Incentive Regulation and Investment
Evidence from European Energy Utilities

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Motivation

- Investment in infrastructure and fixed network modernization is crucial to the quantity, quality and price of public utility services, but is also irreversible, risky and expensive
- Pro-competitive and pro-efficiency regulatory regimes may undermine incentives to invest → Does investment differ across regulatory regimes: incentive vs. rate of return regulation?
- Some EU countries have recently reformed their energy sectors and introduced incentive regulation: Is energy utilities' investment sensitive to different regulatory regimes and instruments

Literature

- Surveys on Incentive Regulation in Energy: Joskow 2008, Vogelsang 2006
- The impact of regulatory policies is different depending on which type of investment is delivered - cost reducing or infrastructure (Armstrong and Sappington, 2006, Guthrie 2006)
- Price-cap regulation spurs network modernization via cost-reducing investments in US telecoms (Ai and Sappington, 2002, Greenstein et al. 1995)
- Incentive regulation increases productivity and service quality in UK electric regional distribution (Domah and Pollit, 2004; Newbery and Pollit, 1998)
- Incentive regulation increases labour productivity in electric distribution in developing countries (Pollit, 2004; Rudnik and Zolezzi 2001)

Contribution of Our Paper

- We investigate the relationship between investment and regulatory regimes for a panel of European energy utilities from 1997 to 2007
  - Do investment decisions differ across different regulatory regimes: Incentive vs. RoR regulation?
  - Is investment sensitive to changes in the regulatory instruments: WACC and X Factors?
- We account for the impact of public vs. private ownership and of country characteristics, i.e. underlying energy demand and existing infrastructure
- We control for the potential endogeneity of regulation and ownership

Regulation of EU Energy Utilities

- Rate of return regulation in Germany, France and, up to late 90s, Spain and Italy
  - A *cost-plus mechanism* where the regulator sets the rate of return the utility can earn on its asset base → The allowed rate or return, through the **WACC**, is the key instrument, providing incentives to invest
- Incentive regulation in UK, Italy and Spain
  - A *fixed-price contract* imposes a *cap* to tariff rates or to firm revenues → RPI – X mechanism: The **X-factor** is the regulatory tool which imposes efficiency increases
- All countries, except Germany, have NRAs → independent regulatory agencies

Independent Regulation

- The inception of Independent Regulatory Agencies is a key aspect of the EU-driven reform of public utility sectors
- IRAs are functional to the privatization and liberalization of utilities
  - Before the reforms: state-owned monopolies "regulated" by ministries and governmental committees
  - Delegation of regulatory tasks to IRAs aims at reducing political interference from executives, which may be strong for state-controlled firms (Cambini and Rondi 2010)
- Privatization is still incomplete → this is why we control for ownership

Ownership of EU Energy Utilities

- In the early '90s the European Commission spurred liberalization of electricity and gas markets and privatisation of utilities
  - The degree of liberalization still differs across countries
- Privatisations started and ended in the '90s
  - Private ownership and control is still the exception rather than the rule (Bortolotti and Faccio, 2008)
  - As of 2000, EU-15 governments controlled 62.4% of "privatized" firms
- Privately-controlled energy utilities mainly are in the UK, in Spain and, partly, in Germany

The Sample

- Panel of 23 largest energy utilities in France, Germany, Italy, Spain,UK from 1997 to 2007
- Small panel, but highly representative
- Firms from France and Italy cover 90% of the market; Germany, 60%; Spain, 80%; UK, 50% of English gas market and 40% of Scottish electric market
  - 6 firms (ITA & SPA) observed as regime switches
  - 13 Transmission Service Operators
  - 5 Vertically and 5 Horizontally integrated
  - 13 State-controlled (30%) and 10 Privately-controlled

The Data

- Balance sheet data
  - Sales, Capital stock (at replacement value), Investment, cash Flow, etc.
- Ownership data
  - Private control dummy based on estimates of the Government ultimate control rights
- Regulatory instruments
  - WACC rates and X-factors observed at various regulatory hearings: 2-3 changes in each country
- National economic indicators and energy statistics
  - Manufacturing share of GDP
  - Energy supply per GDP
  - OECD indexes of Market openness and Vertical Integration (Nicoletti et al. 200??)

The Empirical Model

- $IK_{it} = \alpha_0 + \alpha_1 IK_{it-1} + \alpha_2 \Delta LogSales_{it} + \alpha_3 CFK_{it-1} + \alpha_4 IncentiveRegulation_{it} + \alpha_5 PrivateControl_{it} + \beta_1 ManufacturingShareGDP_{jt-1} + \beta_2 InterestRate_{jt-1} + \mu_i + \delta_t + \varepsilon_{it}$
- IK = Investment rate
- Sales growth → Accelerator
- Cash-flow to Capital Stock → Financial factors
- Manufacturing Share of GDP → Underlying energy demand
  - Or Energy Supply per GDP → existing energy infrastructure
- LT Interest rate
- Firm and Time dummies

Endogeneity Problems

- The choice of regulatory regime may derive from the decision to opt for rate of return if the government thinks that either larger infrastructure or cost reducing investment is needed
- The choice of privatization may fall on those firms in a healthier financial situation to fulfil investment programs than on firms under a budget constrained government
- 2SLS with external instruments: measures of the competitive, political and institutional environment
- GMM with internal instruments, lags of all RHS variables

Investment, Regulation, Ownership

	OLS	Fixed effects	2SLS Estimation	One-step difference GMM
	(1)	(2)	(3)	(4)
Investment Rate $_{t-1}$	**0.458*** ***(0.094)***	**0.181** ***(0.072)***	**0.160*** ***(0.082)***	**0.341*** ***(0.106)***
ΔLog of Sales $_{t}$	**0.048*** ***(0.017)***	**0.066*** ***(0.024)***	**0.064** ***(0.025)***	**0.150*** ***(0.049)***
Cash Flow to Total Asset $_{t-1}$	**0.124*** ***(0.066)***	**0.151*** ***(0.075)***	**0.177** ***(0.083)***	**0.152** ***(0.166)***
LT Interest Rate $_{t-1}$	**-0.004** ***(0.007)***	**0.015** ***(0009)***	**0.022*** ***(0.012)***	**-** **-**
Manufacturing Share of GDP $_{t-1}$	**-0.026** ***(0.053)***	**0.046** ***(0.304)***	**0.226** ***(0.312)***	**-0.329** ***(0.831)***
Incentive Regulation Dummy$_t$	**0.009** ***(0.004)***	**0.022*** ***(0.012)***	**0.038** ***(0.015)***	**0.038*** ***(0.021)***
Private Control Dummy$_t$	**0.007*** ***(0.004)***	**0.033*** ***(0.004)***	**0.052** ***(0.136)***	**0.022** ***(0.015)***
Arellano-Bond test AR(1) (p-value)	-	-	-	0.015
Arellano-Bond test AR(2) (p-value)	-	-	-	0.512
Hansen χ^2 test (p-value)	-	-	-	0.999
R squared (within)	0.481	0.299	0.623	-
N. Firms [N. Obs.]	186 [23]	186 [23]	182 [23]	138 [23]

Investment, the X and the WACC

	Full sample	Firms Under Incentive Mechanisms			
		Fixed effects		2SLS	GMM
	(1)	(2)	(3)	(4)	(5)
Investment Rate $_{t-1}$	0.136	0.141	0.117	0.063	0.188***
	(0.115)	*(0.117)*	*(0.085)*	*(0.123)*	*(0.058)*
ΔLog of Sales$_t$	0.057**	0.070**	0.062***	0.067**	0.168*
	(0.024)	*(0.031)*	*(0.011)*	*(0.029)*	*(0.098)*
Cash Flow to Total Asset $_{t-1}$	0.143**	0.148*	0.166**	0.185***	-0.257
	(0.069)	*(0.082)*	*(0.067)*	*(0.071)*	*(0.246)*
Manufacturing Share of GDP $_{t-1}$	-0.187	-1.478	-1.063	-0.469	0.014
	(0.314)	*(0.939)*	*(0.964)*	*(1.141)*	*(1.602)*
Private Control Dummy$_t$	0.028***	0.031***	0.036***	0.090	0.152
	(0.004)	*(0.007)*	*(0.005)*	*(0.072)*	*(0.120)*
Incentive Regulation Dummy$_t$	0.059***	-	-	-	-
	(0.007)	-	-	-	-
WACC$_t$	0.782[a]	0.385	-	-	-
	(0.473)	*(0.448)*	-	-	-
X Factor$_t$	-	-	-0.676**	-1.280*	-2.652**
	-	-	*(0.269)*	(0.738)	(0.999)
Arellano-Bond test AR(1) (p-value)	-	-	-	-	0.036
Arellano-Bond test AR(2) (p-value)	-	-	-	-	0.285
Hansen χ^2 test (p-value)	-	-	-	-	0.999
R squared (within)	0.311	0.312	0.349	0.595	-
N. Firms [N. Obs.]	143 [20]	112 [16]	126 [19]	124 [19]	100 [19]

Summary of the Results

- In the first decade after reforms, investment at EU energy utilities under incentive regulation was higher than at firms under Ror regulation
  - Private firms appear to invest more, but not if we account for endogeneity of ownership
- Allowed WACC rates positively affect investment of firms under RoR regulation and electric utilities
- Investment of firms under Incentive regulation is negatively related to X-factor
  - What is the transmission mechanism? Higher X reduce current revenues, generating financial constraints and reduce expected returns, weakening incentives to invest in cost reducing

Robustness and Extensions

- We check for omitted country variables and lack of variability over time
  - OLS with time dummies; time and country; time and country*sector interacted dummies
  - Control for the impact of Energy existing infrastructure (energy supply per GDP)
  - Control for the impact of "Market Entry" (conditions of third party access and extent of market openness) and "Vertical Integration" – OECD variables
- We re-estimate on the sub-sample of 15 electric utilities: Results hold and are even sharper: WACC is positive and significant

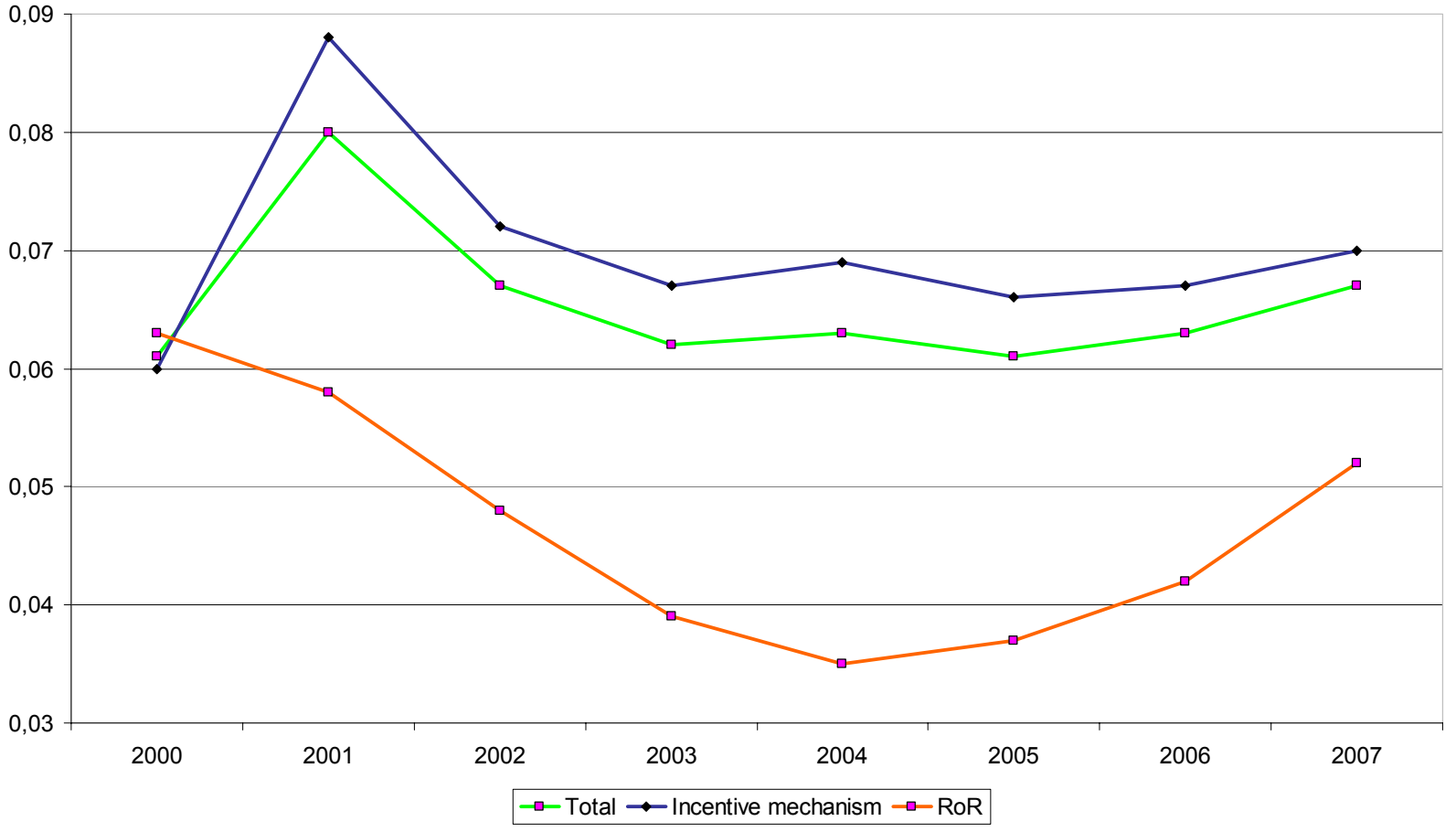
Conclusions and Future Agenda

- EU energy utilities' investment in 1997-2007 has been quite sensitive to Incentive Regulation and to regulatory variables, X and WACC
- The lack of significance of structural characteristics suggests that Incentive Regulation may be more effective in encouraging investment aimed at cost-reducing rather than at expanding infrastructure
- If regulators want to balance cost-efficiency and infrastructure investments, then increases in the X have to be compensated by including a premium in the WACC aimed at investment programs
- Next step is to investigate the additional effect of incentive compensation schemes to managers

The Sample of Energy Utilities

		TRANSMISSION	DISTRIBUTION
ELECTRICITY	Italy	Terna (TSO)	Enel, AEM Milano ASM Brescia, Iride, Hera, ACE
	Spain	Red Electrica (TSO)	Endesa, Iberdrola, Union Feros
	UK	National Grid (TSO)	Scottish Power, CE Electric, Scottish and Southern Energy
	France	EDF	EDF
	Germany	E.On, RWE	E.On, RWE
GAS	Italy	Snam Rete Gas (TSO)	AEM Milano, ASM Brescia Italgas, Hera
	Spain	Enagas	Gas Natural
	UK	National Grid	National Grid
	France	Gaz de France	Gaz de France
	Germany	E.On (Ruhrgas), RWE	E.On (Ruhrgas), RWE

Energy Utilities Investment by Regulatory Regime



Energy utilities by Type of Regulation and by Ownership

	Mean differences			Mean differences		
	Incentive Regulation	RoR	Mean diff. Sign.	Private	Public	Mean diff. Sig
Capex to total asset	0.071	0.057	***	0.074	0.062	***
Log of sales	3.423	4.096	***	3.684	3.582	-
Cashflow/ total asset	0.095	0.068	***	0.098	0.078	**
Private control	0.506	0.242	***	0.831	0.606	***
Regulatory variables						
WACC	0.071	0.070		0.068	0.072	**
X Factor	0.025	-	-	0.013	0.035	***

"Capped" and Private firms appear to invest more and to be more profitable than firms under RoR and State control

More privately controlled firms operate under Incentive regulation

Energy and Economic Indicators by Type of Regulation

	Incentive Regulation	*Rate of return*	Mean diff. Sign.
Structural Indicators			
Manufacturing Share of GDP	**0.176**	**0.183**	*
Energy Supply per GDP	**0.133**	**0.156**	***
Energy Dependence	**62.685**	**61.012**	-
Price Indexes			
Energy price	**107.989**	**103.368**	**
Gas price	**9.259**	**9.664**	-
Electricity price	**0.120**	**0.112**	*
Long term Interest rate	**4.618**	**4.655**	-

Energy supply is higher in RoR countries;
Energy "demand" high in Germany (RoR), but also in Italy (incentive regulation)