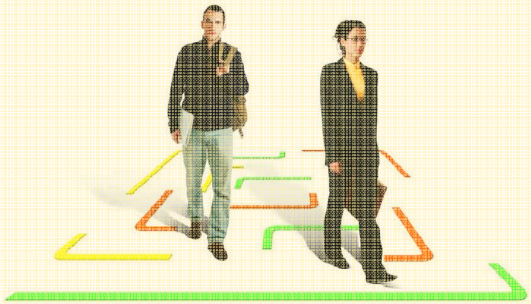

Theory of Regulation

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Introduction to the Course

- Regulation and privatization affect our everyday lives:
  - Radio and TV
  - Telecommunications
  - Transport (local bus industry, airline, railways ..)
  - Energy (gas and electricity)
  - Water and waste industry
  - Health
  - Education

Why regulate?

- **Kinds of market failures**:
- Market power (leading to inefficiently high prices):
  - Economies of scale and scope
  - Anticompetitive behaviour
  - Network externalities
  - Government limits to competition (e.g. patents)
- Externalities (leading to inappropriate prices)
- Information problems (maybe leading to market breakdown): quality
- Typically, no need for intervention in competitive markets!!

Competition policy vs. regulation

- CP attempts to avoid situation where market power can be exploited; regulation deals with the situation.
- Prices/profits/quality are not usually explicitly controlled with CP
- Regulation specifies precise details of what firm can and cannot do (ex ante intervention); CP issues “guidelines” and uses precedent (ex post intervention)
- Typically have sector-specific regulators, and a generalist competition policy authority

Some aims of the Government

- Economic efficiency :
  - “price equals marginal cost”
  - take account of externalities
  - Assure entry of most efficient firms (“productive efficiency”)
  - “dynamic efficiency”
- Re-distributional concerns
  - between consumers and shareholders
  - between poor and rich consumers
- Usually, trade off between efficient purposes!!
- Get re-elected
- Do what lobby groups pay them to do (regulatory capture)

Kind of government/regulatory failure

- Incompetence (lack of qualified staff)
- Information problems :
  - unrealistic to expect regulators know everything
  - regulators usually know less than the firms
  - firms have incentive to conceal or mis-report
  - information damaging to their interests
- Lack of predictable long-term policy
  - governments don't look far beyond next election
  - regulators have incentive to "expropriate" a firm's sunk investment

Kind of government/regulatory failure

- Corruption and capture
  - Regulators come to be overly sympathetic to firms they "regulate"
  - Entry may be limited at the behest of the firm
  - Regulators look forward to working in the industry once their term has ended
- International and National laws state that Regulators should be independent and autonomous (from national Government)

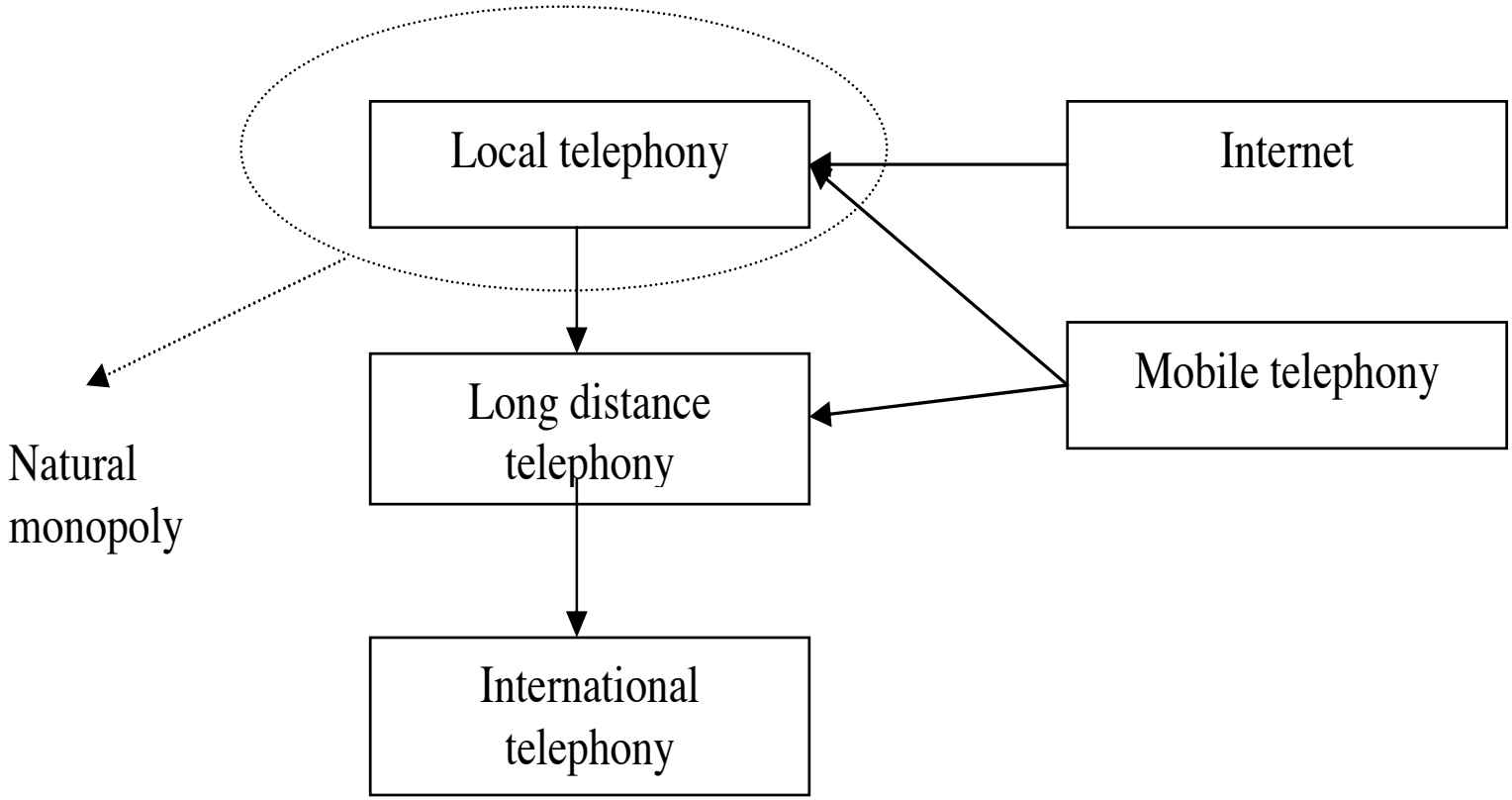
Questions that need to be addressed:

- Whether (and how) to privatise?
- Whether to break up monopoly (or allow mergers)? *Structural regulation* (vertical or horizontal separation)
- Which parts of the industry to regulate?
- What should regulation control? *Conduct regulation* on:
  - Prices
  - Profits
  - quality

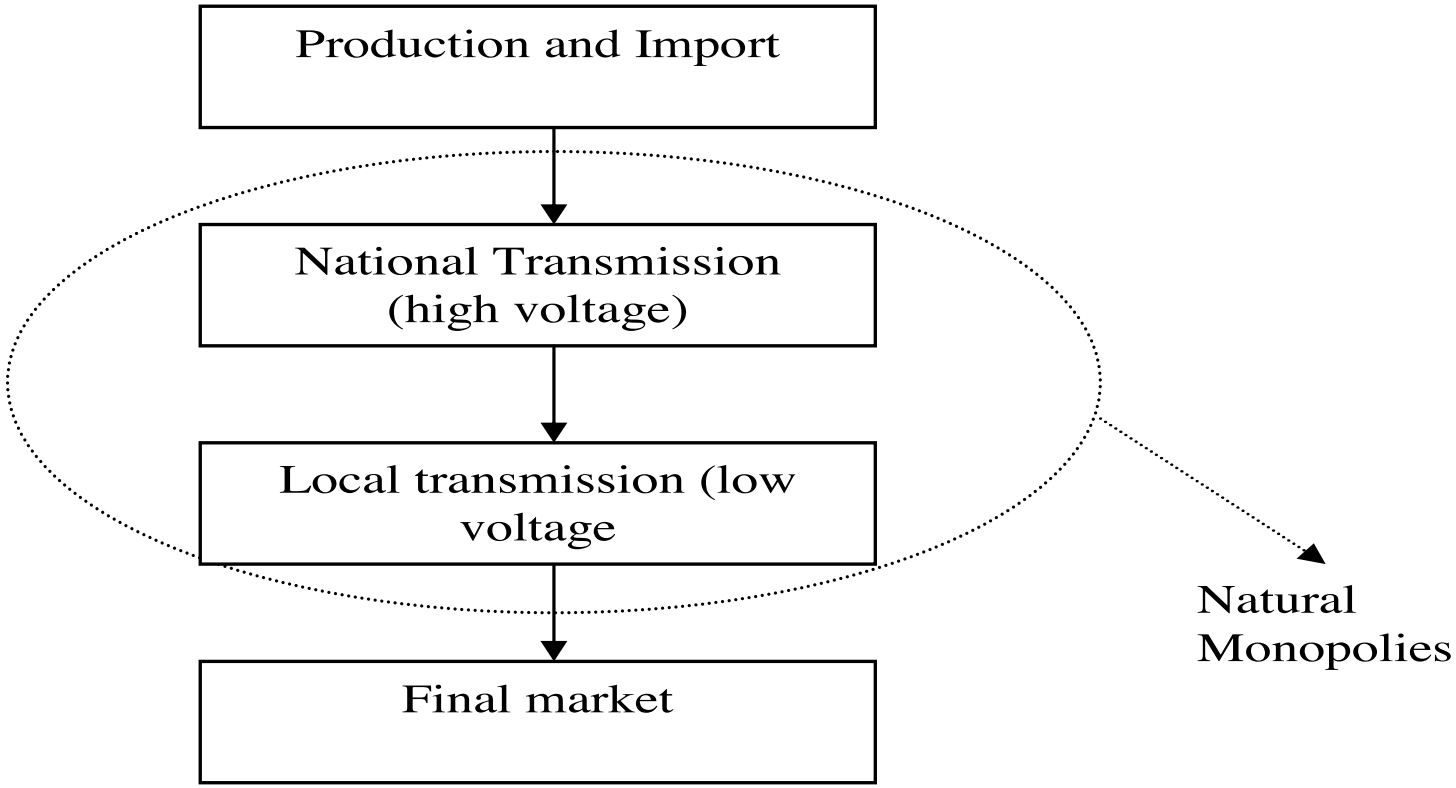
New role of the State

- No more direct producer of services.
- Regulators define the rules of the industry.
- *Competition in the market* when technology permits the presence of more than one firms
- *Competition for the market* (through auction mechanism) when competition in the market is not (legally or technological) feasible

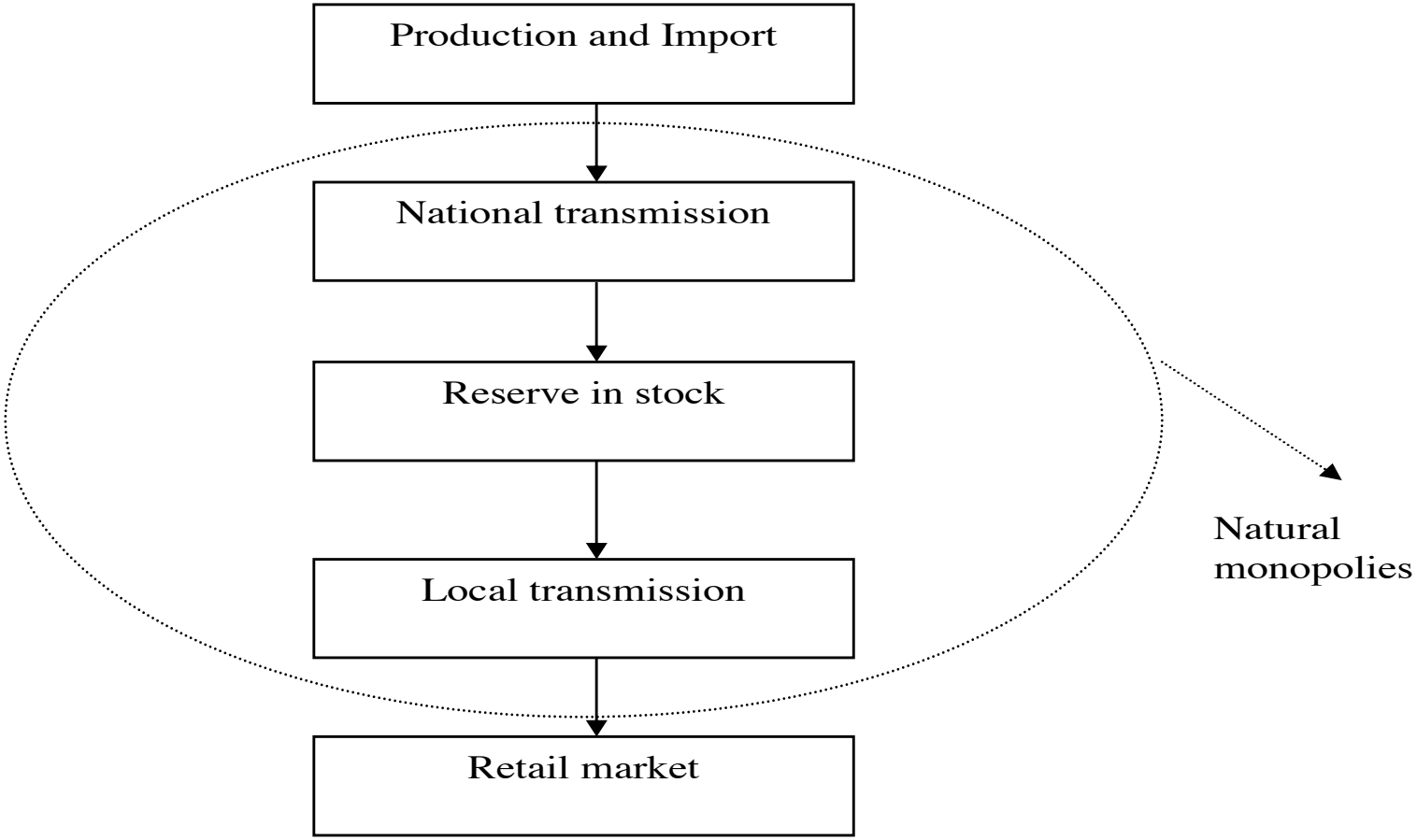
Example: Telecommunications



Example: Electricity market



Example: Gas industry

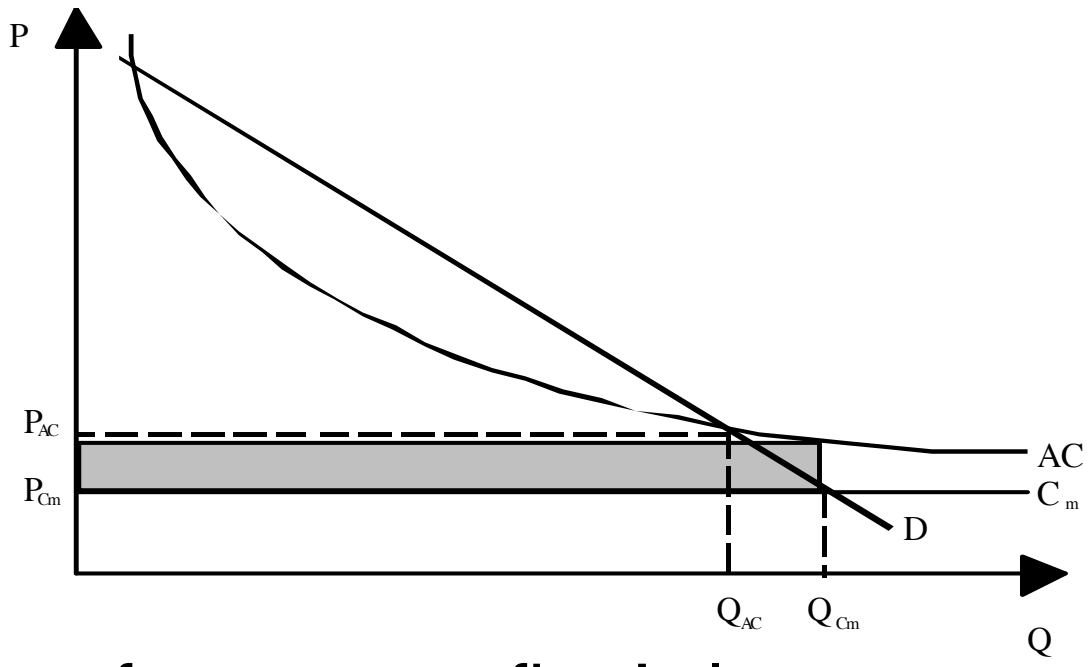


Some basic microeconomics: Monopoly Loss

- No allocative efficiency
- No incentive to minimize cost (no productive and managerial efficiency)
- Rent seeking behaviour and waste of resources
- Hicks's statement: "The best of all monopoly profit is quite life!!"
- Dynamic efficiency? Shumpeter vs. Arrow approach on the effect of the market structure on investments

Conduct regulation: price control/1

- **First best pricing**: price equal to marginal cost (as in a perfect competitive environment)



- Public transfer to cover firm's loss

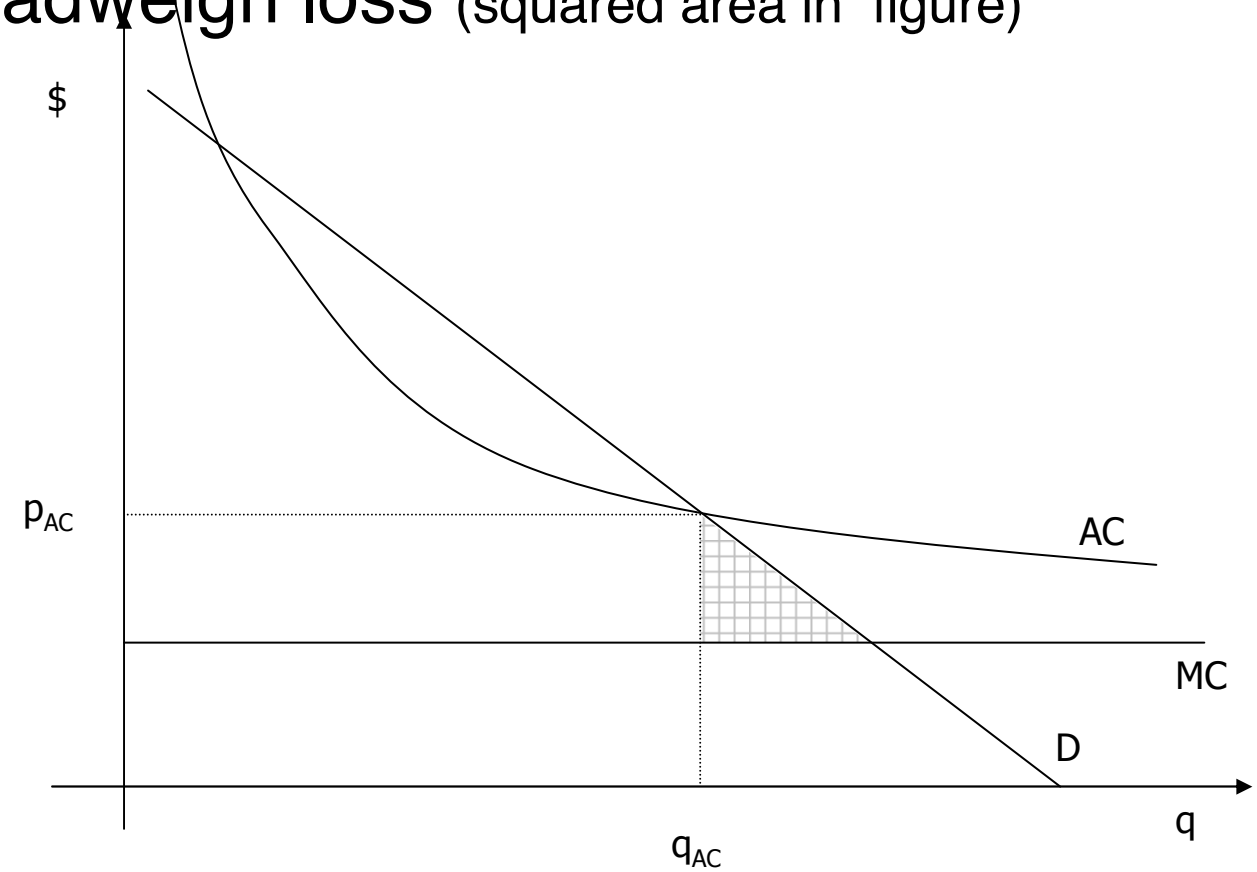
Conduct regulation: price control/2

- In absence of any kind of transfer from regulator to the firm, what could happen?
- The regulator should set prices in order to let the firm reach its break even

- **Second best solution:** price = AC
- The average cost pricing rule

Conduct regulation: price control/3

- Firm's profit are zero, but there is always a deadweigh loss (squared area in figure)



Conduct regulation: price control/4

- Multiproduct setting: practical methods, *fully distributed costs (FDC)*
- Suppose to have a cost function:

$$C = F + \sum_i c_i q_i = F + c_1 q_1 + c_2 q_2$$

- Price equal marginal cost leads to losses. How to cover them?
- A rule to share the fixed cost *F* should be defined by the regulator.

Conduct regulation: price control/5

- *Fully distributed costs (FDC)*: price should cover not only direct (marginal) cost, but also a share of the fixed costs, i.e.

$$p_i = c_i + \frac{f_i F}{q_i}$$

- where f_i is the so called *cost driver*:

$$f_i = \begin{cases} (a) \quad R_i \Big/ \sum_{i=1}^{n} R_i & \text{if (Gross Revenues Method)} \\ (b) \quad Q_i \Big/ \sum_{i=1}^{n} Q_i & \text{if (Relative Output Method)} \\ (c) \quad CD_i \Big/ \sum_{i=1}^{n} CD_i & \text{if (Attribuit able Cost Method)} \end{cases}$$

Practical Incentive regulation instruments

- *Price caps*: defined by an index of the regulated services adjusted annually by an inflation factor, an index of firm efficiency and a factor that allow for pass-through of specific items outside firm's control
- *Rate moratoria*: special case of price caps with the efficiency factor equal to the rate of inflation, and no pass-though factor
- *Profit sharing* (sliding scale regulation) lets the consumers direclty participate in excess profits or profit shortfalls earned by the utility (ex post refunds or price reductions for future purchases)
- *Banded rate of regulation* lets the utility keep its excess profits and suffer profits shortfalls within a pre-specified band
- *Yardstick regulation* makes the prices the utility can charge dependent on the performance of the other firms
- Related to yardstick regulation is *benchmarking* on a hypothetical firm and *cost-proxy models* that try to measure the total long-run incremental cost of a service

- Overall, price caps (PC) are most widely used
  - Price-cap regulation has been firstly applied in the UK to gas, airports, water, electricity and the railways.
  - In the US a price cap was imposed on the dominant long-distance carrier, AT&T, in 1989 by the Federal Communications Commission.

- As competition in telecommunications, electricity and gas has developed price caps in retail supply have been eliminated.

- Price caps remain in place for the network services parts of these industries where complete or substantial market power is still present.

Rate of return regulation

- The method consists in define a limit level to the rate of retun on investments.
- Using accounting terms, the rate of return is given by the fraction between net profits and investment level (i.e. the stock of capital, net of depreciation)
- In a monoproduct setting, *R* is total revenues, *k* is capital factor, *l* is the labour factor, and *r* and *w* the unit cost of input factors, we have:

$$ROR = \frac{R - wl}{k} \leq \rho$$

Rate of return regulation

- Empirically, the regulator sets the Total Revenues of the firm (TR) as:

$$TR = \rho * k + \mathrm{VC}$$

- Where VC = variable costs
- Then, indicating with Q the total quantities of the goods/services (minutes, kWh …)

$$P = TR / Q$$

- *Hearing* process: when the ex post rate of return is higher than ρ, regulator reduces prices; if it is lower than ρ, regulator increases prices.

Rate of return regulation

- Pros of ROR:
  - Financial integrity of regulated firm is always guaranteed;
  - Monitoring of profits
  - No incentive to reduce service quality
- Cons of ROR:
  - No incentive to reduce costs (no productive efficiency) $\Rightarrow$ *cost plus mechanism*
  - Incentive to overinvest (inefficiently) if $\rho > r$ (Averch – Johnson effect)
  - Risk of accounting manipulation
  - Information demanded method and so high administrative costs

Price Cap Contracts

- The price cap mechanism is characterized by four characteristics:
  - in the single product case, the regulator set a cap and the regulated firm may choose a price below or equal to this cap, and it is allowed to retain whatever profits it earns at that price;
  - in the multi-product case, the regulator defines an aggregate cap for a basket of related products. This aggregate cap takes the form of a price index or a weighted average of prices. While the firm has to obey the aggregate cap, it is allowed to choose relative prices;
  - the regulator specifies that the price cap will be adjusted over time by a preannounced adjustment factor;
  - at longer intervals, the price cap is updated by the regulator.

Price cap regulation

- Regulator defines, for a certain period of time, a limit to the growth of price(s) of a (single or a weight average) set of goods or services:

$$P_t = (1 + RPI_t - X)\ P_{t-1}$$

- RPI_t = *retail price index*
- X = (estimated) growth in productivity $\Rightarrow$ reduction that regulator wants to pass to consumers

Price Cap regulation

- The regulator should define the *X* factor and, in a multiproduct setting how to evaluate the average level of price (i.e. the weight to apply to every services).
- Given the general rule, the regulated firm is free to set single prices with respect only to the imposed contraint on their average level
- In addition, regulator sets the time period in which the constraint is valid (*regulatory lag*). In Italy it lasts (almost) three years.

Price cap regulation

- Pros of PC:
  - It induces firms to reduce their operative costs $\Rightarrow$ increase in productive efficiency $\Rightarrow$ *fixed price* method
  - Regulated firms freely set their prices. Thus, regulator delegates to regulated firms the definition of every single services' price
  - It can be proved that this *delegation* leads regulated firm to set prices according to the Ramsey rule … our optimal second best pricing scheme!
  - Less administrative burdens on regulator … almost at first sight!!!!

Price Cap regulation

- Cons of PC:
  - Incentive to reduce costs … especially quality expenditure!
  - If *X* is set too high, regulated firm risk to go out of business
  - Risk on cost fluctuations is completely in charge of the firm
  - Discretion in setting *X* factor and implicitly the rate of return on investment …. More risk of regulatory capture!
  - Incentive is related to how long is the regulatory lag: if it is too short … no incentive at all!!
  - *Rachet effect*: since regulation is a dynamic control activity, if regulated firm anticipate that the information they reveal could be used in future to reduce retail prices … no incentive to increase efficiency so much!

Empirical evidence on Price Caps

- Mathios and Rogers (1989) examined AT&T's long-distance prices and found that most prices were significantly lower in states that allowed pricing flexibility than in states that used rate-of-return regulation. They used a simple dummy variable technique to capture PCR, and of course this evidence does not prove that PCR caused prices to be lower.
- Alexander et al. (1996) examine the evidence on the cost of capital for regulated industries and find that, as expected, firms facing incentive regulation have higher systematic risk than firms subject to rate-of-return regulation.
- Resende (2000) applies a combination of data envelopment analysis (DEA) and econometric techniques to US local telephony and finds that incentive regulation (including PC) is associated with greater productive efficiency than rate-of-return regulation.

- Ai and Sappington (2002) examine the impact of three types of state incentive regulation (PCR, rate case moratoria and earnings sharing) and of traditional rate-of-return regulation on various performance measures for local telecommunications services in the US.
  - They find that under the three forms of incentive regulation there is greater network modernization. Costs tend to be lower under rate case moratoria, and are reduced under earnings sharing and PCR when there is sufficient local competition. While local call rates for business are lower under PCR the form of regulation appears to make no difference to residential call rates.

- De Fraja and Iozzi (2001) show that it could be the case in which the initial price vector preferred in the short term (in the sense that it gives a higher score under the chosen welfare criterion) makes the regulator worse off in the long one.
  - A trade off between short term and long term can arise.

Price Cap regulation

- Empirical evidence on PC (Sappington, 2003) using data from US Telecommunications Industry:
  - Incentive to renew some type of equipments (digital commutator, digital transmission) but not to increase aggregate investment
  - Incentive to increase total factor productivity
  - Decrease in retail prices … but not consistently
  - Increase in net profits … even if no clear evidence for reductions in *operative costs*
  - No clear incentive to reduce services' quality

Incentive regulation in Energy Sectors

- Incentive regulation increases productivity and service quality in UK electric regional distribution (Jamasb and Pollitt 2007; Domah and Pollit, 2004; Newbery and Pollit, 1998)
- Quality impact is ambiguous: Not negative impact of incentive regulation in quality provision in Norway (Growitsch *et al.* 2010); negative effect of IR on quality in the US (Ter Martirosyan and Kwoka, 2010) without MQS.
- Incentive regulation increases labour productivity in electric distribution in developing countries (Pollit, 2004; Rudnik and Zolezzi, 2001)
- Incentive regulation increases firms' investments, but only in cost-reducing activities (Cambini and Rondi, 2010).
- Surveys on IR in Energy: Joskow 2008, Vogelsang 2006

A sum up

- Theory (Baron and Myerson, 1982; Laffont and Tirole, 1986, 1993):
  - Adverse selection and/or moral hazard models: menu of contracts is the first best solution

- "One contract does not fit all!!"

- In practice? RoR (cost plus) and Price cap (fixed price) are extreme case ….

Incentive Regulation

- How to practically apply this theory?
- Price mechanism in US telecoms
- ***Banded ROR and Rate Case Moratorium:*** variant of ROR; Regulator allows regulated firm to earn a ror higher than the regulated level up to a limit.
- ***Earnings Sharing Plans:*** regulator lets the firm make more profits than the regulated level but imposes that part of these additional profits would be shared with regulator (i.e. with consumers in term of reduced charges;
- ***Revenue Sharing Plans***: regulator lets the firm obtain more revenues than the regulated level, but imposes that part of these additional revenues would be shared with regulator (i.e. with consumers in term of reduced charges.

Incentive Regulation

Ch. 7: Price Regulation

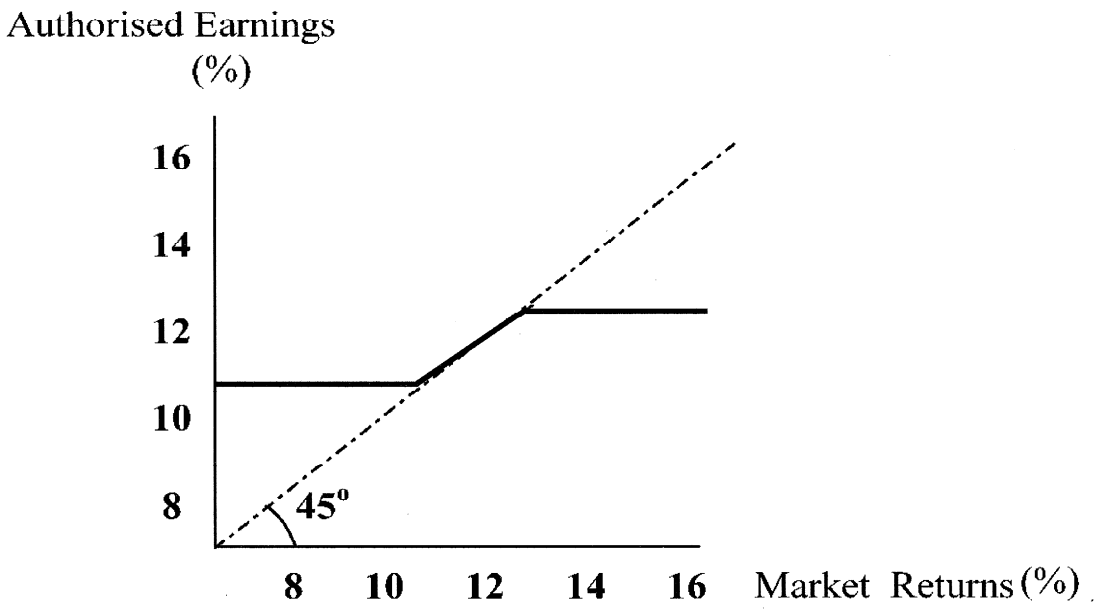


Fig. 1. Banded rate of return regulation.

Incentive Regulation

D.E.M. Sappington

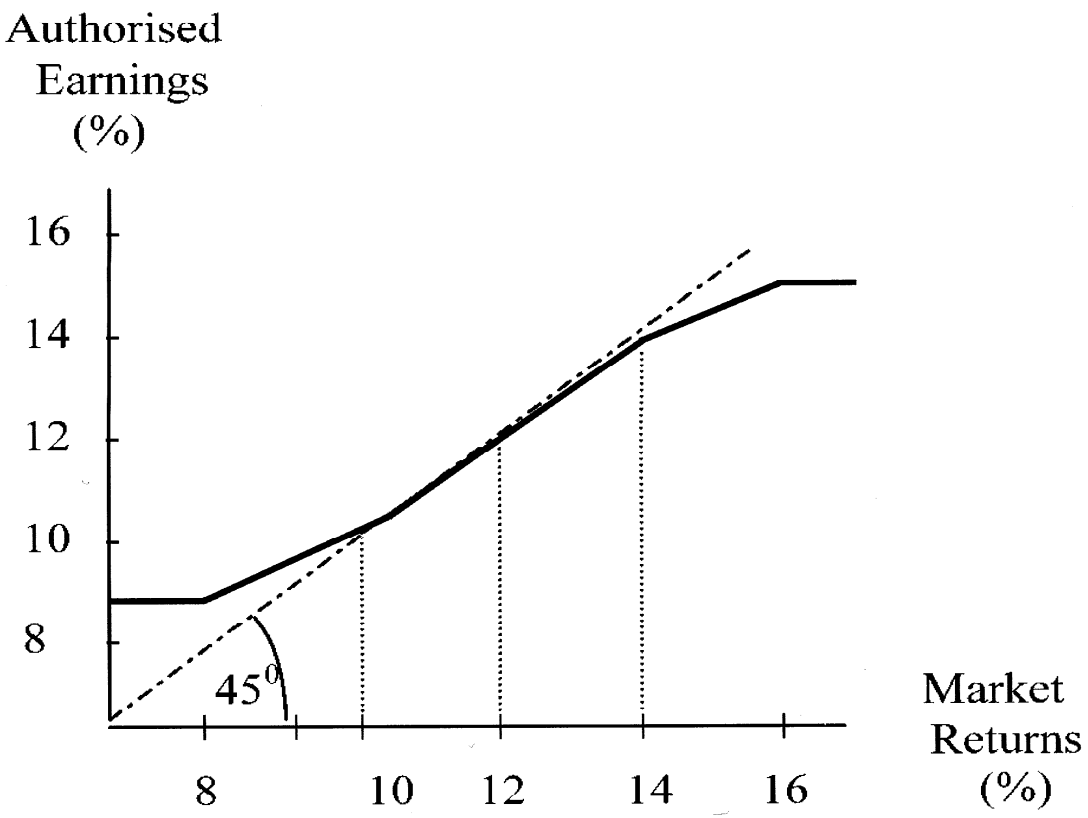


Fig. 2. Earnings sharing regulation.

Incentive Regulation

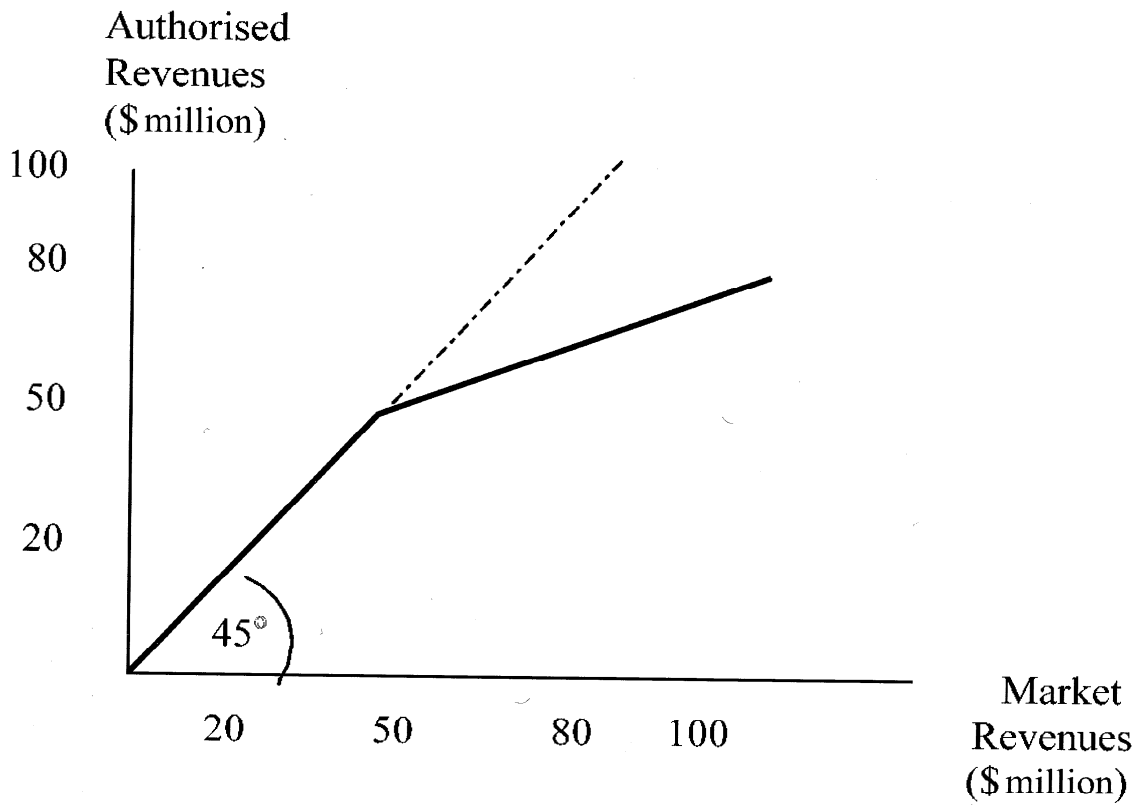


Fig. 3. Revenue sharing regulation.

Incentive Regulation in US telecoms

ANNO	Rate of return Regulation	Rate Case Moratoria	Earnings Sharing Regulation	Price Cap Regulation	Altri
1985	50	0	0	0	0
1986	45	5	0	0	0
1987	36	10	3	0	1
1988	35	10	4	0	1
1989	31	10	8	0	1
1990	23	9	14	1	3
1991	19	8	19	1	3
1992	18	6	20	3	3
1993	17	5	22	3	3
1994	20	2	19	6	3
1995	18	3	17	9	3
1996	14	4	5	24	3
1997	12	4	4	28	2
1998	13	3	2	30	2
1999	11	1	1	35	2
2000	7	1	1	39	2

Fonte: Sappington (2002).

Some difficulties: investment incentives

- Conflict between social and private interests may arise whenever pro-competitive and efficiency enhancing regulatory regimes undermine the firm's incentives to invest.
- Laffont and Tirole (2000, p. 7) note that: "*There is in general a trade-off between promoting competition to increase social welfare once the infrastructure is in place and encouraging ex ante the incumbent to invest and maintain the infrastructure*".
- The relationship between regulation and investment has received much attention by economic theory in the last twenty years (see the survey by Guthrie, 2006), but the empirical evidence is scant and mostly focussed on US regulated utilities.

Some difficulties: investment incentives

- The literature suggests that regulatory policies affect utilities' investment decisions differently, depending on which type of investment – in cost reducing or infrastructure - the firm undertakes (Armstrong and Sappington, 2006).
- Typically, regulatory interventions that deliver no extra profit to the firm, even when its operating costs decline (like in a rate of return regulation), deprive the firm's incentive to invest in cost reduction.
- In contrast, if firm's allowed revenues do not depend on realized cost savings (like in a price- or revenue- cap mechanism), the incentive to invest in cost reducing activities is predicted to be more pronounced (Cabral and Riordan, 1989)
- A complicating factor, however, is that incentives work differently for infrastructure and for cost reducing investment. Rate of return regulation is thought to provide strong incentives for developing new infrastructure since the rate of return on the asset base is guaranteed and the risk faced by the firm considerably reduced. On the contrary, price cap mechanism may weaken the incentive to invest in infrastructure, especially when the regulatory lags are shorter than the life of the assets, due to regulatory opportunism (Guthrie, 2006)

Some difficulties: investment incentives & Commitment (Armstrong and Sappington, 2006; Guthrie, 2006)

- Underinvestment due to lack of regulatory commitment
- Stage 1: Firm chooses investment
  - sunk investment K reduces unit cost $c_0 \rightarrow c_1$
  - investment is efficient: $(c_0 - c_1)Q > rK$
  - firm will invest iff can gain return $\geq rK$
- Stage 2: Periodic review of price cap P
  - *ex ante*: regulator promises $P = c_1 + rK/Q$
  - *ex post*: incentive to set $P = c_1$
  - foreseeing that K will not be recouped, firm will not invest
- Solutions: reputation and commitment (repeated game); transparency over criteria; appeal to CC; regulatory duties (finance operations)

Regulation and Investment in EU energy Industries

(Cambini and Rondi, 2010 JRE)

- Panel of 23 largest energy utilities in France, Germany, Italy, Spain and 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 and SPA) observed as regime switches
  - 12 Transmission Service Operators
  - 5 Vertically and 5 Horizontally integrated
  - 13 State-controlled (30%) and 10 Privately-controlled
- Balance sheet and ownership data
- WACC rates and X-factors observed at various regulatory hearings: 2-3 changes in each country
- National economic indicators and energy statistics

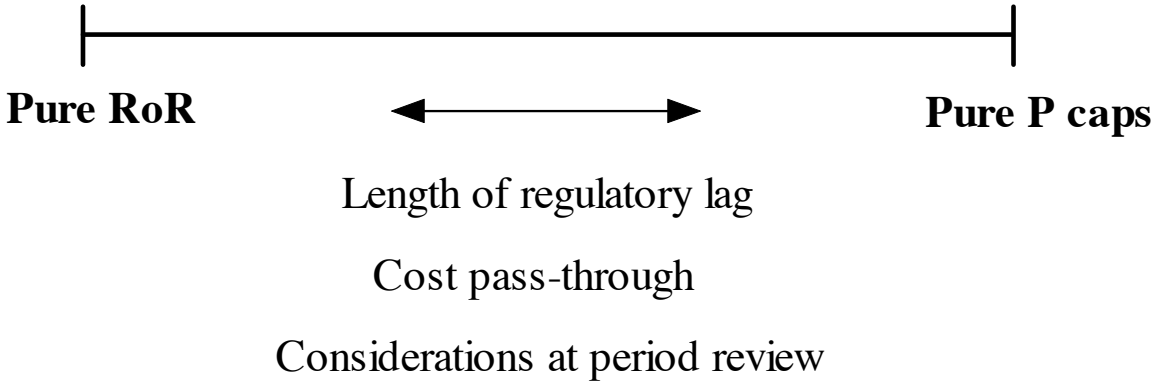
Investment, Regulation, Ownership

Investment rate	**2SLS Estimation**		**One-step difference GMM**	
	(5)	**(6)**	**(7)**	**(8)**
Investment Rate $_{t-1}$	0.182**	0.160*	0.337***	0.341***
	(0.072)	*(0.082)*	*(0.106)*	*(0.106)*
ΔLog of Sales $_t$	0.063**	0.064**	0.155***	0.150***
	(0.026)	*(0.025)*	*(0.051)*	*(0.049)*
Cash Flow to Total Asset $_{t-1}$	0.146*	0.177**	0.146	0.152
	(0.084)	*(0.083)*	*(0.168)*	*(0.166)*
LT Interest Rate $_{t-1}$	0.014	0.022*	-	-
	(0.009)	*(0.012)*	-	-
Manufacturing Share of GDP $_{t-1}$	0.023	0.226	-0.275	-0.329
	(0.345)	*(0.312)*	*(0.800)*	*(0.831)*
Incentive Regulation Dummy$_t$	0.026*	0.038**	0.037*	0.038*
	(0.014)	*(0.015)*	*(0.012)*	*(0.021)*
Private Control Dummy$_t$	-	0.052	-	0.022
	-	*(0.136)*	-	*(0.015)*
Arellano-Bond test for AR(1) (p-value)	-	-	0.016	0.015
Arellano-Bond test for AR(2) (p-value)	-	-	0.482	0.512
Hansen χ^2 test of overid. restrictions (p-value)	-	-	0.995	0.999
R squared (within)	0.608	0.623	-	-
F-test (p value)	0.00	0.00	-	-
N. Firms [N. Obs.]	186 [23]	182 [23]	138 [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: rate of return v. price cap regulation



✣ Price adjusts continuously	• Pre-specified price path
✣ Good for allocative efficiency	• Poor for allocative efficiency
✣ Poor for productive efficiency	• Good for productive efficiency
✣ Over-investment incentive	• Under-investment incentive
✣ Possible quality over-provision	• Incentive to cut quality

Yardstick Competition

- Presence of multiple local monopolies.
- *Intuition*: using information of other to regulate a firm

$$p_i = \bar{c}_i \equiv \frac{1}{n-1} \sum_{j \neq i} c_j$$

- *Critics*: a) different firms and heterogeneity; b) potential collusion among regulated firms; c) not credible treat from regulator

More focus on Price Cap

- **Tariff basket mechanism**
- Suppose $i = 1,..,n$ services under price control:

$$\sum_{i=1}^{n} p_i^t q_i^{t-1} \leq \left(1 + RPI^t - X\right) \sum_{i=1}^{n} p_i^{t-1} q_i^{t-1}$$

- Single service's weight:

$$w_i = \frac{q_i^{t-1}}{\sum_{i=1}^{n} p_i^{t-1} q_i^{t-1}}$$

More focus on Price Cap

- It means that:

$$\frac{\sum_{i=1}^{n} p_i^t q_i^{t-1}}{\sum_{i=1}^{n} p_i^{t-1} q_i^{t-1}} \leq 1 + RPI^t - X$$

- Laspeyres Index should be lower than 1 + $RPI^t - X$.
- This means that in time *t* prices should be set in order to make hypothetical revenues generated by selling the same quantities sold in period *t*-1 at new prices lower than previous period revenues (adjusted by the factor *RPI – X*).
- Risk of manipulation: the weights in one period depend on prices in previous period

More focus on Price Cap

- **Average revenue price cap**
- Suppose $i = 1,..,n$ services under price control:

$$\frac{\sum_{i=1}^{n} p_i^t q_i^{t-1}}{\sum_{i=1}^{n} q_i^{t-1}} \leq \hat{p}^t = \left[1 + RPI^t - X\right]\hat{p}^{t-1}$$

- Single service's weight:

$$w_i = \frac{q_i^{t-1}}{\sum_{i=1}^{n} q_i^{t-1}}$$

An application: the British Telecom price cap

- For British Telecom, OFCOM uses a variant of the tariff basket mechanism as it follows:

$$\sum_{i=1}^{n} w_i^t p_i^t \leq \left(1 + RPI^t - X\right) \sum_{i=1}^{n} w_i^t p_i^{t-1} \quad \text{dove } w_i^t = p_i^{t-1} q_i^{t-1} \Big/ \sum_{i=1}^{n} p_i^{t-1} q_i^{t-1}$$

- In words, weights are given by the fraction of past period per service revenues and total services's revenues

Other practical issues

- In some industries, part of the operating cost are out of the controll of the regulated firm. Regulator should consider these costs apart $\Rightarrow$ *pass through terms*, Z^t (but risk of accounting manipulation!!):

$$\frac{\sum_{i=1}^{n} p_i^t q_i^{t-1}}{\sum_{i=1}^{n} q_i^{t-1}} \leq \hat{p}^t = \left[1 + RPI^t - X\right]\hat{p}^{t-1} + Z^t$$

Other practical issues

- Financial issues in Price Cap regulation:
- It is true that in price cap regulation Regulator does not *directly* set a return on investment …. But it has to do that almost *indirectly* in order to correctly take into account the cost of capital when evaluating a policy intervention.

Financial issue in Price Cap regulation

Setting a price cap *(X)* in a monopolistic market:

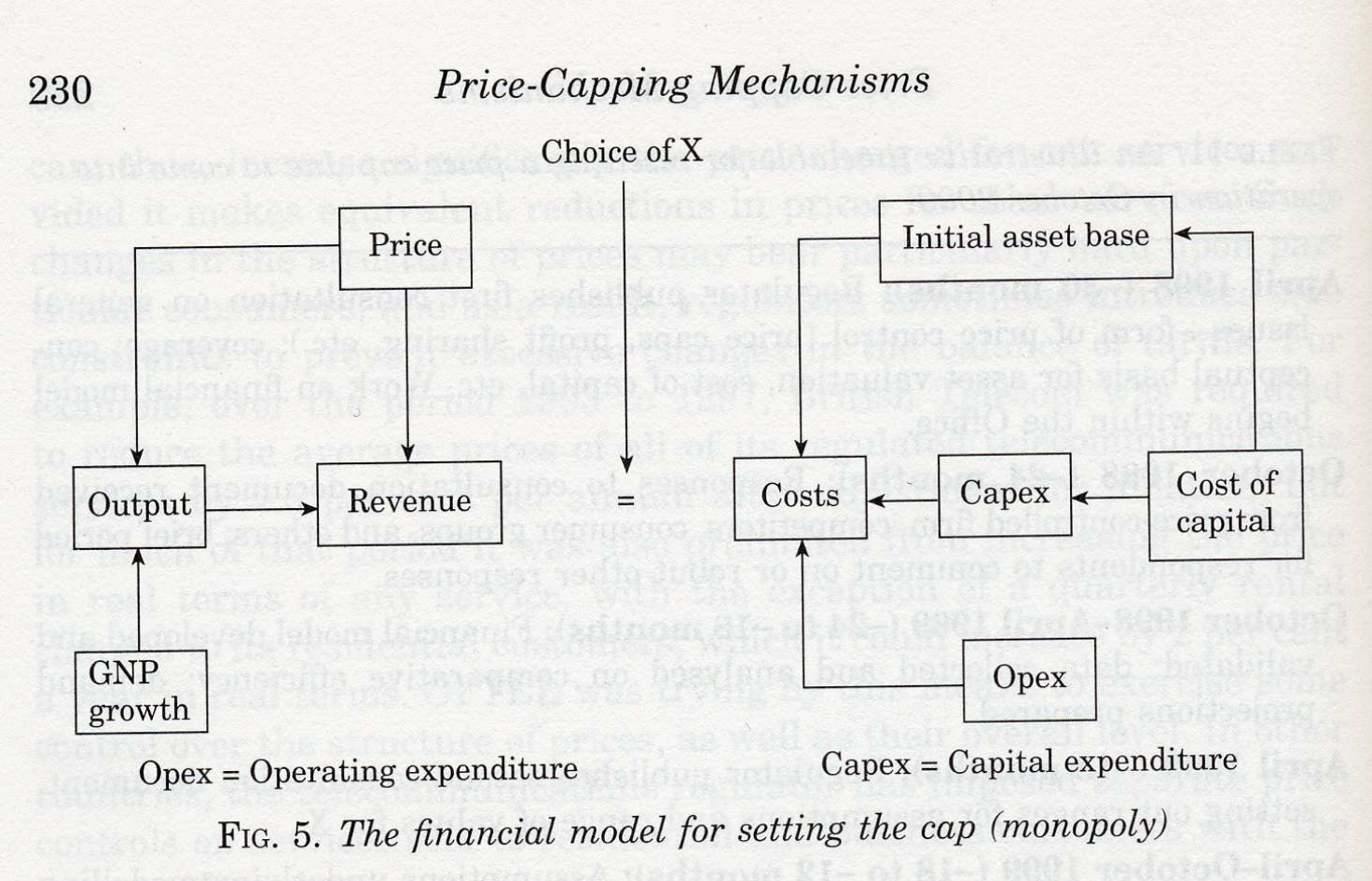


FIG. 5. *The financial model for setting the cap (monopoly)*

Financial issue in Price Cap regulation

Setting a price cap *(X)* in a (almost partial) competitive market:

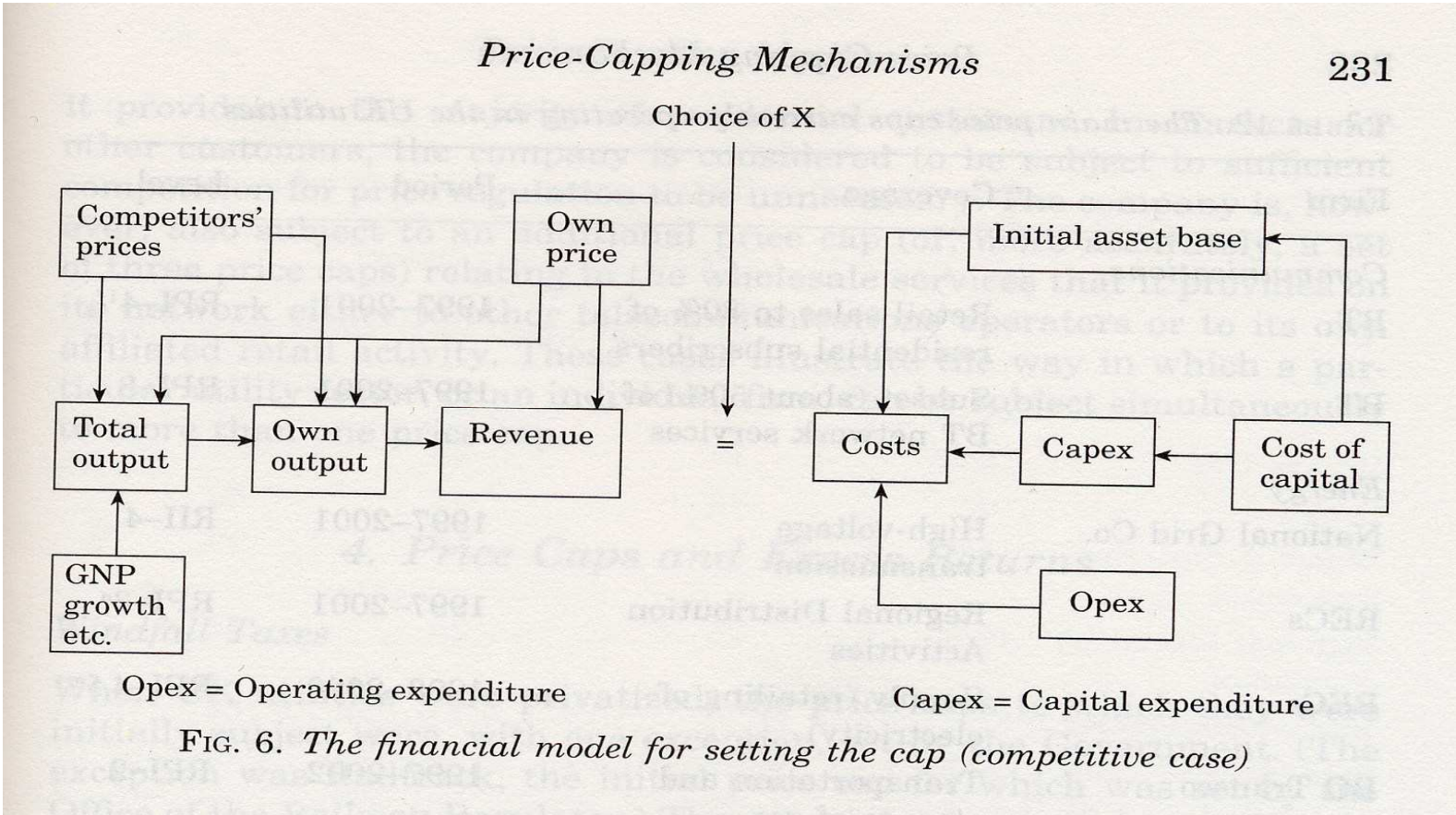


FIG. 6. *The financial model for setting the cap (competitive case)*

Financial issues in Price Cap regulation

- Measure and index to be used to evaluate capital expenditure :
- Cost of capital (r_{it}): *CAPM*
- $$r_{it} = r_{ft} + \beta\left(r_{mt} - r_{ft}\right) \qquad \beta = \left[\sum_{t=1}^{T}(r_{it} - \bar{r}_i)(r_{mt} - \bar{r}_m)\right] \Big/ \sum_{t=1}^{T}(r_{mt} - \bar{r}_m)^2$$
- where r_{ft} is the interest rate of free risk public bonds.
- *Weight Average cost of capital:*
- $$WACC = [r_{it}\, E/(E+D)]/(1 - t) + rd\, D/(E+D)$$
- Where *E* level of Capital Invested by shareholders, *D* level of Debt, *rd* the cost of debt and *t* is the tax level (%).

Example: the WACC in italian telecoms

- *Free interest rate, rf* = 5% equal to average rate of BTP (public bonds from 10 to 30 years);
- Market premium $(r_m - r_f)$ equal to 4%
- *Risk coefficient* β = 1,05.
- *Thus,* $r_t = r_f + (r_m - r_f)\beta = 9{,}2\%$.
- Cost of Debt, *rd* = 5,35%, tax level *t* = 41%, *E* = 80%, *D* = 20%:
- $WACC = [r_{it}\, E/(E+D)]/(1 - t) + rd\, D/(E+D) = 13{,}5$

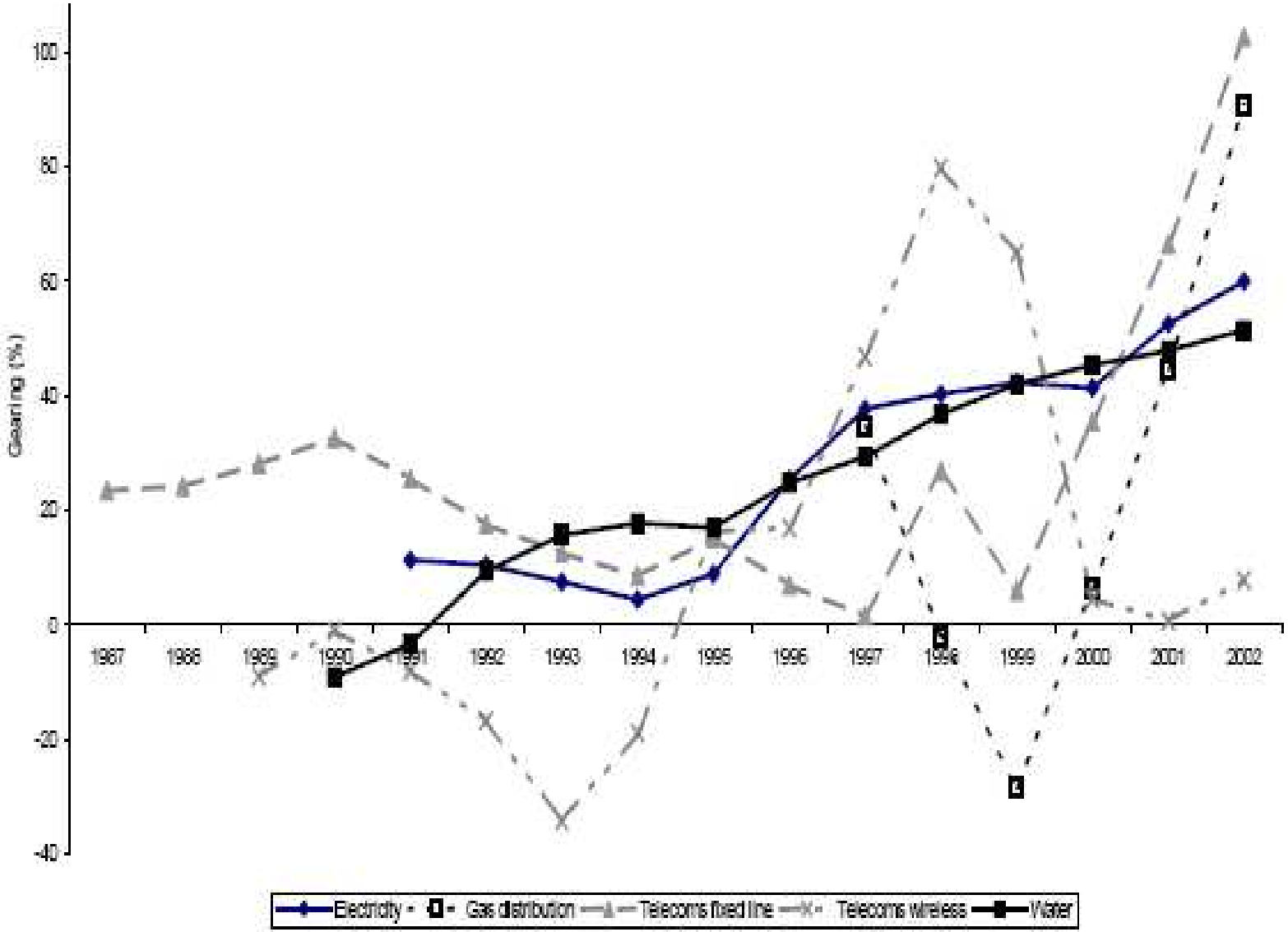
Financial aspects

- In italian electricity market, Regulator sets for Transmission β = 0,43 (less risky activity).
- International comparison (1999) in Transmission: National Grid (UK) β = 0,56, Electrabel (Belgium) β = 0,33;
- In Distribution and Retail Southern Electic (Uk) β = 0,66;
- For integrated firm: Endesa (Spain) β = 0,82, Iberdrola (Spain) β = 0,82, Scottish Power (Uk) β = 0,96.

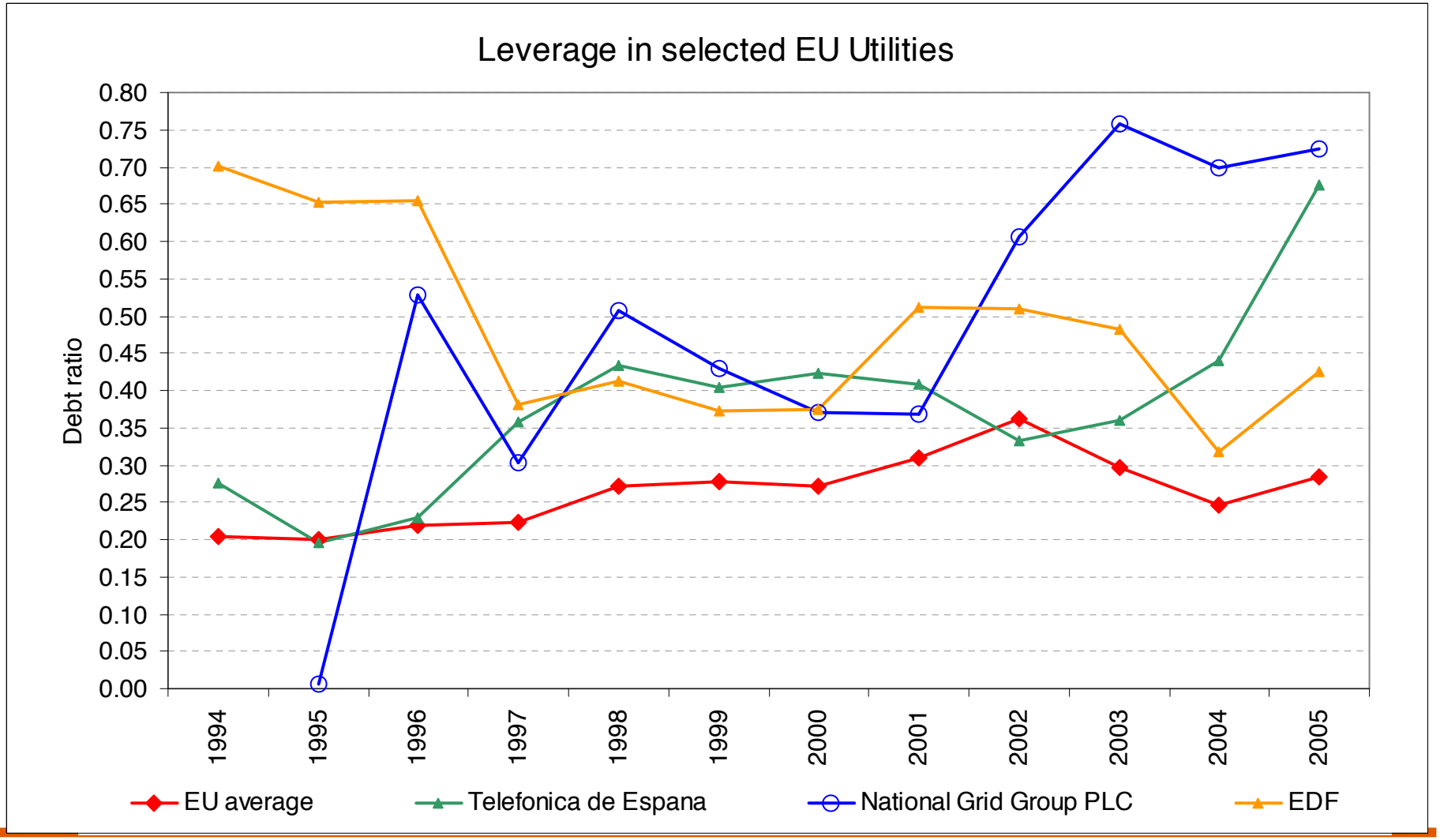
Problem: debt increase!

- 10 yrs after privatization, several regulated utilities in Europe have moved away from all-equity financing to being *heavily leveraged*
- Well known and well documented phenomenon in the US starting from 1910.
- DTI and HM Treasury (2004) emphasize the "*dash for debt*" of UK utilities in water, electricity, gas, TLC, mainly to finance investment programs

The UK Experience



The EU



Source: *Worldscope*

Why is Capital Structure Important?

- Regulated rates are set so as to assure the firm a “fair” rate of return on its capital

- The determination of this “fair” rate of return depends to a large extent on the firm’s capital structure

⇒ By properly choosing its capital structure, a regulated firm can affect its rates and hence its profitability

…A Strategic Explanation of Leverage (Spiegel and Spulber, 1994, *RJE*)

- Regulators select the "fair" rate of return to provide investment incentives
- Firms fear that regulatory opportunism (due to lack of long term commitment) will reduce the price after the investment is sunk
- May capital structure be the "device" used by the firm to affect regulators' choice and offset regulatory lack of commitment?
- … and the "device" used by regulators to limit their opportunism, hence *underinvestment?*

Spiegel and Spulber (RJE, 1994)

- A regulated firm finances its investment (sunk) with debt

- A welfare maximizing regulator has an incentive to set a high regulated price that lowers the probability that the regulated firm will become financially distressed

$\Rightarrow$ The firm's leverage mitigates regulatory opportunism

- The regulator allows the firm to apply discretion in choosing its leverage in order to commit not to engage in opportunistic behaviour

A study from EU data

- Bortolotti, Cambini, Rondi and Spiegel (JEMS, 2011) show that regulated firms use leverage strategically to limit regulatory opportunism
- Privately-controlled regulated firms rely on debt financing as a way to shield themselves against opportunistic behavior when an IRA is in place.
- The leverage and prices of regulated utilities are positively related, provided that they are privately controlled. Granger causality tests reveal that leverage affects price but not vice versa
- But ownership matter: theory holds only for privately controlled firms