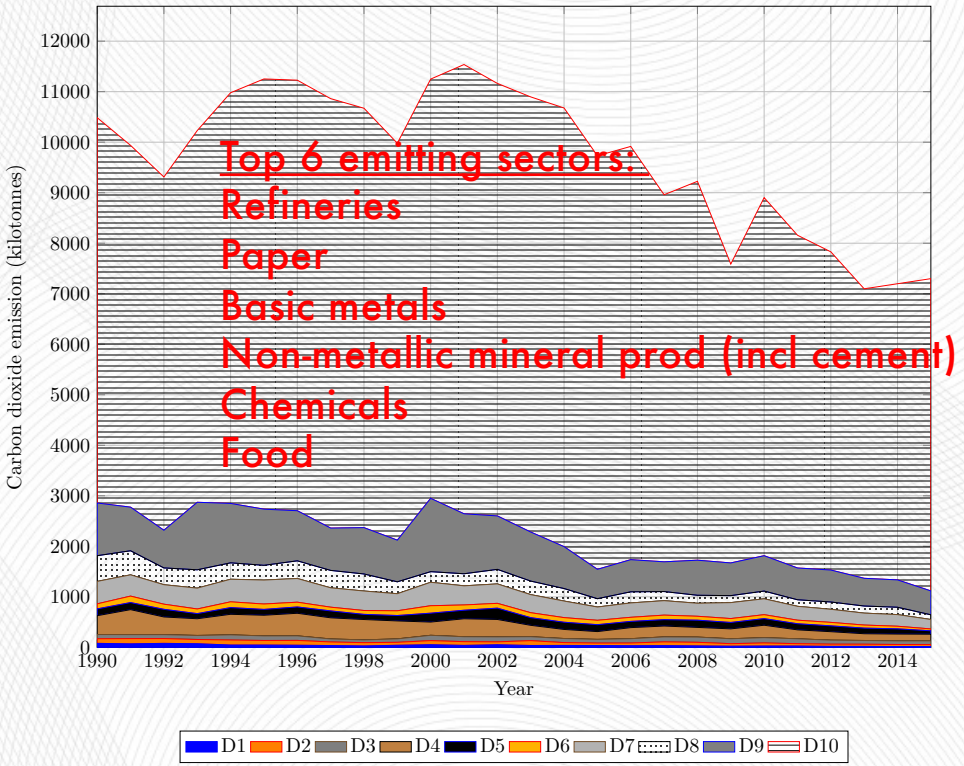

Figure 3 reports the distribution of CO_2 emissions in the Swedish manufacturing sector. The sample is divided into ten deciles based on the firms' carbon intensity (i.e. CO_2 emissions over sales) in 1990.

Sales by 4-digit NACS emission decile

Emissions by 4-digit NACS emissions decile

CO_2-taxes paid by manuf. firms

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Figure 6: Changes to the carbon tax: emissions and carbon tax payments by regime

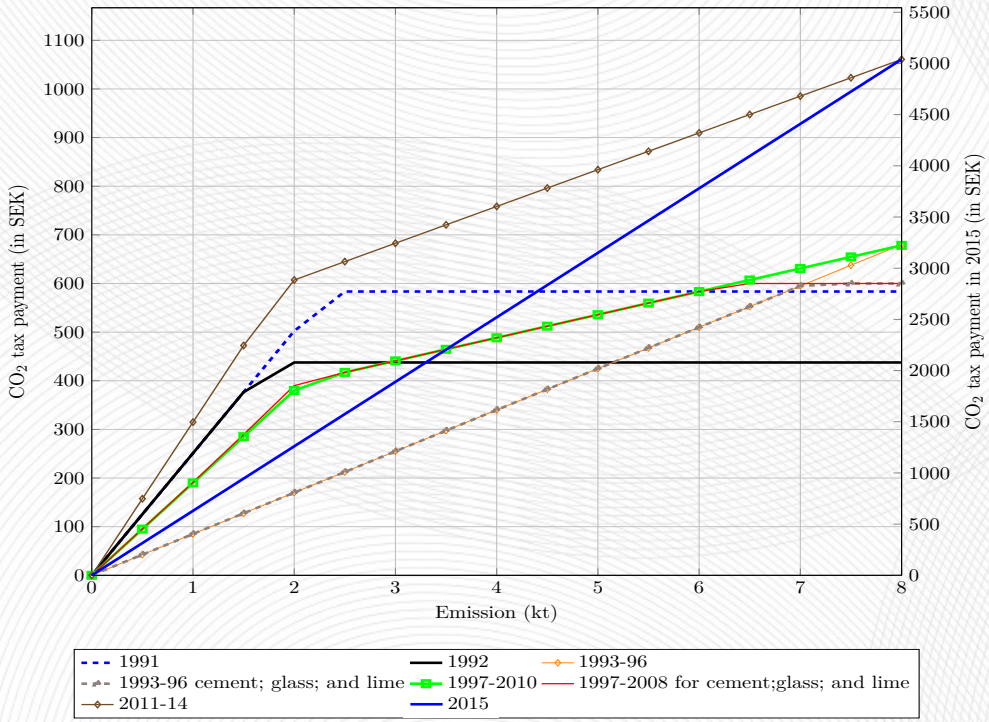

Figure 6 compares the carbon tax payments under the different regimes through a representative manufacturing firm. The hypothetical firm earns 50,000 SEK each year, and assumed to burn only coal in 1991 and 1992. All carbon tax payments with the exception of 2015 are shown on the vertical axis on the left side. Carbon tax payments in 2015 are shown on the vertical axis on the right side.

Figure 7: Average and marginal tax rates (1990-2015)

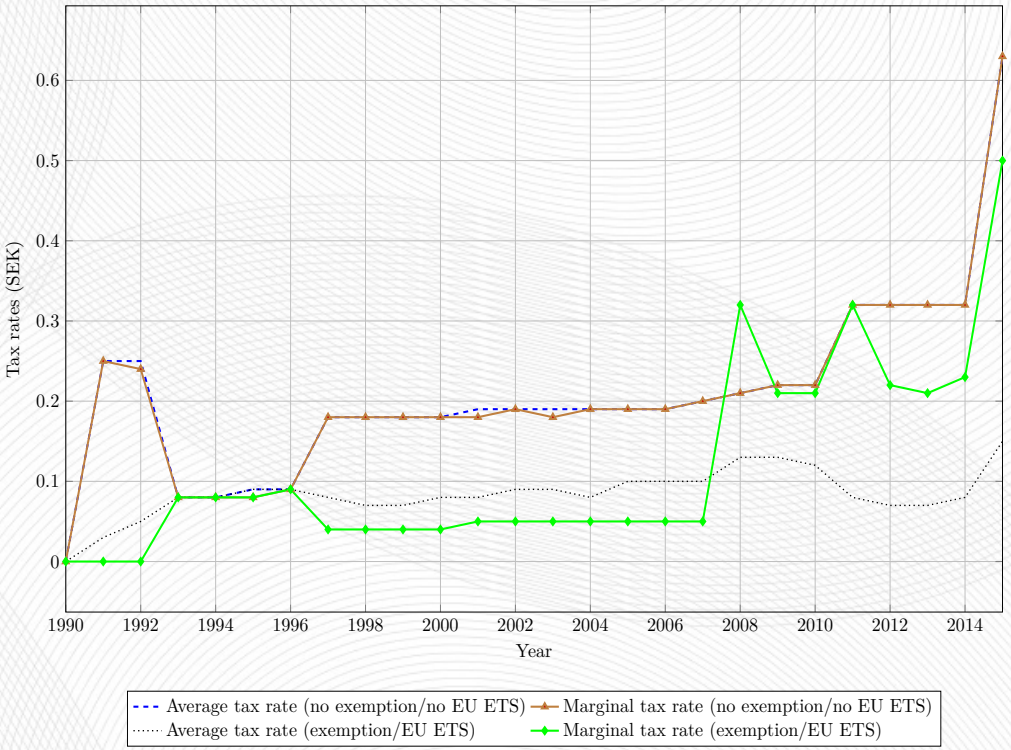

Figure 7 displays the average and marginal tax rates depending on whether the firm is eligible for carbon tax exemptions and covered by the EU ETS. *no exemption/n* denotes firms that are not regulated by the EU ETS and are not entitled to carbon tax cut, *exemption/EU ETS* refers to the firms with available exemptions until they emission trading scheme. Average tax rates are backward-looking effective tax rates. Marginal tax rates are obtained as forward-looking effective tax rates. Marginal ta EU ETS are the price for emission rights. Average tax rates for EU ETS are backward-looking, consider historical prices and free distribution of emission rights.

Findings

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- Carbon taxation works:
  - 1% increase in marginal tax cost → 2% lower emission intensity
  - Economic significance: Swedish manufacturing emissions of CO_2 would have been roughly 30% higher without carbon pricing
- Sector heterogeneity important:
  - Large emitters have lower elasticities due to higher abatement costs
  - Access to financing matters the most for these firms
- Swedish carbon tax was suboptimally designed:
  - CO_2 emissions are concentrated to a few high-emitting sectors
  - Highest emitters paid significant carbon tax - making them less competitive and more financially constrained - but had lowest marginal benefit of reducing emissions

Calibrated effect of carbon pricing 2015 base year

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	(1)	(2)	(3)	(4)	(5)
	Share CO_2	**Elasticity**	**CO_2 intensity**	**Without tax**	**Relative**
Panel A: PACE, mobility and aggregate emissions					
All	1.0000	2.0769	0.0049	0.0071	47%
Low pace & Low mobility	0.0415	2.7789	0.0033	0.0057	74%
Low pace & High mobility	0.0125	2.9284	0.0025	0.0042	68%
High pace & Low mobility	0.9021	1.7213	0.0077	0.0098	27%
High pace & High mobility	0.0438	2.4516	0.0049	0.0068	38%
Aggregate emissions					30%
Deciles 1-4	0.0310	6.7230	0.0025	0.0069	175%
Deciles 5-8	0.0591	2.7340	0.0039	0.0069	78%
Deciles 9-10	0.9099	1.2970	0.0142	0.0174	23%

Calibrated effect of carbon pricing 2015 base year

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	(1)	(2)	(3)	(4)	(5)
	Share CO_2	**Elasticity**	**CO_2 intensity**	**Without tax**	**Relative**
Panel C: Ownership, size, dividend payout and age					
Public firm	0.4684	2.2195	0.0074	0.0103	39%
Private firm	0.5316	0.9591	0.0044	0.0050	14%
Large firm	0.7077	2.1150	0.0047	0.0065	38%
Small firm	0.2923	0.5854	0.0049	0.0056	12%
High dividend firm	0.4110	2.6990	0.0047	0.0071	51%
Low dividend firm	0.5890	0.7429	0.0050	0.0050	0%
Mature firm	0.6616	2.9335	0.0045	0.0076	69%
Young firm	0.3384	0.5620	0.0051	0.0057	13%

Thank you