

Incentive Regulation and Investment in Network Infrastructures

Ingo Vogelsang, Boston University

***NETCONOMICA 2008
Regulatory Risk, Cost of Capital and Investment
Incentives***

Königswinter, September 3, 2008

An old, but timely regulatory problem

- When I started working on regulation in the 1970s the main problem tackled by economists was regulatory incentives for excessive investment under rate-of-return regulation (Averch-Johnson effect). However: Joskow-MacAvoy (AER, 1975)
- In the U.S. regulation started with the investment issue: Franchise contracts.
- Doubts about investment incentives were replaced by “Hope” (1944).
- Rate-of-return regulation has been replaced by incentive regulation with an emphasis on cost reduction and efficient pricing. Has investment been neglected? What about the over-investment in Telecommunications before 2000/2001?
- New German telecommunications law provides a regulatory holiday for innovative investment as does new practice of the FCC.

Overview

- ➔ • **Basic Considerations about Regulation and Investment**
- **Regulation Under Full Commitment**
- **Long-term Investment and Variable Commitment**
- **Conclusions**

Specific investment problems in network industries

- **Economies of scale lead to lumpiness**
 - in size of increments and to (wasteful) duplicate investments
 - in lead time and duration
- **Sunkness implies risks associated with real options**
- **Examples**
 - Electricity transmission and distribution networks (weak competitive risks)
 - Broadband telecommunications access and backhaul (strong competitive risks)
 - NGN Networks (strong competitive risks)
- **Investment benefits are potentially high relative to benefits from efficient pricing.**

Different types of investment may be affected differently by regulation

- **Investment in cost reduction**
 - Arrow effect (price-cap regulation): Regulation → Investment
- **Investment in quality improvements**
 - Lower quality is substitute for price increase
 - Empirical effects inconclusive
- **Investment in new products: Regulation constrains upside opportunities.**
 - End user regulation
 - Regulation of bottleneck inputs
- **Investment in capacity expansion (infrastructure investment) by incumbent**
- **Investment of alternative competitors**
 - In complementary infrastructure
 - In bottleneck bypass (ladder of investment)

Regulation and investment

- **Two perceived regulatory sources of investment risks**
 - **Truncation of investment outcomes**
 - **Lack of commitment**
- **Incentives and governance**
 - **Prices as regulatory incentive variables**
 - **signal for expected price, which in turn determines output and therefore investment**
 - **Source of revenues for financing investment**
 - **Truncation of price distribution as source of investment risk**
 - **Regulatory governance variables**
 - **(Lack of) regulatory commitment as source of investment risk**
 - **Regulators want investment**
 - **Regulators also want low prices**
 - **Ex post conflict with ex ante desire**

Overview

- **Basic Considerations about Regulation and Investment**
- • **Regulation Under Full Commitment**
- **Long-term Investment and Variable Commitment**
- **Conclusions**

Two Types of Infrastructure Investment and Two Types of Regulation

- **Investment**

- **Bottleneck**

- Legacy infrastructure of incumbent
 - Bypass infrastructure

- **Downstream/upstream of bottleneck**

- Incumbent infrastructure
 - Competitors' infrastructure
 - Access-related infrastructure

- **Regulation**

- **Bottleneck**

- **End-user**

Effects of Bottleneck Regulation on Infrastructure Investment

Investment Type Regulation	Incumbent Bottleneck	Competitive Bypass (Make or Buy)	Incumbent Downstream	Competitive Downstream
tight	-/+	- Sappington: 0	-/+	+
intermediate	+	0 Sappington: 0	+	0
soft	+/-	+(-) Sappington: 0/+	+/-	-

Effects of End-User Regulation on Infrastructure Investment

Investment Type Regulation	Incumbent Bottleneck	Competitive Bypass (Make or Buy)	Incumbent Downstream	Competitive Downstream
tight	-/+	-	-/+	-
intermediate	+	0	+	0
soft	+/-	+	+/-	+

Best Regulation for Infrastructure Investment

- **Bottleneck regulation**
 - **Tight regulation best for upstream/downstream investment**
 - **Soft regulation best for bottleneck and bypass investment**
 - **Best overall approach depends on relative weight and relative sunkness of bottleneck infrastructure vs. other infrastructure**
 - **Intermediate regulation generally best compromise**
- **End-user regulation**
 - **Soft/intermediate regulation dominates for all types of investment**
 - **Soft regulation enhances competition**
 - **Foreclosure avoided via bottleneck regulation**

Soft Incentive Regulation for Infrastructure Investment?

- **How can soft regulation provide productive efficiency incentives?**
 - **Profit-sharing regulation**
 - **Soft definition of (excess) profit**
 - **Soft = more sharing → ror-regulation**
 - **Soft = asymmetric in favor of firm → distortions**
 - **Price-cap regulation**
 - **Cost-reducing incentives largely independent of price-cap level**
 - **Price-cap period can be extended if price caps are soft (have a buffer against risk of being too low or too high)**
 - **Consequently a larger regulatory commitment**
 - **Regulation based on analytical cost model**
 - **Intrinsic incentive if model independent of incumbent's costs**
 - **Soft regulation via built-in rate of return**
 - **Benchmarking (Yardstick)**
 - **Allow pre-set distance from efficiency frontier**
 - **Bayesian regulation: Allow for positive profit at participation constraint → Similar incentives but higher expected profits**

Tool for Separating Allocation and Financing Incentives: Two-part Tariff Price-caps

- **Two-part tariff pricing constraint can be combined with any type of price-level regulation**
- **Marginal price as main determinant of demanded quantity affects amount and direction of expansion investment (for given number of customers)**
- **Flexible fixed fee helps keep average price constant and thereby allows for financing of investment.**
- **Two-part tariffs can reduce price truncation problem under uncertain demand.**
- **Price-cap weights substantially affect marginal price and average revenue (revenue/usage quantity)**

Overview

- **Basic Considerations about Regulation and Investment**
- **Regulation Under Full Commitment**
- • **Long-term Investment and Variable Commitment**
- **Conclusions**

Incentive Regulation and Investment: The Role of Commitment

- (1) The longer the time horizon the less regulators can commit.
- (2) Infrastructure investment has long lead time and long life.
- (1) + (2) } → Full regulatory commitment for time horizon of investment not possible.
- (3) General result of the literature on Bayesian Incentive Regulation: The less the regulator can commit to incentives (and the associated profits and losses) the weaker should incentives be.
- (1) + (2) + (3) } → Compatibility of incentive regulation and efficient investment in doubt

A Two-period Framework

- **The short period**
 - Regulatory lag, (RPI-X)-type adjustments or profit sharing
 - Firm decisions on operations, repairs and maintenance costs
 - Full regulatory commitment
 - Steep incentives for cost reductions feasible
- **The long (commitment) period**
 - Revisions of (RPI-X)-adjustments and of incentive mechanisms at the end of each long period
 - Almost full commitment feasible
- **Beyond the long period**
 - Infrastructure investments go beyond several long periods
 - Only very basic regulatory commitment beyond a long period
 - Little or no cost-reducing regulatory incentives feasible beyond a long period

Tightness of Regulation and the Two-period Framework

- **Soft regulation likely to lead to excess profits over time → Reduces length of commitment period**
- **Tight regulation likely to lead to losses over time → Reduces length of commitment period**
- **Intermediate regulation viable for longer than either soft or tight regulation**
- **Regulatory holidays**
 - **Regulation begins with a lag after regulatory requirement has been met.**
 - **Lag can be viewed as short period, for which commitment is feasible.**
 - **Holidays unlikely to be long enough for financing large sunk investments**
 - **Regulatory threat as long-term commitment: No regulation as long as incumbent behaves?**

Tightness of Regulation and the Two-period Framework

- **Consequences of the two-period framework for investment:**
 - **Intermediate regulation enhances commitment power and investment incentives**
 - **Intermediate regulation is compatible with short-term incentive regulation**
 - **Regulatory holidays need to be combined with intermediate regulation after holidays expire. Combination of intermediate with regulatory holidays could spur investment.**

U.S. Approaches to Solving the Commitment Problem

- **Combine rate-of-return regulation (intermediate to soft regulation) with a used-and-useful criterion for including assets in the rate base.**
 - **Rate-of-return regulation credible because of Supreme Court decisions (“Hope”)**
 - **Used-and-useful criterion subject to court review**
 - **Problem of reserve capacity against demand uncertainty and outages**
 - **Problem of lumpy capacity additions**
 - **Who is efficient risk bearer: Firm or customers?**
 - **Regulatory shortcomings reflected in firm’s cost of capital (Baumol/Sidak)**
 - **Gilbert/Newbery: Efficient approach**

U.S. Approaches to Solving the Commitment Problem

- **Regulatory forbearance under Telecommunications Act of 1996**
 - **Abolish regulation that reduces investment incentives**
 - **Lifting of unbundling requirements for UNEP (Platform of unbundled network elements)**
 - **Deregulation as credible commitment**
 - **Exercised by FCC for new fiber lines**
 - **Claimed to have increased fiber deployment**

U.S. Approaches to Solving the Commitment Problem

- **Repair models for insufficient investments under regulation**
 - **Widespread universal service subsidies in telecommunications; now under discussion for broadband access**
 - **Investment commitment by regulated telecommunications carriers in exchange for favorable regulation, e.g., in New York state around 1990**
 - **Generation resource adequacy regulation to compensate investment disincentives from price-cap regulation of electricity generation spot pricing**

Overview

- **Basic Considerations about Regulation and Investment**
- **Regulation Under Full Commitment**
- **Long-term Investment and Variable Commitment**
- **Conclusions**



Conclusions

- **The longer the time horizon of investments the less the applicability of incentive regulation**
- **In the long run intermediate regulation is generally better for infrastructure investment than soft or tight regulation**
 - **Soft end-user regulation is slightly better in the short run (compatible with the view that end-user regulation should be abolished first).**
 - **Soft/intermediate regulation can be made compatible with efficiency incentives.**
- **Intermediate regulation dominates investment incentives provided by soft or tight regulation of bottlenecks**
 - **Pricing signals**
 - **Financing**
 - **Regulatory commitment**

Reserve 1: Types of Incentive Regulation

- **Basis for incentives is asymmetric information.**
- **Non-Bayesian approach:**
 - Based on simple principles
 - Directed towards welfare improvement, not optimization
 - Geared for application, but investments have generally not been addressed explicitly
- **Bayesian approach:**
 - Uses principal-agent framework
 - Full constrained welfare optimization:
 - No direct applicability, but addresses investment incentives via commitment
 - Qualitative insights usable for non-Bayesian approach in this talk

Reserve 2: Multiproduct Issues

**Price level regulation vs. price structure regulation
(Germany seems to treat electricity transmission as a single product w.r.t. time and location!)**

- **Price level regulation → average price →**
 - **Inverted ‘U’-relationship between average price and investment**
 - **High price: Demanded quantity constrains investment**
 - **Low price: Low profit contribution/high risk constrains investment**
- **Price structure regulation → marginal price →**
 - **Capacity utilization (Peak-load pricing)**
 - **Direction and amount of capacity expansion**

Reserve 3: Risk/price trade-off from price level regulation

Ranked from lenient to tight regulation, but in each case regulator can make compensating adjustments:

- **Rate-of-return regulation/cost-plus regulation**
 - Low risk/incentives
 - Medium/high average price
- **Profit-sharing regulation**
 - Medium risk/incentives
 - Medium average price
- **Price-cap regulation**
 - Medium/high risk/incentives
 - Low/medium average price
- **Yardstick/benchmarking regulation**
 - High risk/incentives
 - Low average price

Reserve 4: Price Index Approach (Under Vertical Separation)

Linear price caps

- **Advantages**

- Easy to understand
- Incentives for cost reduction
- Can lead to Ramsey pricing

- **Disadvantages**

- Inefficient pricing between adjustment periods
- Upward rigidity of prices can lead to under-investment and non-price rationing under uncertainty (Dobbs, 2004).
Can obligation-to-serve overcome this problem?

Reserve 5: Price Index Approach (Under Vertical Separation)

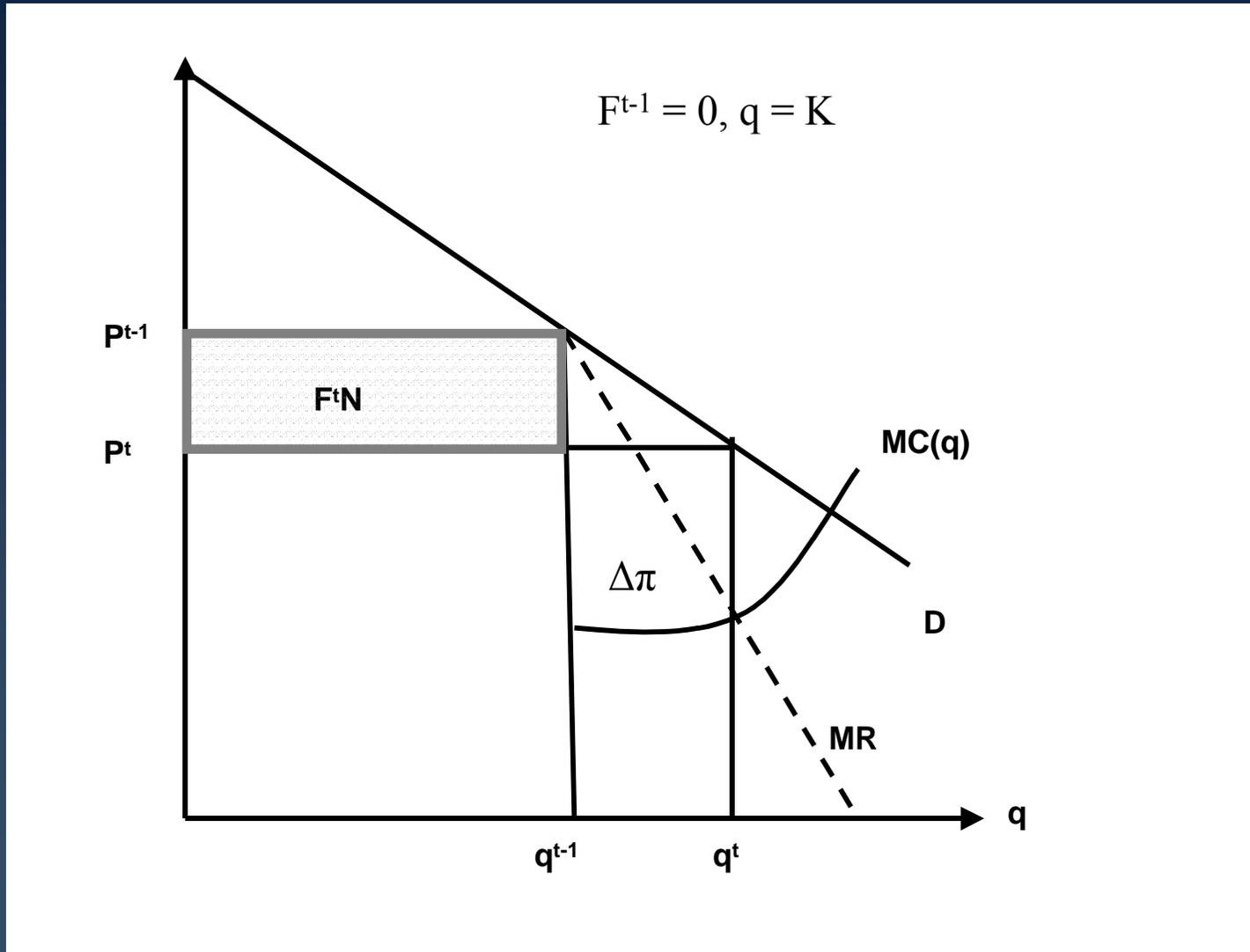
Two-part tariffs defined as a price index of variable and fixed fees

- **Variable fees: Utilization**
 - Congestion
 - Peak-load pricing
- **Fixed fees: Capacity expansion**
 - Truly fixed fees
 - Discriminatory and partly variable: Access charges
 - Compensating adjustments for fluctuating variable fees

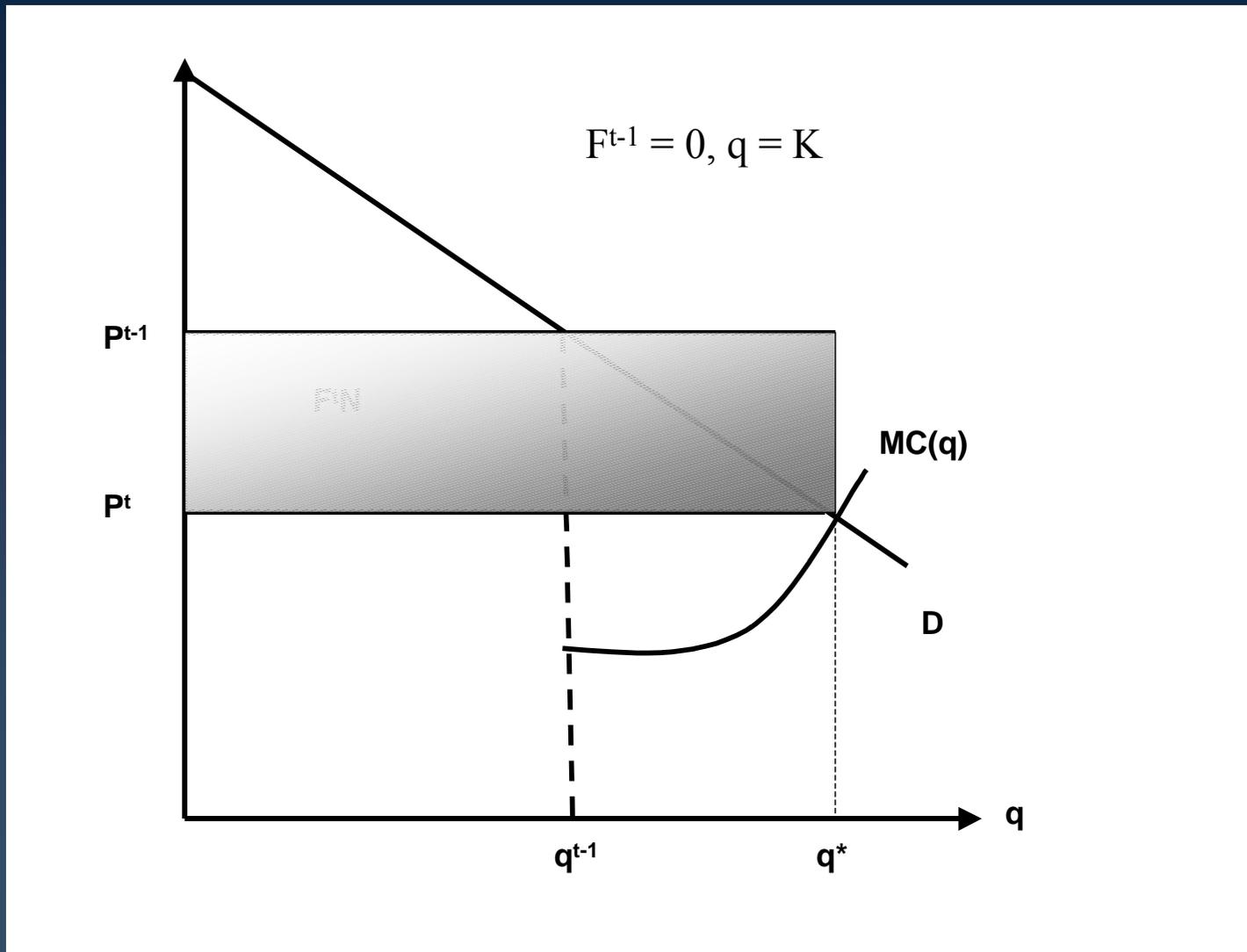
Weights of the price-cap index

- Quantities of the previous period (chained Laspeyres price index)
- Projected quantities (idealized weights)
- Average of Laspeyres and Paasche

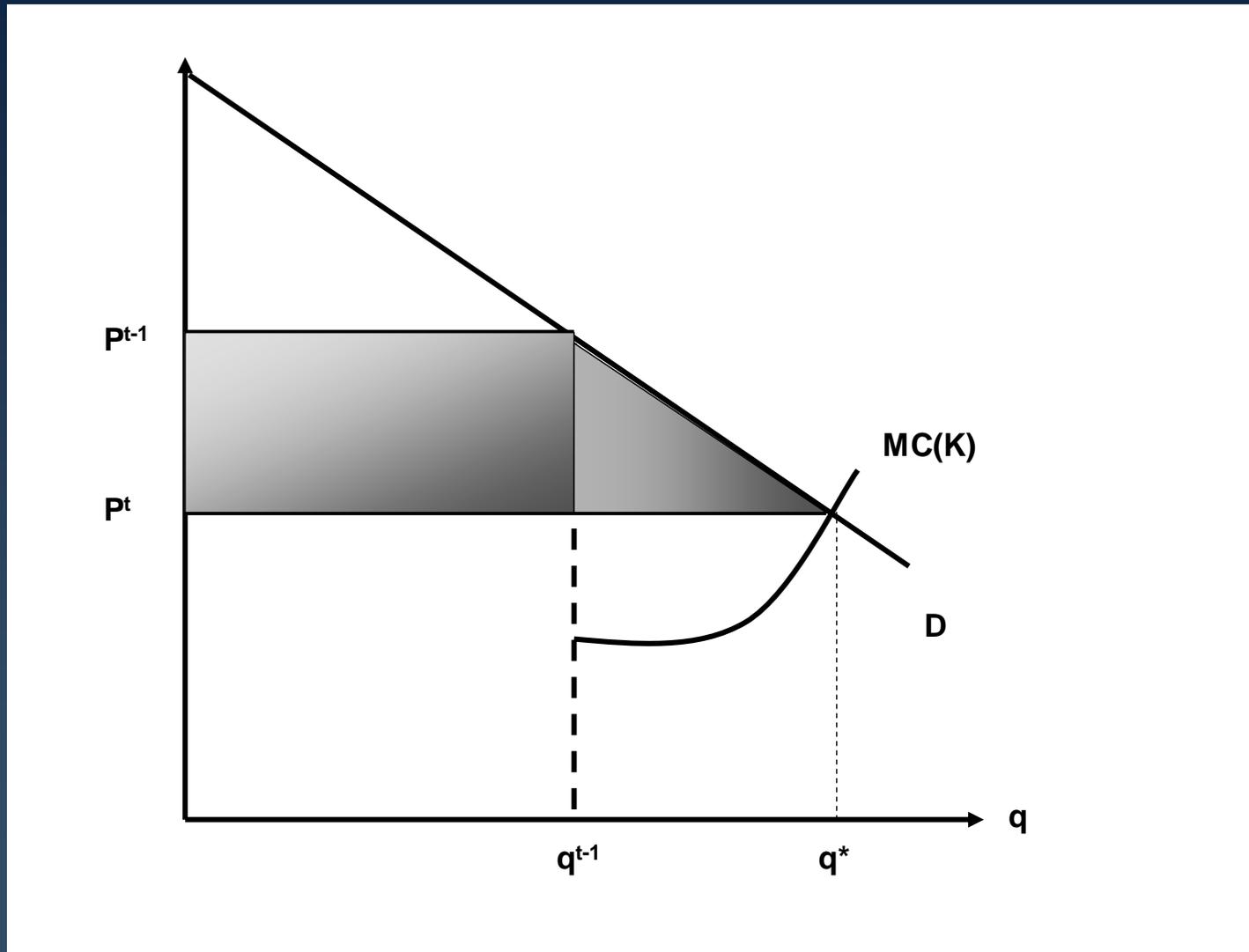
Reserve 6: Price Cap with Laspeyres Index: $q^w = q^{t-1}$



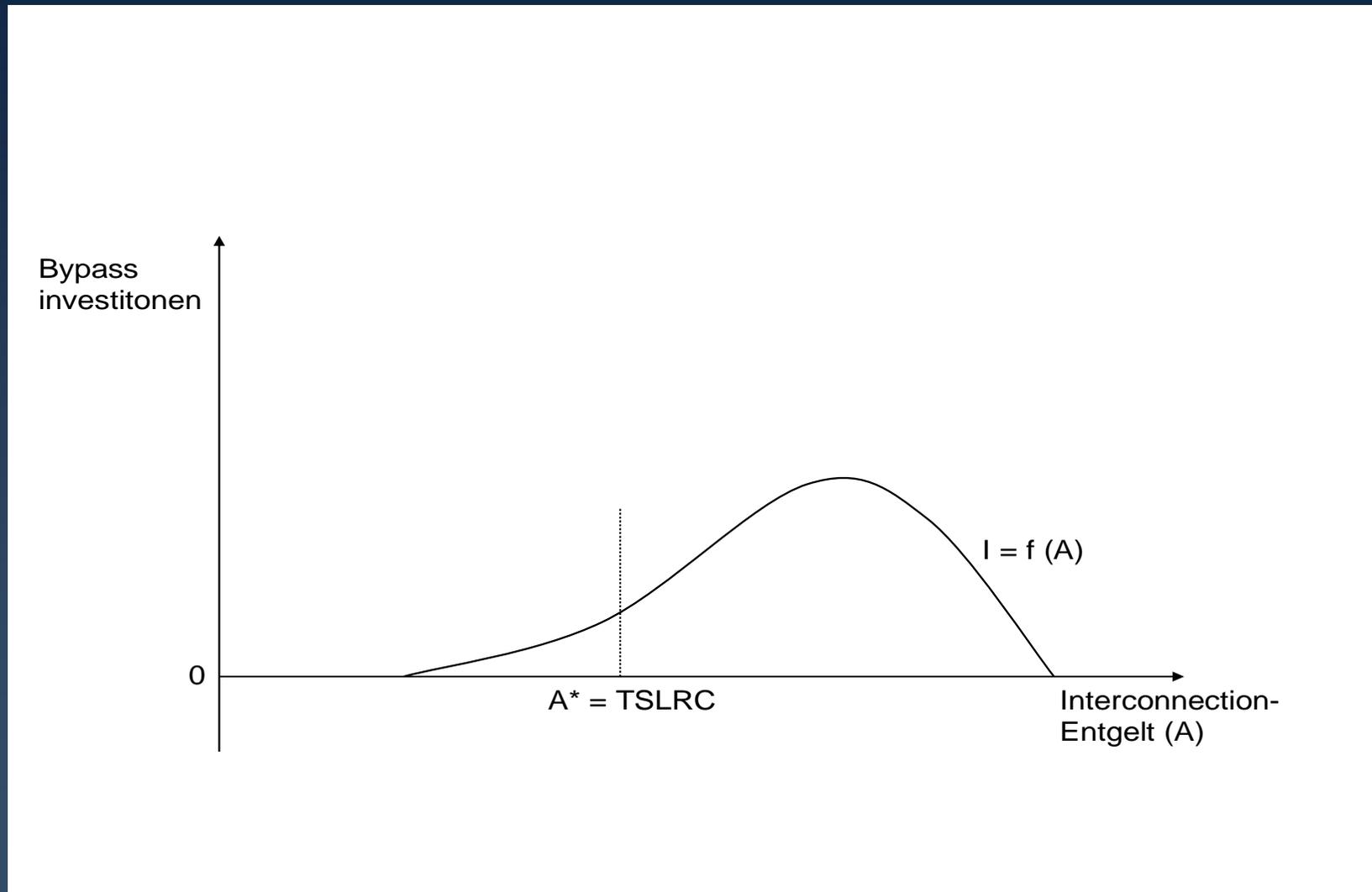
Reserve 7: Price Cap with Idealized Weights ($q^w = q^*$)



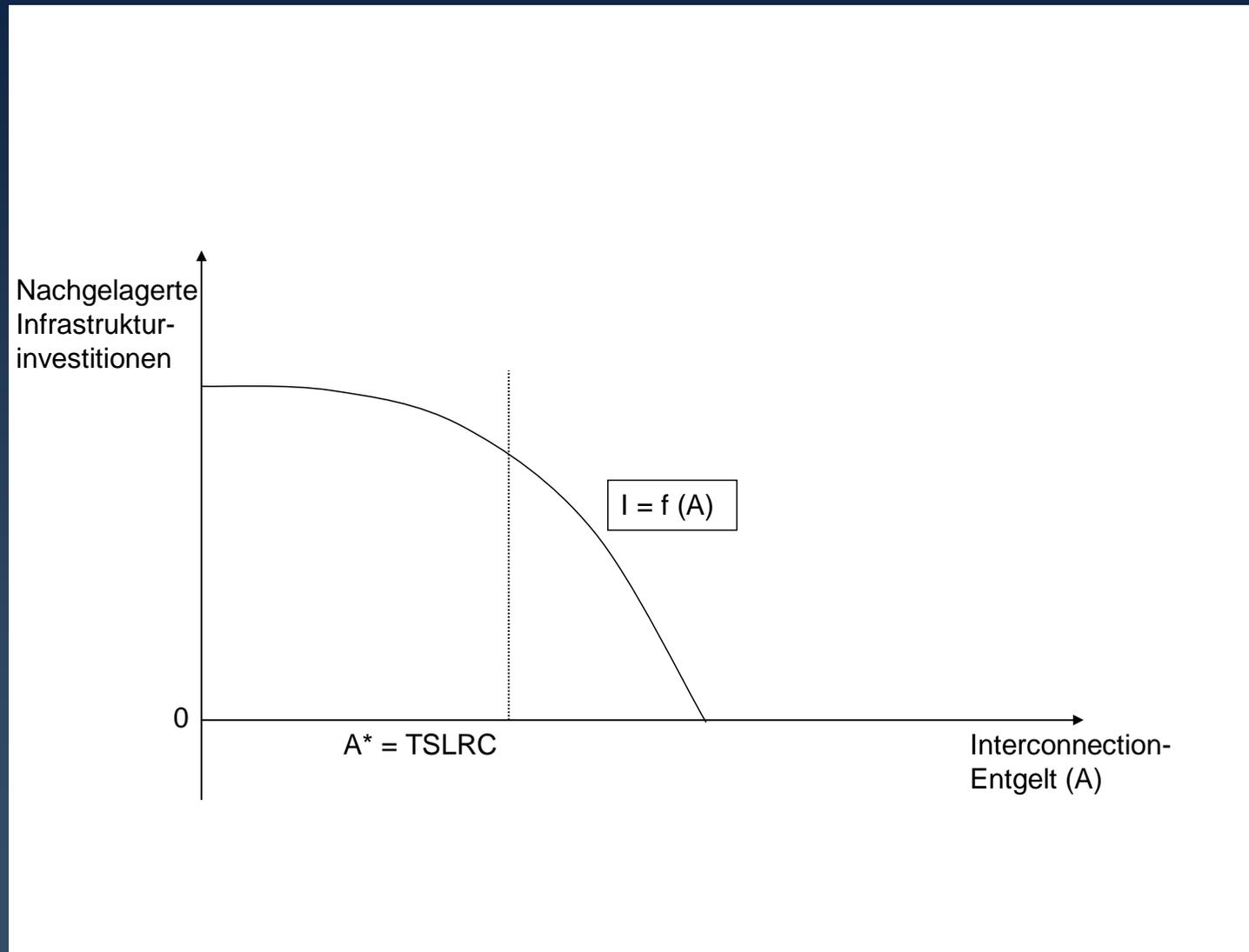
Reserve 8: Price Cap with Averaged Laspeyres/Paasche Weights



Reserve 9: Bypass Investments as a Function of Interconnection Prices



Reserve 10: Downstream Infrastructure Investments as a Function of Interconnection Prices



Reserve 11: Regulatory Governance for Efficient Investment

Regulatory governance aspects relevant for investment

- **Safeguards against arbitrary changes**
 - **Due process**
 - **Contents**
- **Predictable criteria for regulation and deregulation**
- **Independence (credibility)**
- **Private ownership of incumbent**
- **Appropriate incentive structures**
 - **Fairness**
 - **Term structure of commitments: Time horizon of regulatory decisions**

