Competition and Regulation in Electricity

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25.10.2017

Introduction

- **1. Competition and Regulation in general**
  - Wealth through competition
  - Incentive regulation
  - Investment incentives
- **2. Applications**
  - Unbundling

Why is competition “good“?

- Sampling benefit of competition:
  - Productive efficiency: most efficient firm provides the good; sometimes not yet existent firm! (Friedrich August von Hayek: “Competition as discovery process “)
- Rent reducing benefit of competition:
  - Allocative efficiency: no “economic rents“
  - John Hicks, 1935: “The best of all monopoly profits is a quiet life.“
- Pressure to innovate:
  - Dynamic efficiency (Joseph Schumpeter; Kenneth Arrow; Philipe Aghion)
- Reduces political power:
  - Lobbying, bribing
  - “Internet giants“: Google, Facebook, Amazon…

Empirical results indicate increases in

- **Productivity**:
  - EU merger and anti-trust policy enforcement leads to higher productivity, especially in markets with low regulation
  - Recent example May 2017: auctions for solar and wind subsidies in Germany; from 8 cent/KWh to 5.5 cent in the first auction for onshore wind: minus 30%!, could go to 3 cent; offshore wind: zero subsidies! Not in Austria; Slovakia?
- **Investment**:
  - EU merger policy enforcement leads to higher investment and higher total factor productivity in energy markets
  - US investment has fallen relative to Tobin‘s Q in concentrated industries

Why regulation/state intervention?

- Market failure: "Natural Monopoly" (cheapest if only one firm provides the good)
  - Dublication of fixed costs; Economies of scale and scope; Network externalities (Google?)
  - "Monopolistic Bottleneck"/"Essential Facility": unbundling?

- "Public good"-problem: Prisoners' dilemma (John Nash)
  - E.g. Security of supply; Climate change

- Irreversibility of sunk costs: asymmetry between incumbent and potential entrants; no contestable market because of market entry and exit barriers

- Long lived, sunk investments with positive externalities (telecom, energy infrastructure etc.)

→No first-best solution by the competitive process (but also state failure; trade off)

How regulate?

1. Cost based/Rate-of-Return regulation

- Realized costs+mark-up/ ex ante fixed return on employed capital

- John Hicks, 1935: “The best of all monopoly profits is a quiet life.“

→ Moral Hazard Problems: insufficient incentives to reduce costs/Averch-Johnson effect
→ Asymmetric risk distribution (consumers/taxpayers bear risk)
→ BUT: “good" infrastructure investment incentives

How regulate?

2. Incentive regulation (nobel laureate 2014 Jean Tirole)

- Asymmetric information!
- Price or revenue cap: disentanglement of prices from costs (incentive!)
  - Stephen Littlechild: British telecom sector
- RPI-X (X … expected total factor productivity growth)

→"Simulation" of competition: better allocative efficiency, risk taking by firm

→BUT: efficient firm could get large information rent or adverse selection problem (if regulator does not pay information rent only bad firms in market);

→AND: "Ratchet effect": be efficient at the beginning, be inefficient at the end of the regulatory period…

→ AND: "not so good" infrastructure investment incentives

Yardstick regulation/Benchmarking

- Compare to similar, non-competing firms (e.g. electricity distribution)
- Reduce asymmetry of information
- Prices follow costs of others
- Firm specific X-factors to catch up
- Strong incentives without allocative inefficiency (information rent reduced)
- BUT
  - Unobserved heterogeneity
  - Different life and investment cycles
  - Different potentials to reduce costs
  - Danger of collusion

How regulate?

3. Vertical unbundling?

- Fair and non-discriminatory access to monopolistic bottleneck/essential facility
- Otherwise: cross-subsidization, non-price discrimination
- E.g. telecom, rail, gas, electricity (generation, transmission, distribution, retail)

- Different degrees of structural separation of network operations from supply activities: Accounting (OeBB), legal (e.g. 3rd energy package in EU in 2009; APG: Austrian Power Grid), ownership unbundling (not mandatory; most transmission grid operators in EU)

- BUT
  - "Economies of Vertical Integration"
  - "Economies of Scope"
  - "Costs of Coordination"
  - Investment incentives

Solution approaches

- 1. "Regulatory holidays" (ultra-fast glass fiber broadband in USA)?
- 2. Cooperation at investment stage then competition (glass fiber in CH)?
- 3. Cost based elements for investments (Austria: Smart Meter)?
- 4. Subsidies (rail; broadband; renewables)?
- 5. Vertical integration?

→ As much competition/incentive regulation as possible, as much market power/investment incentives as necessary?!

Case: Unbundling

- Transmission network unbundling in Europe (e.g. Meletiou, Cambini, Masera, 2017; Gugler, Rammerstorfer, Schmitt (2013), Energy Economics; Gugler, Liebensteiner, Schmitt, 2016, IJIO)
- Third legislative package of the European Commission in September 2007: advanced forms of unbundling the transmission grid are required in the electricity and gas sector. Countries can choose between three options:

- Full ownership unbundling (FOU)

Or the TSO may remain part of a vertically integrated utility:

- Independent system operator (ISO)
- Independent transmission operator (ITO

Transmission network unbundling in Europe (from Meletiou, Cambini, Masera, 2017)

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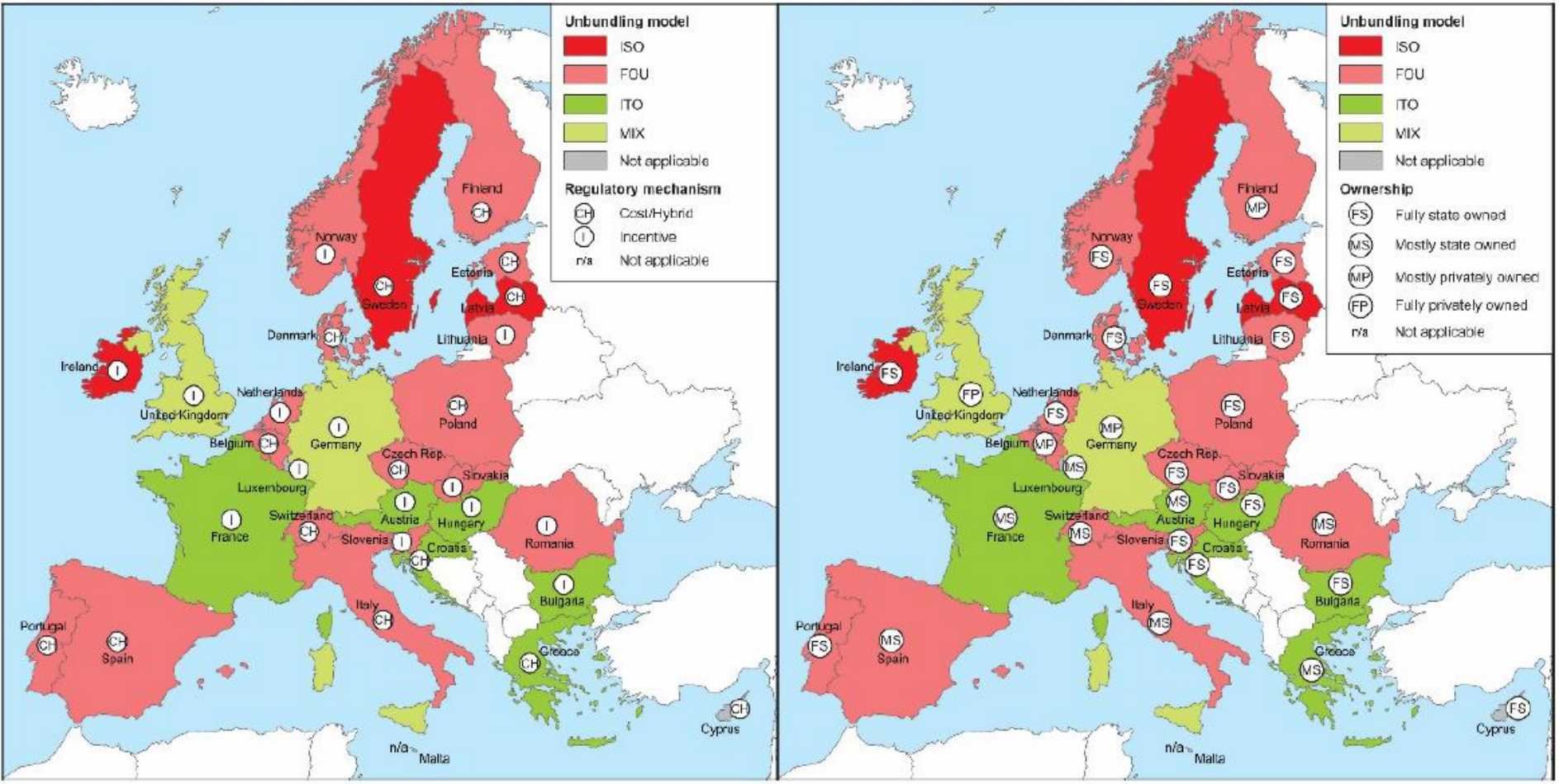
Country	Utility	Year of Unbu-ndling	Unbu-ndling Model	REG	OS	GCR	Cons_ GDP	NetIMP	KML (x1000)
Albania	OST	2017	FOU	Incentive	100	72	0.126	-0.005	2.58
Austria	APG	2012	ITO	Incentive	76	55.3	0.131	0.18	6.77
Austria	VUN	2012	FOU	Incentive	100	55.3	0.131	-0.40	0.40
Belgium	Elia	2012	FOU	Cost	48.9	70.7	0.131	0.03	8.38
Bulgaria	ESO	2015	ITO	Hybrid	100	65	0.122	-0.30	14.70
Croatia	HOPS d.o.o.	2015	ITO	Cost	100	80.5	0.122	0.28	7.51
Czech Rep.	ČEPS	2005	FOU	Hybrid	100	73	0.152	-0.26	12.50
Denmark	Energinet.dk	2005	FOU	Hybrid	100	36	0.152	-0.09	6.10
Estonia	Elering AS	2013	FOU	Incentive	100	88	0.131	-0.28	5.25
Finland	FingridOyj	1997	FOU	Cost	49.9	25	0.176	0.05	13.50
France	RTE	2012	ITO	Incentive	84.5	86	0.131	-0.12	48.00
Germany	TenneT TSO	2011	FOU	Incentive	0	29	0.137	-0.07	10.60
Germany	Transnet BW	2012	ITO	Incentive	93.5	9	0.131	-0.01	3.70
Germany	50 Hertz	2011	FOU	Incentive	0	11	0.137	-0.05	9.70
Germany	Amprion	2012	ITO	Incentive	30	24	0.131	0.10	11.00
Greece	IPTO	2012	ITO	Cost	51	81.5	0.131	0.06	11.14
Hungary	MAVIR ZRt.	2012	ITO	Hybrid	99	44.1	0.131	0.17	3.76
Ireland	ESB Networks	2005	ISO	Incentive	95	59	0.152	-0.07	6.50
Italy	Terna	2004	FOU	Hybrid	61	46.3	0.154	0.16	44.50
Latvia	LET AS	2013	ISO	Hybrid	100	89	0.131	0.22	5.20
Lithuania	Litgrid AB	2013	FOU	Incentive	97.5	30.4	0.131	0.68	6.50
Netherlands	TenneT TSO	2002	FOU	Incentive	100	25	0.155	0.16	3.24
Norway	Statnett SF	2002	FOU	Incentive	100	30.7	0.155	0.03	10.00
Poland	PSE	2006	FOU	Hybrid	100	18.5	0.149	-0.09	26.00
Portugal	REN	2003	FOU	Hybrid	100	61.5	0.152	0.04	6.54
Romania	Transelectrica	2013	FOU	Incentive	87.2	26.7	0.131	-0.08	8.80
Slovakia	SEPS	2006	FOU	Incentive	100	83.6	0.149	-0.10	2.72
Slovenia	ELES	2015	FOU	Incentive	100	52.4	0.121	-0.20	2.50
Spain	REE	2002	FOU	Hybrid	51	43.8	0.155	0.02	27.80
Sweden	SvK	1996	FOU	Cost	100	54	0.174	0.05	15.00
Switzerland	Swissgrid	2013	ITO	Cost	87.5	35	0.131	-0.01	6.60
UK	SHETL	2005	ISO	Incentive	0	11	0.152	-0.25	5.10
UK	SPTL	2005	ISO	Incentive	0	4	0.152	-0.25	4.00
UK	NGET	1995	FOU	Incentive	0	23	0.173	0.07	14.20
UK	NIE Networks	2009	ISO	Incentive	0	17	0.138	0.04	2.20

Fig.1: Snapshot of (a) the applied regulatory mechanism and (b)the ownership of the transmission networks in EU-28, one year before the implementation of the ownership unbundling.



Variable	Variable description	Source
Investments, I	Gross investments in tangible goods in the overall electricity industry (i.e. investments in generation, distribution or transmission assets)	Eurostat
Capital stock, K	Since capital stock data is not directly available from the data base, we derive it indirectly from investments using the perpetual-inventory method	Eurostat
Final consumer prices, P	Electricity end-user prices for households in USD per kWh. Prices are purchasing power parity corrected and taxes are subtracted.	IEA
Ownership unbundling, OU	Ownership unbundling of the transmission grid (0 = no OU, 1 = OU)	EU documents
Third party access, TPA	Third party access to the electricity transmission grid (0 = no TPA, 1 = negotiated TPA, 2 = regulated TPA)	OECD International Regulation Database
Liberalized wholesale market, LWM	Existence of a liberalized wholesale market for electricity (0 = no LWM , 1 = LWM)	OECD International Regulation Database
Minimum consumption threshold, MCT	Minimum consumption threshold for consumers to be allowed to choose their electricity supplier (0 = no choice , 1 = more than 1000 gigawatts (GW), 2 = between 500 and 1000 GW, 3 = between 250 and 500 GW, 4 = less than 250 GW, 5 = no MCT)	OECD International Regulation Database
Public ownership, PO	Ownership structure of the largest companies in the generation, transmission, distribution and supply segments of the electricity industry (0 = private, 1 = mostly private, 2 = mixed, 3 = mostly public, 4 = public)	OECD International Regulation Database
Per-capita consumption, CON	Per-capita consumption of electricity	OECD
Long-term interest rate, R	Long-term interest rate	OECD

Short and long run effects

	FE ECM	FE Without ECM	GMM-DIFF ECM	GMM-DIFF Without ECM
Short log P	0.0373	0.4057 (p=0.12)	0.1196*	0.4084**
Long log P			0.1461*	0.5716***
Short OU	-0.0191 (p=0.13)	-0.1135*	-0.0398**	-0.0676**
Long OU			-0.0486**	-0.0946***
Short TPA	0.0072	-0.0254	-0.0511*	-0.0412
Long TPA			-0.0624*	-0.0576
Short LWM	-0.0008	0.0700*	0.0193	0.0761***
Long LWM			0.0236	0.1066***
Short MCT	-0.0041	0.0071	0.0125	0.0118
Long MCT			0.0153	0.0166
Short PO	-0.0237*	-0.0931**	0.0398	-0.0308*
Long PO			0.0486	-0.0431

- Short-run coefficient $(\beta_1 + \beta_2)$ for prices; analogous for the other coefficients and variables
- Long-run coefficient $(\beta_1 + \beta_2)/(1 - \alpha_1)$ for prices; analogous for the other coefficients and variables
- $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Main results on investment incentives:

- Higher electricity end-user prices induce higher investments in the overall sector → Trade-off between static and dynamic efficiency
- Ownership unbundling of the transmission grid leads to lower investment spending (corroborating evidence in telecom: Nardotto, Valletti, Verboven, 2015) → Trade-off between competition and vertical synergies
- Regulation affecting the incumbent directly (OU, TPA) may lead to lower investments
- Introducing competition via market based measures (LWM, MCT) increases investments

Table 1. Sample statistics

Description	Variable	Main sources	Obs.	Mean	S.D.	Min.	Max.
Dependent variable							
TOTEX excl. purchased power (htEUR)	C	Worldscope; Orbis; Annual reports	242	73.61	118.83	1.20	578.98
Outputs							
Generation (TWh)	Y_G	Annual reports	242	74.80	136.85	0.00	669.00
Transmission (tKm)	Y_T	Annual reports	242	9.80	21.65	0.00	100.69
Input prices							
Price of labor (tEUR/empl.)	w_L	Worldscope; Orbis; Annual reports	242	57.69	21.53	12.07	141.01
Price of natural gas (tEUR/GWh)	w_F	OECD Observer	242	26.03	8.55	9.75	44.78
Price of capital (%)	w_C	Worldscope; Orbis; Annual reports	242	7.05	3.77	0.68	30.32
Other control variables							
Share hydro capacity (%)	hyd	Platts PowerVision	242	28.28	26.63	0.00	100.00
Share nuclear capacity (%)	nuc	Platts PowerVision	242	11.77	17.10	0.00	61.46
Binary indicator: generation only	α_G		242	0.43	0.50	0.00	1.00
Binary indicator: transmission only	α_T		242	0.12	0.33	0.00	1.00
Sources of vertical economies							
Binary indicator: registered patents	$d\_patents$	Orbis	242	0.44	0.50	0.00	1.00
Yearly time trend	$trend$		242	5.74	3.01	0.00	10.00
Share of renewable energy supply	$rnwbl$	Eurostat	224	0.11	0.10	0.01	0.46
Plant concentration index	HHI^{plant}	Platts PowerVision	242	0.03	0.04	0.01	0.25
Firm concentration index	HHI^{firm}	Platts PowerVision	242	0.27	0.24	0.09	1.00

Notes: Obs. refers to utility-year observations, S.D. is standard deviation, Min. is minimum, Max. is maximum, htEUR is hundred thousand (10^8) EUR, tEUR is thousand EUR, tKM is thousand Km, TWh is thousand GWh.

Main results on vertical synergies:

- Economies of vertical integration (EVI) ≈14% for median sized firm
- Non-negligible hurdle for successful unbundling regime
- EVI tend to increase with firm size
- Sources of EVI are asset specificity and market complexity

Conclusions

- Competition and proper regulation crucial for wealth of nations
- However?
- Trade off between static and dynamic efficiency
- Trade-off between competition and vertical synergies

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