Regulatory Path Planning - Introducing Competitive Behaviour in Infrastructure Industries

Current Trends in Competition
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Reference

This presentation draws on

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Outline

Incentive regulation

Dynamic regulation

Contestable regulation

Empirical testing

Discussion

Incentive regulation

Incentive regulation

"…the implementation of rules that encourage a regulated firm to achieve desired goals by granting some, but not complete, discretion to the firm."

Sappington and Weisman, 1996

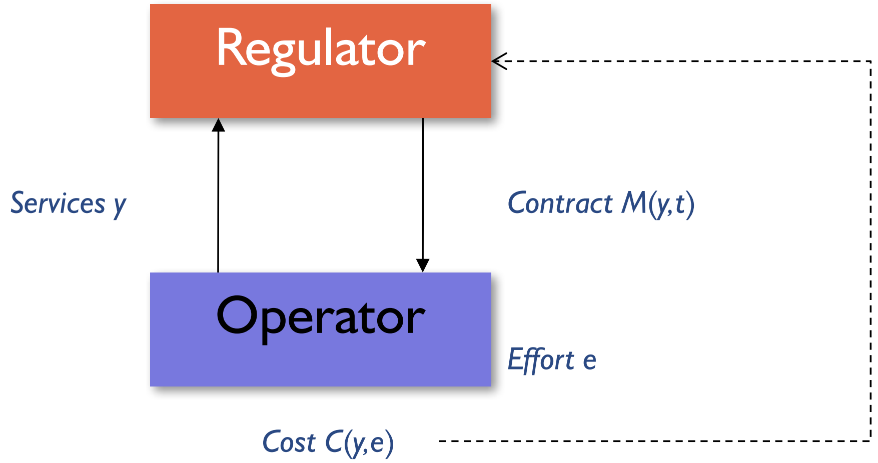
Distinguished by partial delegation of pricing to the regulated firm and the possibility for the firm to retain profits resulting from cost reductions.

Vogelsang, 2002

Regulation with intermediate incentive power, as opposed to price-cap regulation and cost of service regulation.

Laffont and Tirole, 1993
(Joskow, 2006)

Incentive regulation in a nutshell



Infrastructure access, unbundled firm, inelastic demand for service
Cost is observable and verifiable, effort is unobservable, multi-output service provision
High-powered regulation is optimal: Laffont (1994), et al.
Practical implementations: yardstick regimes: Schleifer (1985), Laffont and Tirole (1986)

Regulation and focus of model

Cost-review, weak incentives

- Command-control; process focus

Light-handed, weak incentives

- No horizontal competition: learning focus

Incentive regulation, strong incentives

- Performance assessment; outcome based

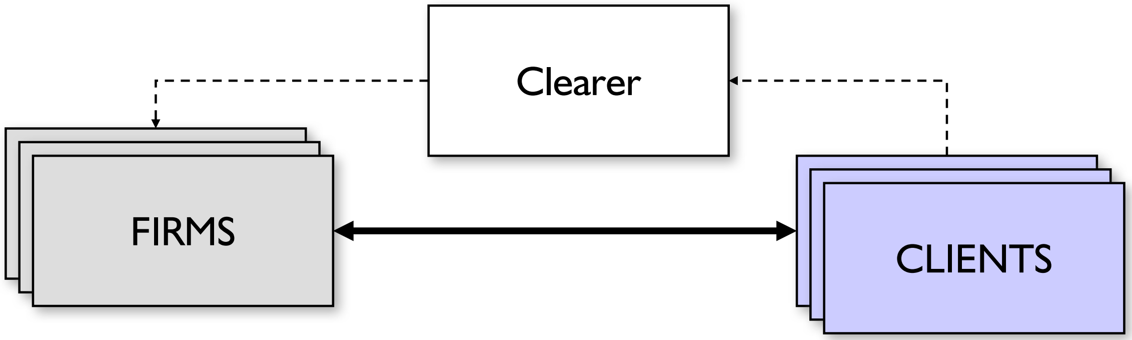
Regulator as proxy buyer or market maker

PROXY BUYER

Revenue generator
Full contract
Market engine
…

MARKET MAKER

Frame contracts
Surveilance
Information verif
….



Two extremes

PROXY BUYER

- Cost-oriented
- Ex-post / ex-ante
- Process defined
- Service fuzzy
- Ratchet effects
- No risk
- Perverse incentives for cost

- Deep monopoly structure

MARKET MAKER

- Revenue-oriented
- Ex-ante / ex-post
- Process irrelevant
- Service defined
- Risk for quality skimping
- Risk of bankruptcy
- Strong efficiency incentives

- Towards contestable markets

Irrelevance of cost norm

Revenue cap = R_0 CPI $(1 - X - X_i)$

Incentive regulation, corollaries

- A profitmaximizing firm do not care about the level of the cap
- A utilitymaximizing firm cares about the incentive power

- What matters are the commitment to and duration of the regime
- No importance of the used cost norm

Setting the X?

"*In deciding how far to revise X the economic regulator needs to examine the company's production methods and investment programme. He must ascertain the scope for cost and price reductions through increased productivity and efficiency and the need for capital expenditure. He needs to predict the consequences of X on what the company will do, how it will do it, how consumers will be affected and how others will react.*"

Littlechild (1983, para 10.2)

Information

Problem

	Verifiable	Non-verifiable
Public	Contractible	Commitment
Private	Secrets, signals	Cheap talk

Solution

	Verifiable	Non-verifiable
Public	Complete contract	Renegotiable contracts
Private	Contingent contracts	Menus of contracts

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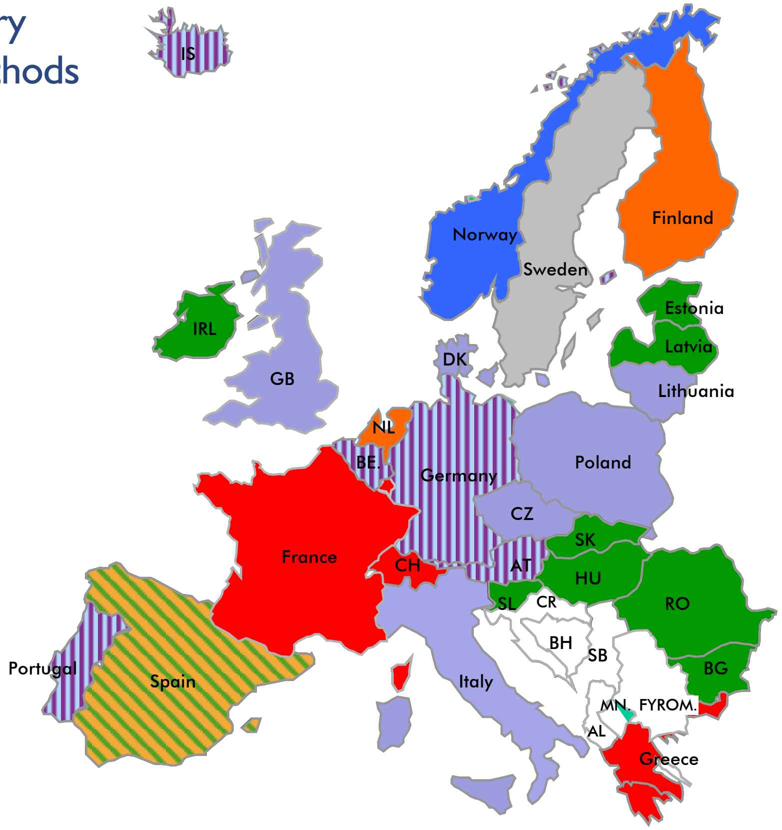
EU Regulatory landscape (Energy)

EU Regulatory landscape – Methods (Energy)



- Cost recovery
- Revenue Cap (CPI-X)
- Revenue Cap (CPI-DEA/SFA)
- Price-Cap
- Yardstick - DEA
- Yardstick - Other
- Yardstick - MNA

Sweden under reform:
Rate-of-return regulation

Switzerland under reform:
incentive regulation (DEA pilot)

Iceland: reform not implemented

Finland: revenue cap with StonED

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Normative models are popular

Country	*Approach*	*Method*	*Analysis*	*Operation*
AUSTRALIA	Ex ante	CPI-DEA	x	x
AUSTRIA	Ex ante	DEA/EngM	x	x
DENMARK	Ex ante	COLS	x	x
FINLAND	Ex ante	DEA->StonED	x	x
GERMANY	Ex ante	DEA/SFA Yard	x	x
NETHERLANDS	Ex ante	Cost Yard	x	x
NEW ZEELAND	Ex ante	CPI-DEA	x	x
NORWAY	Ex ante	DEA Yard	x	x
ICELAND	Ex ante	CPI-DEA	x	-
PORTUGAL	Ex ante	SFA	x	?
CHILE	Ex ante	EngM	x	x
SPAIN	Ex ante	EngM	x	x
ENGLAND	Ex ante	CPI-X	x	x
BELGIUM	Ex ante	CPI-DEA -> CR	x	-
SWITZERLAND	Ex ante	(RoR)->?	x	-
SWEDEN	Ex ante	(EngM)->RoR	x	x

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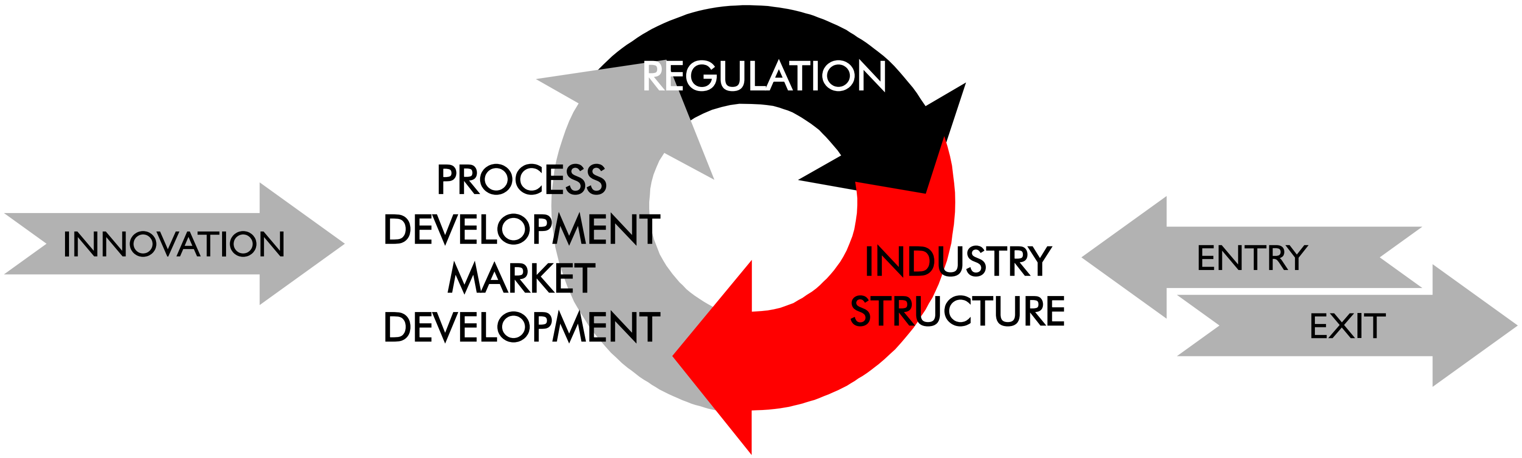
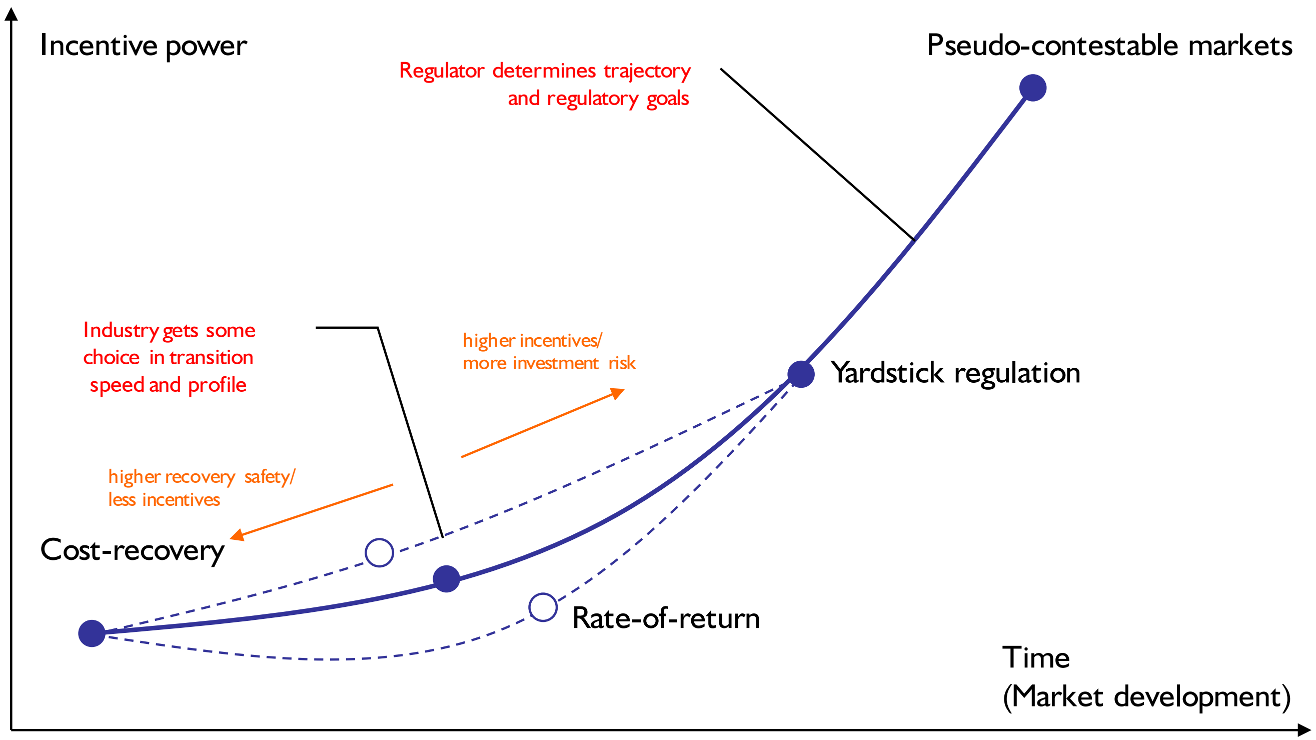
Dynamic regulation

Regulation, industry structure and innovation



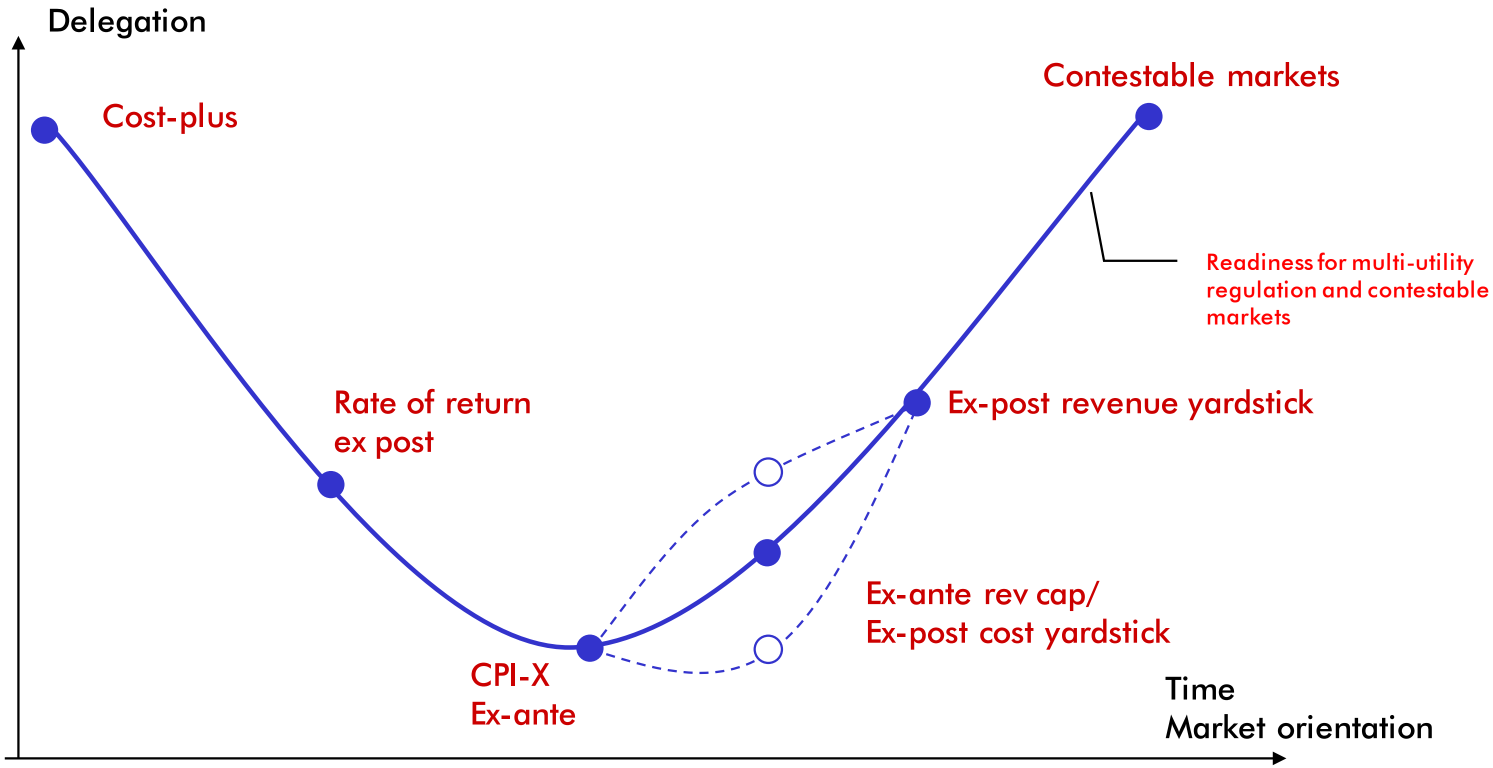
Agrell, Bogetoft and Tind (2002)

Regulatory path



Source: Agrell and Bogetoft (2003)

Regulatory path
Example from Norway



Empirical significance

1. Revenue cap CPI-X

   Based on 96/97 productivity estimates

2. Norwegian DEA system (uncapped)
3. Norwegian DEA system (capped)
4. DEA Yardstick

actual cost cost sharing

$$b_t^A(y_t) = c_t + R_0 - c_0 + \rho\,(c_t^o E_t^{sr} - c_t^o)$$

allowance initial profit

Basic Ideas

Create social welfare gains by better adaptation of costs and benefits

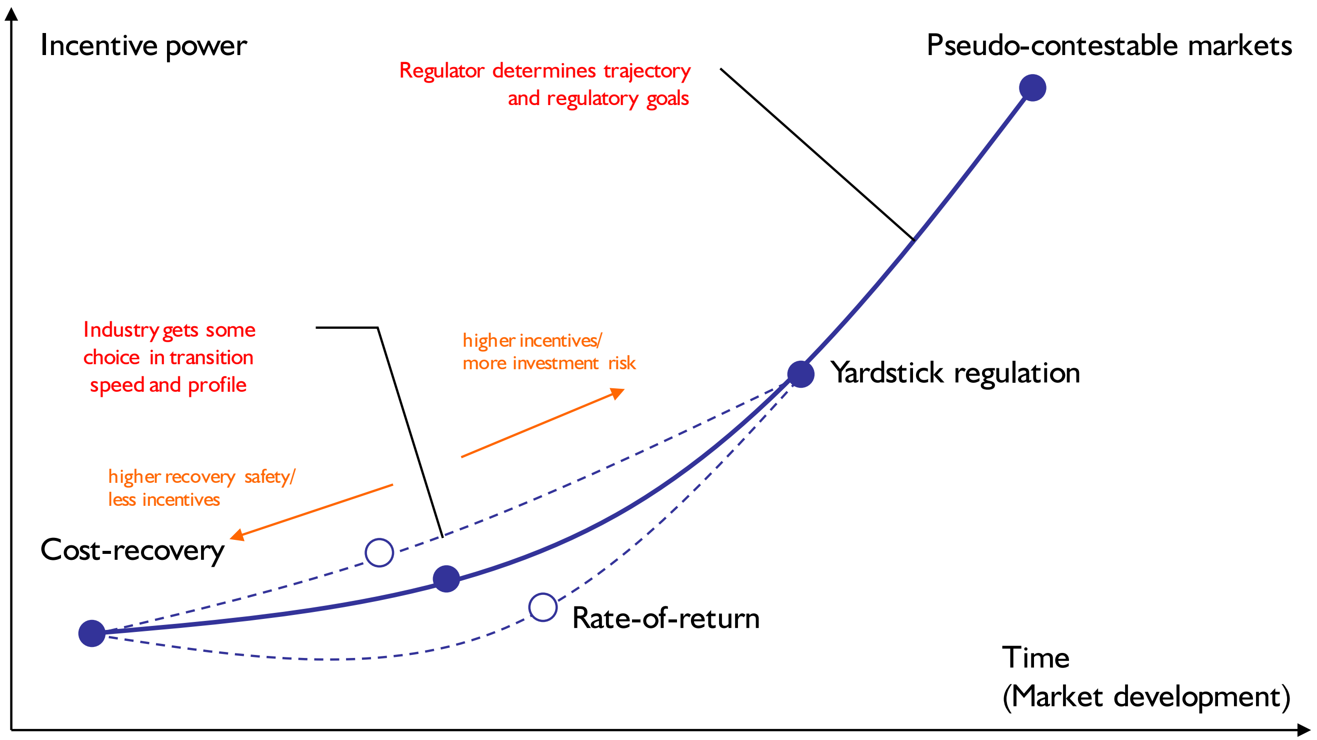
Sub-optimal to treat all areas equally

Gains generated by exploiting differences on the supply and demand sides

Instead of trying to make everyone happy by the same product, we differentiate the product to take advantage of local demand and cost conditions

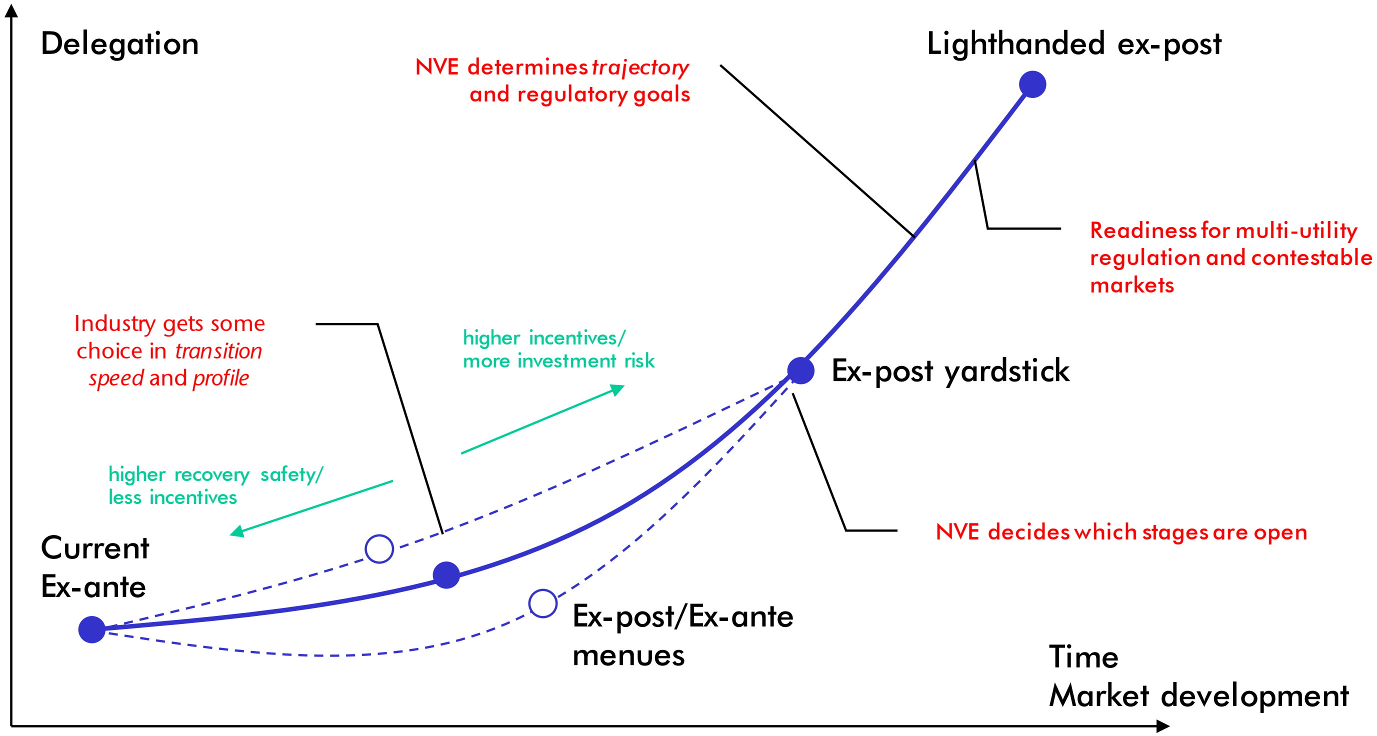
Minor point: May have to forego some social welfare to ensure an appropriate division of the gains (the social welfare cake)

Menus of regulation in the path



Source: Agrell and Bogetoft (2003)

Menus of regulation: Norway



Contestable regulation

Does it hold in practice?

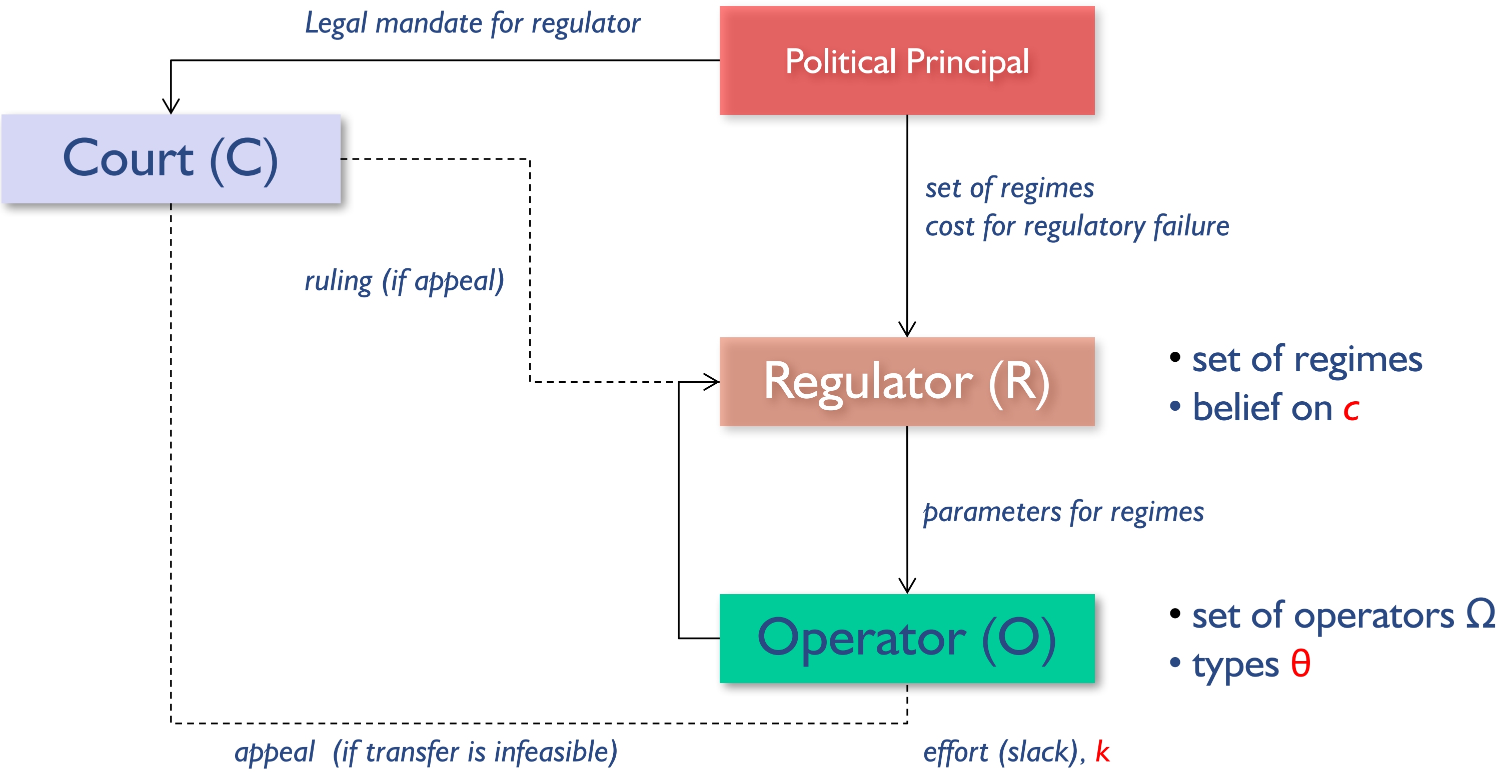
The regulation is based on the cost norm

Regulation must hold for all firms without bias

It is not sufficient to be right on expectation

Judicial recourse to protect from expropriation

- Firms may appeal rulings
- If a ruling shows a flaw in the model, the regime falls



Legal mandate for regulator
Political Principal
Court (C)
set of regimes
cost for regulatory failure
ruling (if appeal)
Regulator (R)
• set of regimes
• belief on c
parameters for regimes
Operator (O)
• set of operators Ω
• types θ
appeal (if transfer is infeasible)
effort (slack), k

Regulation and focus of model

Cost-review, weak incentives

- Command-control; process focus

Light-handed, weak incentives

- No horizontal competition: learning focus

Incentive regulation, strong incentives

- Performance assessment; outcome based

Credibility

Commitment is based on a rational expectation of durability

The robustness of a regulation depends on

- Participation of the regulated firms
- Sustainability of rents left to stakeholders
- Properties of the cost norm (soundness)

A regulation regime not satisfying these criteria is not credible

"If it sounds too good to be true, it is not true"

Failing regulation in Europe

Netherlands

- Frontier model revoked 2004, debacle 140 M€ in welfare losses
- Nillesen and Pollitt (2007)
- Moratorium and average cost model

Belgium

- Preparation for incentive regulation, overturned and decentralized in 2012
- Agrell and Teusch (2015)
- Cost-plus regulation by region since 2012 …

Sweden

- Network performance assessment model (NAPM) falls in 2006
- Moratorium and cost-plus regulation until 2014 …

Idea

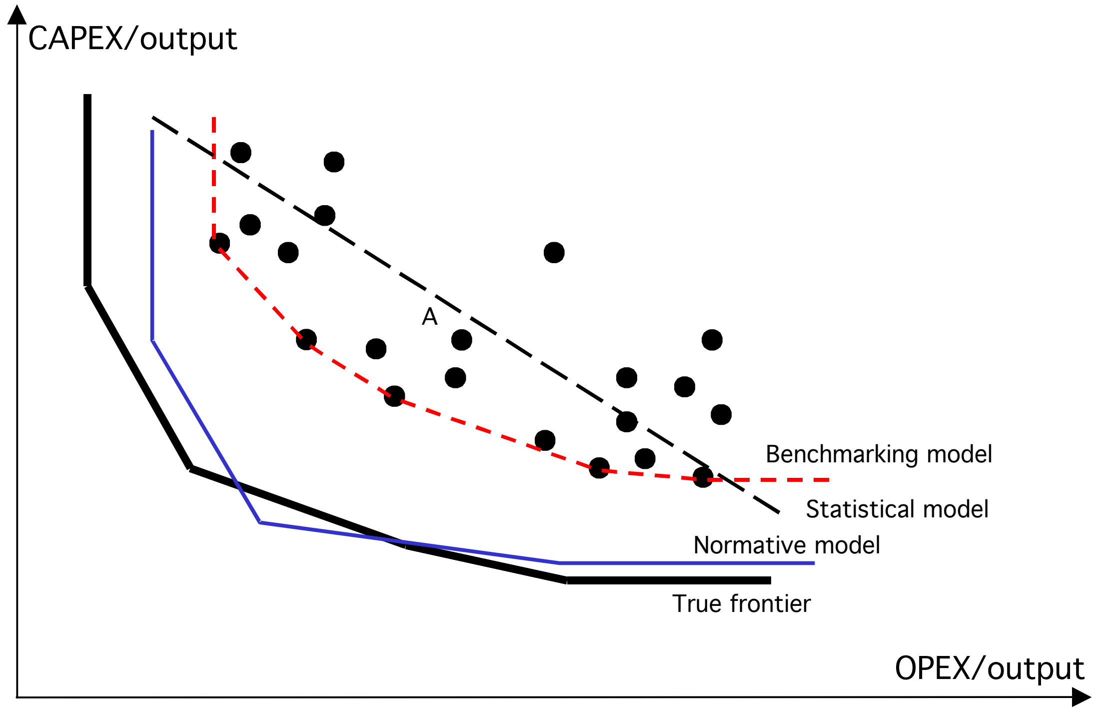
Intuition:

– A rational firm reveals only its full efficiency for a regime with a credible commitment and cost norm.

Method:

– Decision model for a firm evaluating a proposed regime
– Methodology to test the hypotheses for firm behavior
– Validation with productivity data for a failed regime

Feasible and infeasible cost norms



Model

Model

One regulated firm

Multi-period game, discount factor δ.

Regulatory regime:

- R(y) = revenue for output y
- x*(y) = minimal cost for output y
- x(y) = ex post cost

Firm single-period utility (for given y):

- max

$$u(x,R) = (R - wx) + \rho(wx - c(y,w))$$

Slack = lack of effort

Regulatory game

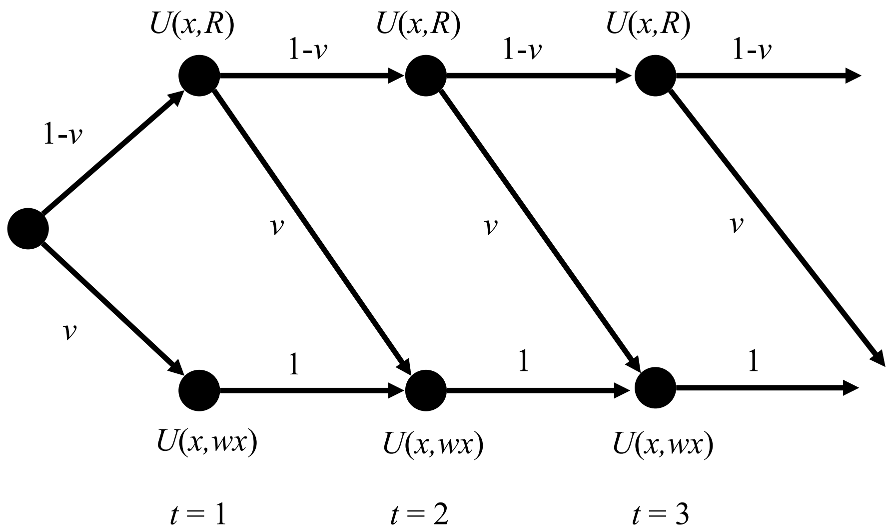
Period 1:

- Launch of high-powered regime $R(y)$

Period $t = 2,\ldots,T$

- In each period, the regime is challenged
- $v = P$(Regime revoked)
- If not revoked: $R_t = \mathrm{R(y)}$
- If revoked: cost-plus regime $R_t = x_{t\text{-}1}$

Game timeline



Incumbent regime
R = R'

Low-powered regime
R = wx

Firm's optimal multi-period policy

$$\begin{aligned} EU(x) &= \sum_{t=1}^{\infty} u(x,wx)v\delta^t + \sum_{t=2}^{\infty} u(x,wx)v\delta^t(1-v)^{t-1} + \sum_{t=1}^{\infty} u(x,R)\delta^t(1-v)^t \\ &= u(x,wx)\left[\frac{v\delta}{1-\delta} + \frac{v\delta^2(1-v)}{1-\delta(1-v)}\right] + u(x,R)\frac{\delta(1-v)}{1-\delta(1-v)} \end{aligned}$$

Optimal response to credible regime: $v = 0$

$$EU(x)_{v=0} = (R - wx + \rho(wx - c(y,w))\frac{\delta}{1-\delta}.$$

Optimal response to non-credible regime: $v = 1$

$$EU(x)_{v=1} = \rho(wx - c(y,w))\frac{\delta}{1-\delta}.$$

Model predictions

Proposition 1:

– The optimal cost policy of a firm in a multi-period policy depends on

1. the probability of regulatory failure (credibility),
2. the time preferences of the firm (impatience) and
3. the utility of inefficient cost (cost of effort).

Corollaries

Corollary 1. *Assume a given cost of effort* $\rho > 0$ *and discounting factor* δ*. Then, there exists a finite failure risk* $\hat{v}(\delta, \rho)$ *above which cost-efficiency is a dominated policy.*

Corollary 2. *Assume a non-credible regime* $v > 0$ *and a given cost of effort* ρ*. Then, for any cost-efficient firm there exists an upper bound* $\hat{\delta}$ *for the discount factor.*

Corollary 3. *Assume a non-credible regime* $v > 0$ *and a given discount factor* δ*. Then, for any cost-efficient firm there exists an upper bound* $\hat{\rho}$ *for the cost of effort.*

Corollary 4. *Assume a non-credible regime* $v > 0$*. The cost efficiency for a firm is then inversely proportional to the discount factor* δ *and the cost of effort* ρ*.*

There will always some laggards …

Remark 1. *Given n independent firms each having a cost of effort drawn from a distribution with density function* $f(\rho)$ *and cumulative density function* $F(\rho)$ *on the support* $[0,1]$*, then the probability that all firms are cost efficient under a non-credible regime is equal to* $1-(F(\hat{\rho}))^n$.

Critical failure probability

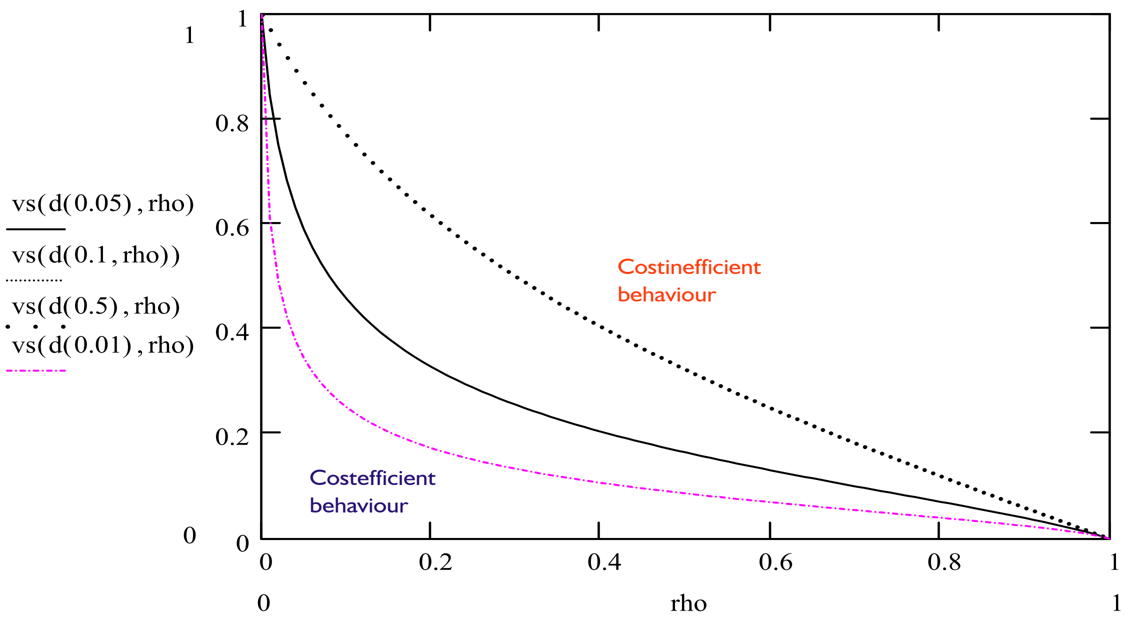


Figure 2: Critical failure probability $\hat{v}(\delta,\rho)$ for $\delta = \{0.99, 0.952, 0.909, 0.667\}$.

VERIFIABLE HYPOTHESES

Research hypotheses

Hypothesis 1. *Firms exhibit a lower cost efficiency CE during a non-credible regime* $v > 0$.

Hypothesis 2. *The technical change of the firms is stagnating for the duration of a non-credible regime* $v > 0$.

Hypothesis 3. *The productivity change of the firms is low or nil for the duration of a non-credible regime* $v > 0$.

Hypothesis 4. *The profitability of the firms is lower on average, and decreasing throughout the duration of a non-credible regime* $v > 0$.

Objective

We are interested in a framework that links

- Profitability changes
- Cost changes
- Revenue changes
- Efficiency changes

Productivity development

Simple approach: efficiency changes vs index ?

Not conclusive, since price changes may be due to

- Input price changes (price recovery)
- Output price changes (profit margin)
- Economies of scale (volume)
- Allocative efficiency (mix)
- Technical efficiency changes

Need decomposed analysis

Profitability change

$$\frac{\Pi^{t+1}}{\Pi^{t}} = \frac{p^{t+1}y^{t+1}/w^{t+1}x^{t+1}}{p^{t}y^{t}/w^{t}x^{t}}$$

$$= \frac{p^{t+1}y^{t+1}/p^{t}y^{t}}{w^{t+1}x^{t+1}/w^{t}x^{t}},$$

Revenue change

Cost change

Revenue change

Fisher output price index

$$\frac{p^{t+1}y^{t+1}}{p^t y^t} = P_F(p^{t+1}, p^t, y^{t+1}, y^t)Y_F(y^{t+1}, y^t, p^{t+1}, p^t),$$

Fisher output quantity index

Cost change

$$\begin{aligned}\frac{w^{t+1}x^{t+1}}{w^t x^t} &= \left[\frac{w^{t+1}x^{t+1}}{w^t x^{t+1}}\frac{w^{t+1}x^t}{w^t x^t}\right]^{1/2}\left[\frac{w^{t+1}x^{t+1}}{w^{t+1}x^t}\frac{w^t x^{t+1}}{w^t x^t}\right]^{1/2} \\ &= W_F(w^{t+1}, w^t, x^{t+1}, x^t)X_F(x^{t+1}, x^t, w^{t+1}, w^t)\end{aligned}$$

Fisher input price index   Fisher input quantity index

Relative change in profitability

Profitability change

Fisher productivity

$$\frac{\Pi^{t+1}}{\Pi^{t}} = \frac{P_F(p^{t+1}, p^t, y^{t+1}, y^t)}{W_F(w^{t+1}, w^t, x^{t+1}, x^t)} \frac{Y_F(y^{t+1}, y^t, p^{t+1}, p^t)}{X_F(x^{t+1}, x^t, w^{t+1}, w^t)}.$$

Price recovery

Ray and Mukherjee (1996), Kousmanen and Sipiläinen (2009), Diewert (2014), **Grifell-Tatje and Lovell** (2003, **2015**)

Fisher productivity index

Cost efficiency — Size change

$$Y_F / X_F = \Delta CE \cdot \Delta TC \cdot \Delta SC$$

Fisher productivity — Technical efficiency

Efficiency measured using non-parametric approach (DEA)
2 outputs (energy LV, HV,)
4 inputs (assetconnections, grid capital, cost OM, energy losses, energy transit)

Empirics: Sweden, electricity distribution

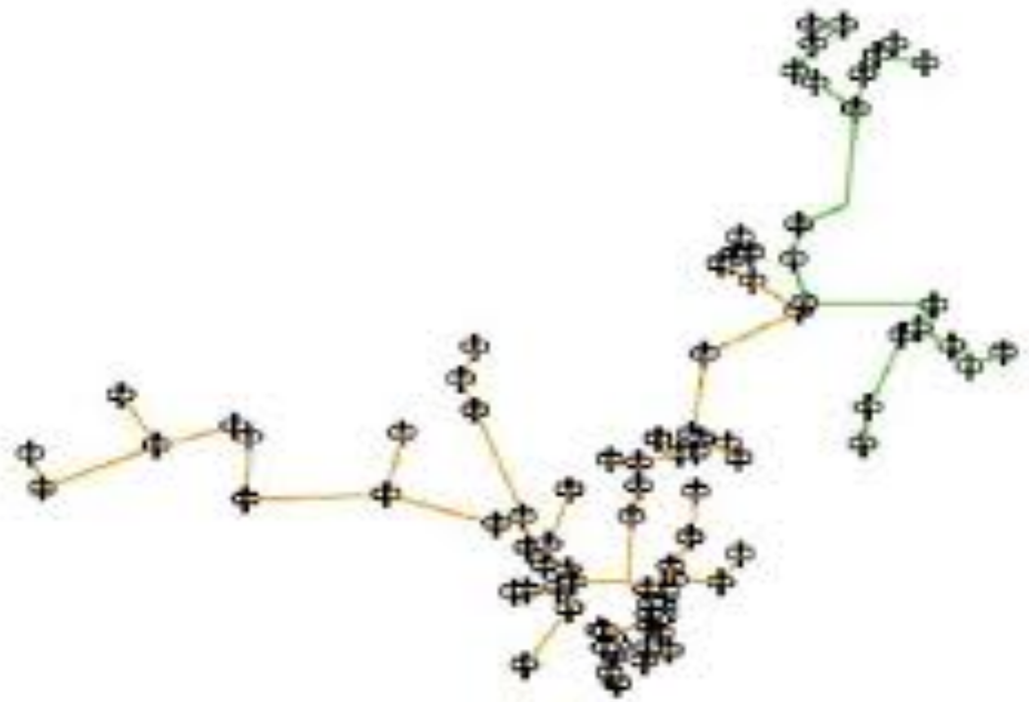
Electricity Act (2000)

- Regulated revenue based on "objective performance"

NPAM (Network Performance Assessment Model)

- Green-field planning model, based on GIS-positioned load points, feed-in points, standard costs
- Critique from industry and academics, model suffers from several methodological flaws (Lantz, 2003; Wennerström and Bertling, 2008; Jamasb and Pollitt, 2008, Jamasb and Söderberg, 2008)

Green-field vs brown-field planning



NPAM rise and fall

2003 Start of implementation

2005 Rulings I for 2003 = 21 DSO for 76,3 MEUR

- All DSO appeal

2006 Reduced claims for 2003: 8 DSO for 23 MEUR

- DSO appeal to higher court

2007 New regulator

- Out-of-court settlement: 8 DSO for 16.5 MEUR.

2009 NPAM suspended (cost-recovery)

2012 New regime: rate-of-return

Data

Audited data from the regulator (EI) for Swedish electricity distributors (LV and MV only, no retail or transmission)

Balanced panel, 128 firms for 2000-2006, in all 896 DMU

Data: DSO 2000-2006

Category	Unit	Definition	mean	median	sd
Revenue $R = py$	kSEK	Total revenue	137,764	49,967	387,118
	kSEK	Revenue LV	118,394	41,876	335,470
	kSEK	Revenue HV	19,371	6,707	53,213
Costs wx	kSEK	Total cost (TOTEX)	119,515	46,483	346,036
	kSEK	Cost transmission	33,791	13,285	100,420
	kSEK	Cost energy losses	7,878	2,864	21,395
	kSEK	Operating expenditure (OPEX)	46,766	18,615	130,483
	kSEK	Capital expenditure (CAPEX)	31,082	8,602	102,922
Outputs y					
	MWh	Energy delivered low voltage (LV)	488,052	204,662	1,235,396
	MWh	Energy delivered high voltage (HV)	221,633	71,037	623,509
Output prices p					
	SEK/kWh	Price per energy delivered LV	0.228	0.226	0.043
	SEK/kWh	Price per energy delivered HV	0.109	0.104	0.057
Inputs x					
	MWh	Energy transported, total	742,112	281,796	1,913,920
	MWh	Energy losses, total	32,427	11,952	86,027
	km	Connection-weighted network LV+HV	41,415	14,198	121,128
	kSEK	Network capital, total	458,831	100,737	1,521,204
Input prices w					
	SEK/kWh	Transmission price	0.049	0.048	0.019
	SEK/kWh	Cost per energy losses	0.260	0.252	0.120
	SEK/m	OPEX per connection-line unit	1.379	1.332	0.543
	%	Cost of capital	0.086	0.083	0.033

Empirical results

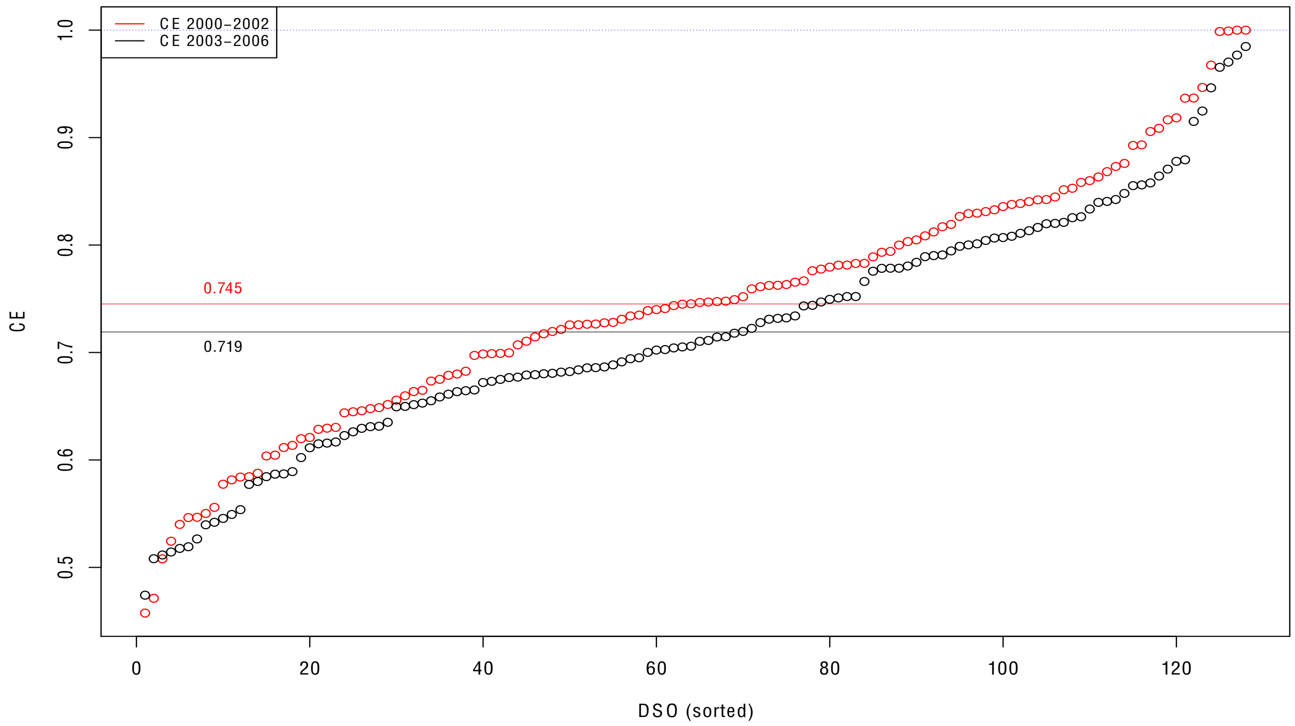
H1: Slumping cost efficiency
H4: Profitability sacrifice

Table 2: Profitability Π^t and cost efficiency CE^t, mean per year, 2000-2006.

	year							period		
	2000	2001	2002	2003	2004	2005	2006	2000-02	2003-06	Diff
Π^t	1.150	1.149	1.141	1.128	1.128	1.086	1.079	1.147	1.105	-0.042***
CE^t	0.762	0.732	0.741	0.732	0.723	0.713	0.708	0.745	0.719	-0.026***

Notes: $***p < 0.001$; $**p < 0.05$; $*p < 0.01$.

H1: Cost efficiency



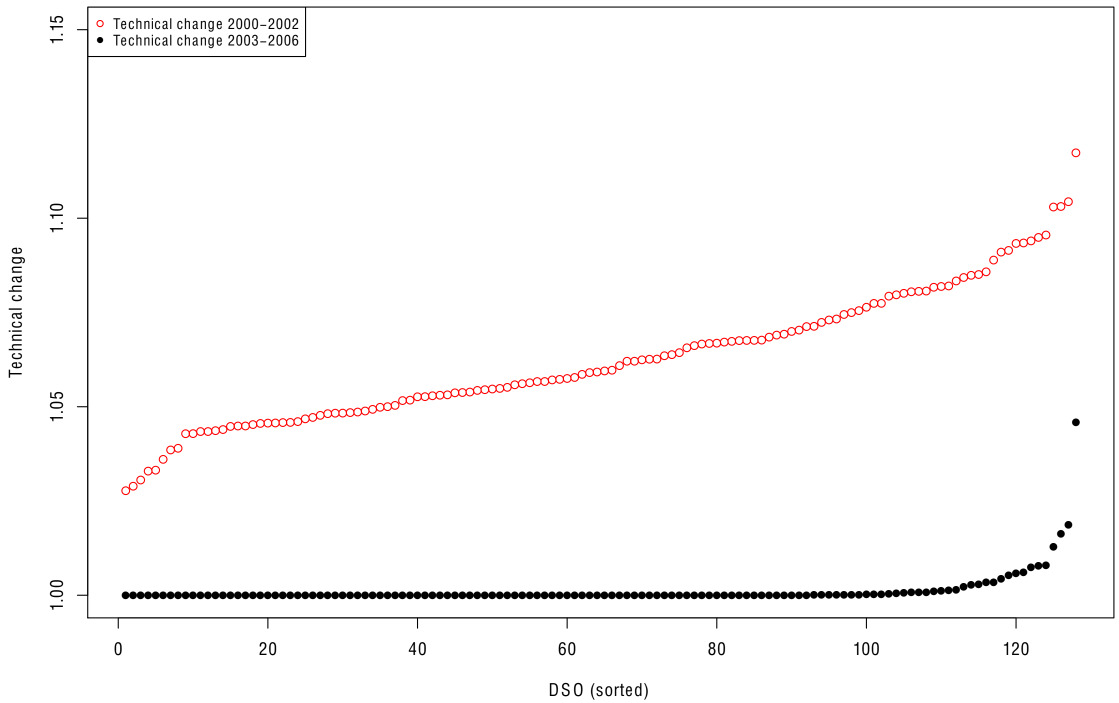
H2: Technical change

Table 3: Cost efficiency ΔCE and technology change ΔTC, before and after NPAM.

	All		Pre NPAM		Post NPAM			
n	768		384		384		384	
period	2000-2006		2000-2002		2003-2006			
	Mean	SD	Mean	SD	Mean	SD	Diff	p-value
ΔCE	0.990	0.065	0.989	0.082	0.991	0.043	0.002	0.778
ΔTC	1.024	0.033	1.048	0.033	1.001	0.009	-0.047***	< 0.001

Notes: $^{***}p < 0.001$; $^{**}p < 0.05$; $^{*}p < 0.01$.

H2: Technical change (before, after)



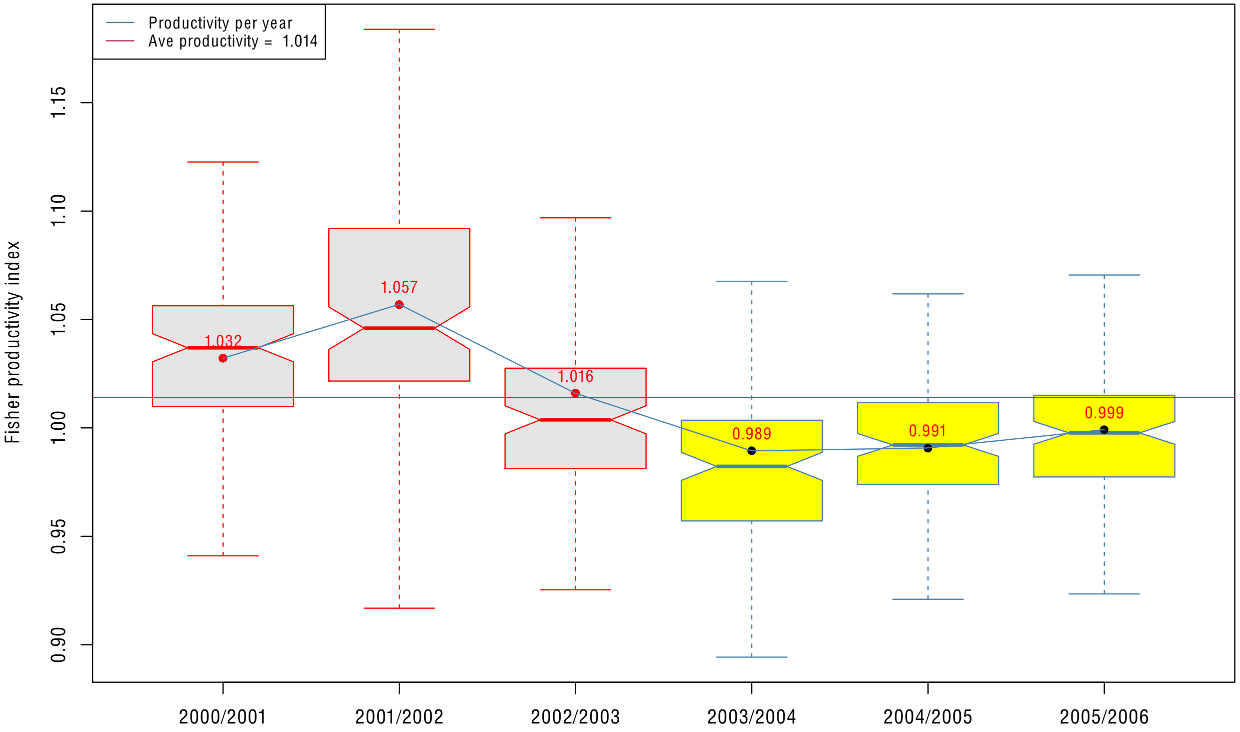
H3: Stalled productivity development

Table 4: Profitability variation, price recovery and productivity change, before and after NPAM.

	All		Pre NPAM		Post NPAM			
n	768		384		384		384	
period	2000-2006		2000-2002		2003-2006			
	Mean	SD	Mean	SD	Mean	SD	Diff	p-value
Profitability variation	0.994	0.097	0.997	0.080	0.991	0.111	-0.006	0.470
Price recovery	0.987	0.137	0.973	0.149	1.001	0.123	0.028**	0.005
Productivity change	1.014	0.084	1.035	0.102	0.993	0.053	-0.042***	< 0.001

Notes: $***p < 0.001$; $**p < 0.05$; $*p < 0.01$.

H3: Stalled productivity development



H4: Sacrifice in profitability

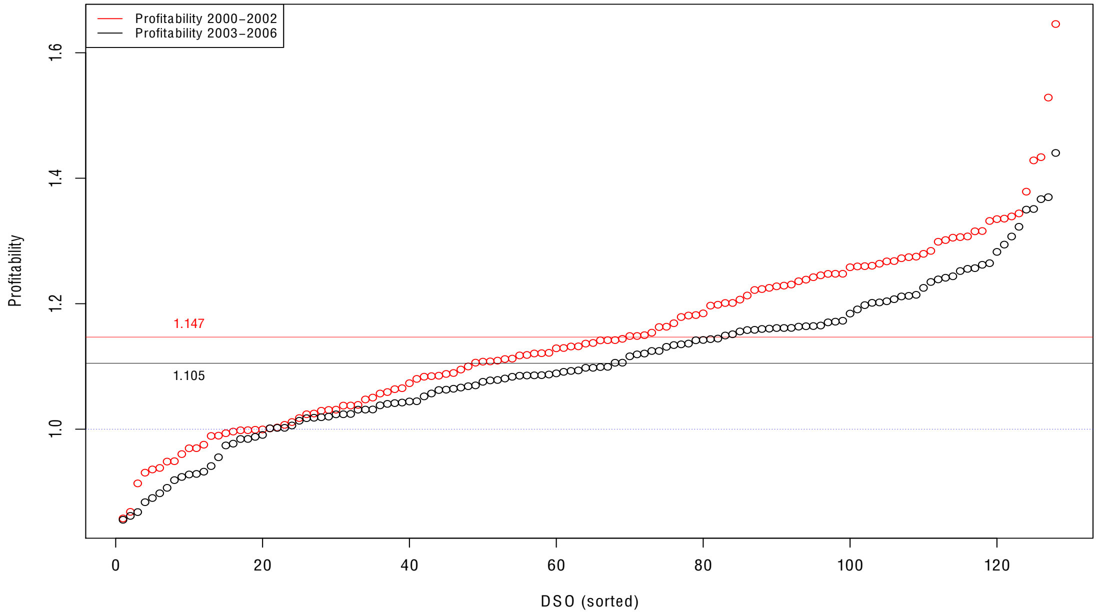


Figure 8: Profitability Π^t, average per DSO, before and after NPAM.

Results

		Result
H1	Cost efficiency slumps for v >0	Supported (***)
H2	No technical change	Supported (***)
H3	Productivity change nil or weak	Supported (***)
H4	Profitability lower and sinking	Supported (***)

Counterfactual?

What if

- The firms just had a ‘golden age’ before, without relevance?
- The shock was unrelated to the regulation?

Supporting evidence

Table 5: Cumulative productivity development, electricity distribution, 1970-2004.

Paper	Country	n	Period	M	TC
Hjalmarsson and Veiderpass (1992)	Sweden	298	1970-78	1.56	1.42
Hjalmarsson and Veiderpass (1992)	Sweden	298	1978-86	1.22	1.39
Kumbhakar and Hjalmarsson (1998)	Sweden	108	1970-90	-	0.019 - 0.022/yr
Førsund and Kittelsen (1998)	Norway	150	1983-89	1.12	1.11
Edvardsen et al. (2006)	Norway	98	1996-03	1.15	-
Agrell et al. (2015)	Norway	198	1995-04	1.24	1.25
Kumbhakar et al. (2014)	Norway	127	1998-10	-	0.01/yr
Miguéis et al. (2011)	Norway	127	2004-07	1.00	1.04

Notes: M = Malmquist index, TC = Technical change, n = average no of obs per year.

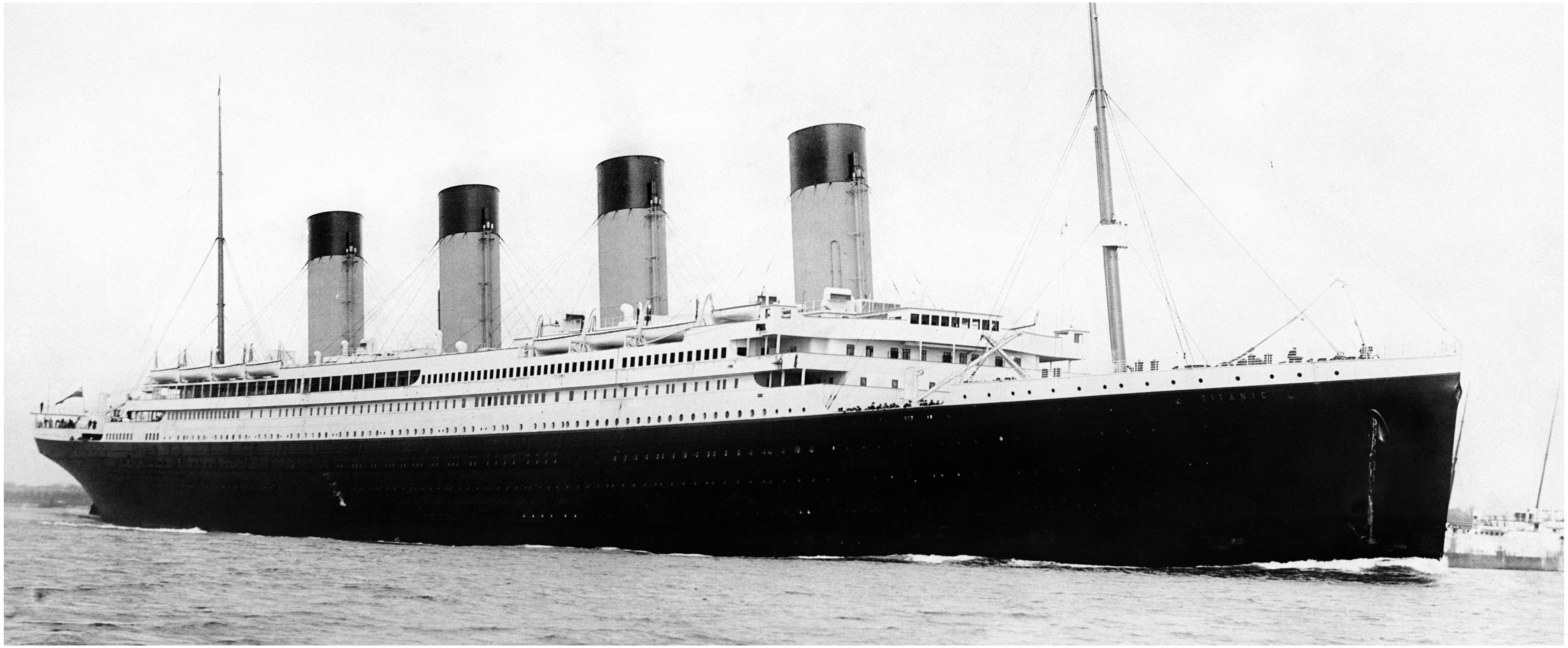
Results

Swedish and Norwegian DSO are similar in size, structure and ownership

Efficiency and productivity prior to 2003 are similar in Sweden and Norway

Norway had positive productivity during the NAPM period

The life vest on Titanic: look beyond inefficiency



Conclusion

Conclusions

Regulation creates conditions for structure and behavior in the sectors

Cost-recovery regulation creates deep distortion of competitive behavior

Incentive regulation creates conditions for cost efficient behavior

Regulation cannot 'jump stages' : the sector needs a regulatory path

Cost norms must be credible: industry better informed

Two results to retain:

- Firms may detect flaws earlier than courts
- Welfare losses proportional to phase-out time
- Important to choose good models and to integrate them in the path

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