Energy Tax Exemptions and Industrial Production

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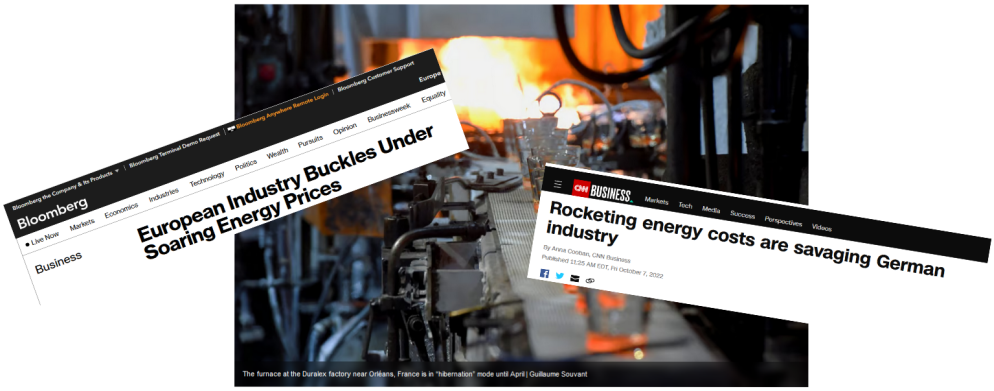
Is this the end of Made in Europe?

From glass-makers to paper producers, European industries face a struggle to survive. What if they don't make it?



BY CHARLIE COOPER AND GIORGIO LEALI

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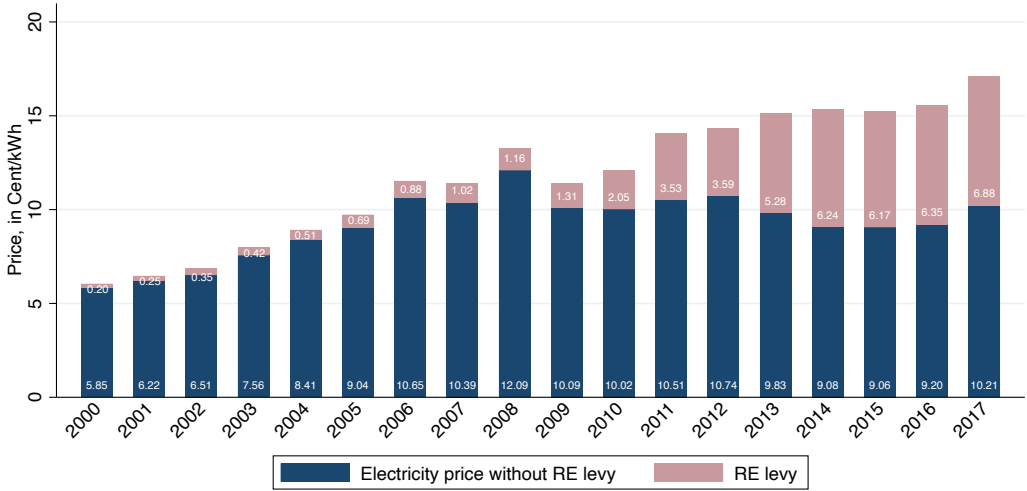
Motivation

- Many environmental regulations only **apply to a subset of jurisdictions** (carbon taxes, EU ETS, etc.)
- Concern about **'leakage' of industrial activity and emissions**
- Policy response: **exemption schemes** for energy-intensive and trade-exposed (EITE) firms

We evaluate EITE firm exemptions in Germany

1. How large are **competitiveness effects** vs. **adverse effects on energy use**?
2. How does the **exemption design** influence production decisions?

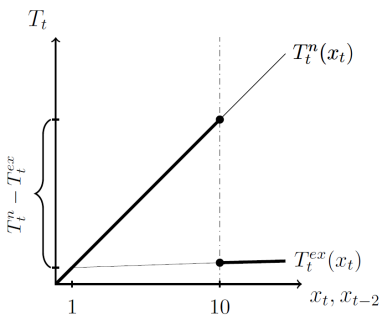
Renewable Energy Levy and Electricity Prices



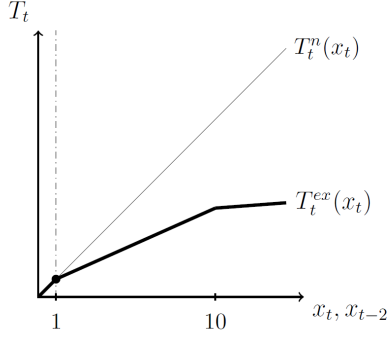
This Paper

- Empirically assess the impact of exemption schemes on **plant-level inputs** and **outputs**
- Contributes to policy design: **'notched' schedule** vs. **'reformed' schedule**, where inframarginal benefits have been largely removed

Notched schedule



Reformed schedule



Main Findings

Qualitatively, both evaluations yield very similar results:

1. Exempted plants increase electricity use
2. No evidence for impact on exemptions on outputs (sales, export share, investment) and employment

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Quantitatively, our results differ:

- **Notched schedule:** $\sim 30\%$ increase in electricity use
- **Reformed schedule:** $\sim 3\%$ increase in electricity use

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Counterfactual simulations:

- Inframarginal **bunching responses** rationalize effect size differences
- **Compliance cost** crucial for market outcomes under notched schemes (if zero: no. of exemptions $\approx +\mathbf{100}\%$, distortive effects: $\approx +\mathbf{60}\%$)

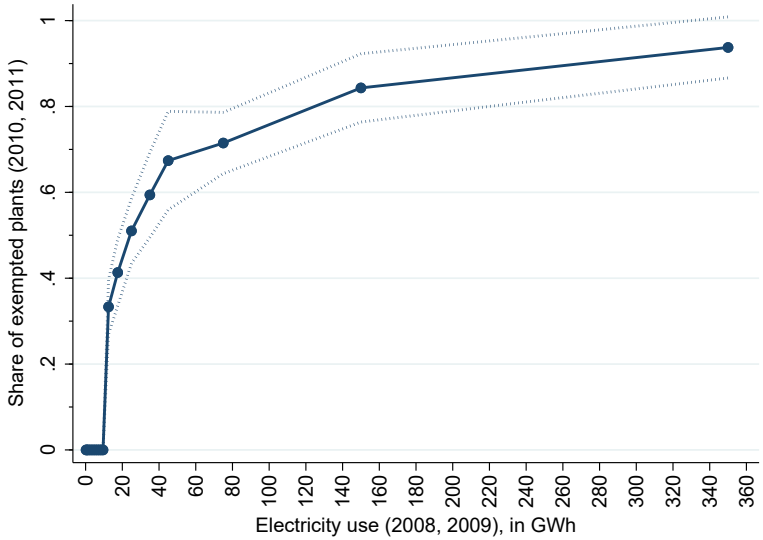
Data

German Manufacturing census (AFiD): 2007-2017

- Scope: all German manufacturing *plants* with more than 20 employees
- Production survey: plant-level information on employment, gross output, exports
- Energy use survey: plant-level energy use
- Cost structure survey: firm-level information on total energy cost and gross value added
- Material and incoming goods statistics (2006, 2010, 2014): firm-level energy input cost

List of REL exempted plants for the years 2010-2013 (BAFA)

1. Not all eligible plants claim an exemption



2. Selection above the 10 GWh threshold only in 2010

Year	2008	2009	2010	2011
McCrary test statistic	0.04	0.05	0.37**	-0.15
	(0.15)	(0.16)	(0.16)	(0.14)
RE levy in $t+2$	2.05 ct/kwh	3.53 ct/kwh	3.59 ct/kwh	5.28 ct/kwh
Notch present in $t+2$	yes	yes	yes	no

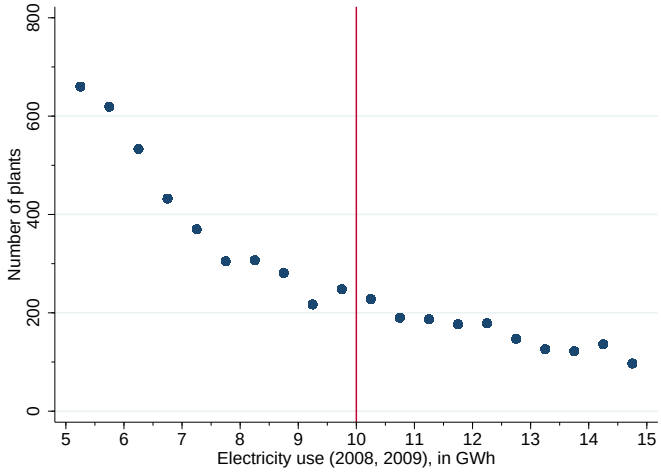
Reduced-Form Policy Evaluations

Policy Evaluation I:

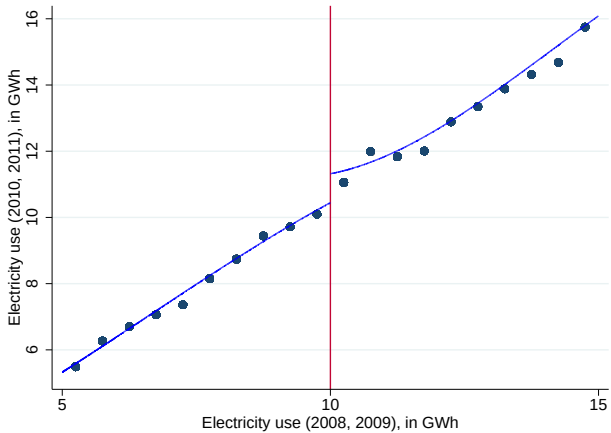
Financial Crisis in 2008/2009 (Notched Tax Exemption Schedule)

- We exploit absence of bunching in 2008/2009 to estimate exemption effects in 2010/2011
- Method: Fuzzy RD
- Identifies the ATT at the 10 GWh cutoff

No evidence for selection above the threshold



Discontinuity in outcome variable



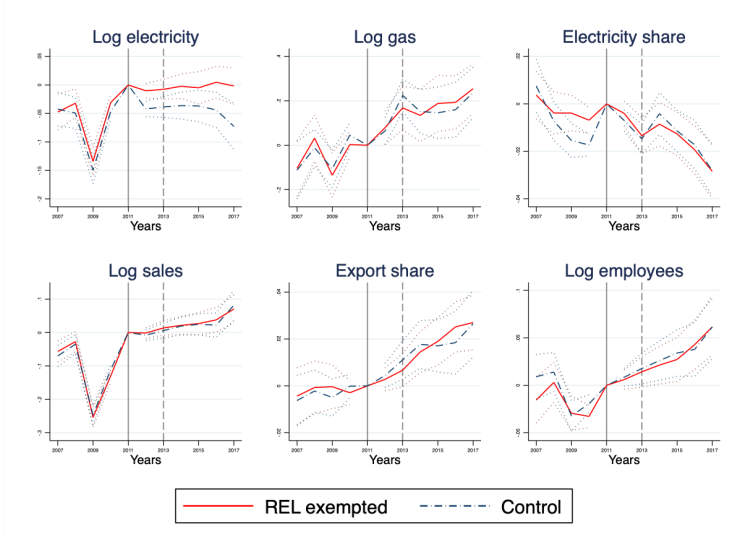
	ATT^{RD}	SE
Panel A: *Electricity & fuel usage*		
Electricity consumption [GWh]	3.156**	1.402
Log electricity consumption	0.578*	0.307
Log fossil fuel consumption	−0.119	0.507
Share of total energy mix:		
Electricity [%]	0.123	0.12
Fossil fuel [%]	−0.186*	0.101
Panel B: *CO2 emissions*		
Log CO_2, direct	−0.082	0.492
Log CO_2, total	0.614*	0.355
Panel C: *Competitiveness indicators*		
Log employment	0.152	0.173
Log sales	0.374	0.288
Export share	−0.118	0.074
Log investment	0.774	1.239
Investment > 0)	−0.166	0.186
Investment machinery > 0	−0.113	0.164
# of observations	39,202	
# of exempted plants	497	
First-stage	0.176	

Policy Evaluation II:

Extension of Eligibility Criteria in 2013 (Tax Exemption Schedule without Notch)

- We exploit that many firms became newly eligible in 2013
- Method: Matching DiD in subsample of newly eligible firms (1-10 GWh)
- Matching on 2011 electricity cost to gross value added (and lags thereof), log of sales and log of employment
- Identifies the ATT for plants with 1-10 GWh of electricity use

Matching DiD: Pre-treatment trends



Main sample	all plants		5-10 GWh	
	ATT^{DiD}	SE	ATT^{DiD}	SE
Δ 2013-2011	(1)	(2)	(3)	(4)
Panel A: *Electricity & fuel usage*				
Electricity consumption [GWh]	0.092*	0.055	0.334**	0.145
Log electricity consumption	0.028**	0.012	0.062**	0.024
Log fossil fuel consumption	−0.055	0.04	−0.041	0.044
Share of total energy mix:				
Electricity [%]	0.004	0.005	0.007	0.007
Fossil fuel [%]	−0.008	0.005	−0.016**	0.007
Panel B: *CO2 emissions*				
Log CO_2, direct	−0.036	0.039	−0.016	0.043
Log CO_2, total	0.017	0.013	0.042*	0.022
Panel C: *Competitiveness indicators*				
Log employment	0.007	0.012	0.021	0.017
Log sales	0.008	0.015	0.016	0.025
Export share	−0.002	0.005	0.015	0.011
Log investment	0.031	0.139	−0.287	0.196
Investment > 0	−0.031	0.022	−0.022	0.032
Investment machinery > 0	0.026	0.02	0.015	0.032
# of observations	702		270	
# of exempted plants	351		135	

Robustness

- Anticipation of policy change: base year 2010 ▸ Anticipation
- Intra-firm spillovers: single-plant firms ▸ Spillover
- Selection into Treatment (growth expectations) ▸ Group DiD
- Balanced sample in electricity and gas use ▸ Sample 2
- Matching: Propensity score based only on electricity intensity (no lags) and economic sub-sectors ▸ Matching

Simulations of Efficiency and Distributional Implications of Policy Designs

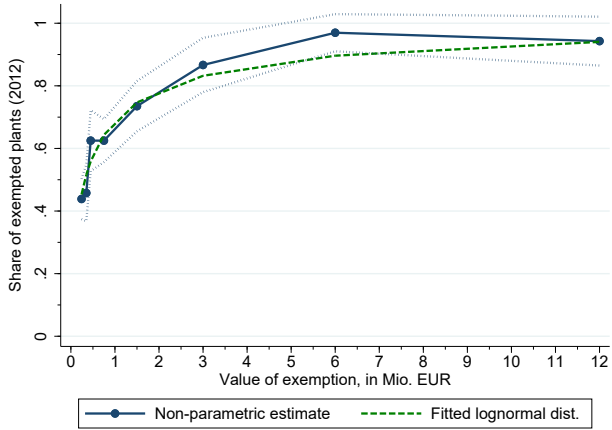
Identification of Structural Parameters

Structural assumptions:

1. Isoelastic production function (electricity use elasticity α)
2. Application cost: $C \sim \text{lognormal}(\mu, \sigma)$, iid
3. Bunching cost: $\kappa = \beta + |\text{DistanceToThreshold}| \times \gamma$
4. Value of an exemption in $t+2$: $A = V_t(x_t)$

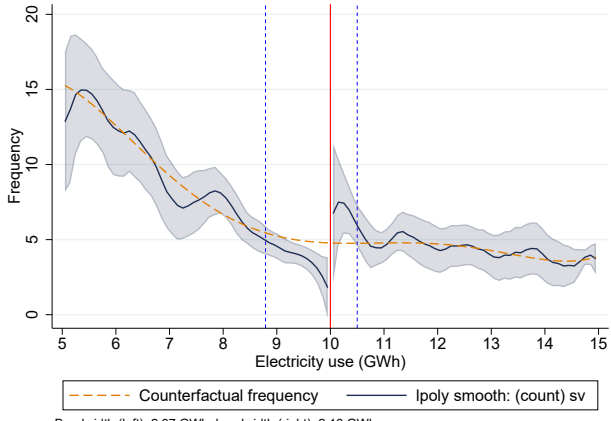
Parameter	Identification
α	Reduced-form electricity use elasticity (under the de-notched schedule)
μ and σ	Exemption shares among the eligible
β and γ	Elec. use of marginal buncher and share of bunchers at threshold

Identifying Compliance Cost from Exemptions in 2010



Parameters	Identification
(μ, σ)	$\Pr(\text{exempt} \mid A(x)) = \Pr(\text{C<A(x)}) = F_C(A(x))$

Identifying Cost Parameters from Bunching Behavior in 2010



Parameter	Identification	Statistic
β	$Pr(bunch\|x = 10) = F_c(A(\hat{x}) - \beta)$	$F_c(A(\hat{x}) - \beta) = 34\%$
γ	$A(x^m) = \beta + \gamma(\hat{x} - x^m)$	$x_m = 8.79$ GWh

Simulations of Efficiency and Distributional Implications - 1

Bunching Behavior (in t)

	(1) # of bunchers	(2) Bunching, in GWh	(3) Max. bunching, in %	(4) Bunching cost, in Mio. EUR	(5) Externality cost, in Mio. EUR
Simulations for Bunching in 2008 to 2011 Under the Respective Exemption Designs					
(1) 2011 (reformed)	0	–	–	–	–
Counterfactual Simulations for 2013 under a Notched Exemption Design					
(3) 2011 (notched)	56	55.3	26.8	7.5	1.4
(4) REL 2017	145	258.2	60.3	28.8	6.4
(5) Costless compliance	181	220.9	29.2	27.8	5.5
(6) No frictions, REL 2017	414	1,008.3	74.2	82.0	25.1

Simulations of Efficiency and Distributional Implications - 2

Exemption Behavior (in $t+2$)

	(6) # of exemptions (actual #)	(7) Electricity use change, in GWh	(8) Exemption value, in Mio. EUR (actual value)	(9) Compliance cost, in Mio. EUR	(10) Externality cost, in Mio. EUR
Simulations for Exemptions in 2010 to 2013 Under the Respective Exemption Designs					
(1) 2013 (reformed)	1,239 (1,574)	2,172.9	3,874 (3,804)	335.7	73.0
Counterfactual Simulations for 2013 under a Notched Exemption Design					
(3) 2013 (notched)	833	2,081.3	3,681	303.2	69.9
(4) REL 2017	1,020	2,887.9	5,108	486.2	97.0
(5) Costless compliance	1,317	2,423.2	4,259	0.0	81.4
(6) No frictions, REL 2017	1,550	3,231.3	5,683	0.0	108.6

Conclusion

- This paper analyzes the impact of a large energy tax exemption scheme on the German manufacturing industry
- Using two sources of exogenous variation, we show that:
  - Notched exemption: $\sim 30\%$ increase in electricity use
  - Reformed exemption: $\sim 3\%$ increase in electricity use
  - Exemptions have no impact on competitiveness indicators
- Exemptions are costly and might not be effective in their objective to retain domestic production
- Policy design and application frictions matter: caution against notched exemption schemes when compliance cost are low

Thank you!

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