

**Regulation incentives for investment
and technological change**

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**Tenth ACCC Regulatory Conference
The regulation of infrastructure in a time of
transition**

Surfers Paradise, July 30, 2009

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**My first infrastructure experience in Queensland:
1970**



Blair Athol: Attempt to back investments in mine, railroad and port
through long-term contracts with overseas customers

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What became of it



I do not know if the long-term contracts achieved this result.

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An old, but timely regulatory problem

- When I started working on regulation in the 1970s the main problem tackled by economists was that of regulatory incentives for excessive investment under rate-of-return regulation (Averch-Johnson effect).
- 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- Rate-of-return regulation has been replaced by incentive regulation with an emphasis on cost reduction and efficient pricing.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?
- Contested German telecommunications law provides a regulatory holiday for innovative investment as does current practice of the FCC.

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Overview

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

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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)
 - Fibre networks in the late 1990s: Race to be first → overcapacity
- **Tradeoff: Investment benefits are potentially high relative to benefits from efficient pricing.**

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Different types of investment may be affected differently by regulation

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

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Regulation and investment

- **Regulation can have ambivalent investment effects**
 - Facilitates race for investment between incumbent and entrants (less cannibalization problem)
 - Lowers expected investment returns; increases or decreases risks
 - Truncation of investment outcomes
 - Price constraints
 - Risk shifting
 - Increased WACC
 - Lack of commitment
- **Effects are result of incentives and governance. We concentrate on**
 - 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 lowering expected returns and affecting investment risk
 - (Lack of) regulatory commitment as regulatory governance variable
 - Regulators want investment (in fact, too much so!)
 - Regulators also want low prices
 - Ex post conflict with ex ante desire

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My approach to regulation and investment

- The literature on the relationship between regulation, investments and innovation suggests many different case-specific outcomes (for example, Gans and King on access holidays). Keeping the cases apart and deriving case-specific regulations is highly information-intensive and may be subject to moral hazard and adverse selection on the side of the regulators.
- I have dealt with regulators in a number of countries and have again and again been impressed by their knowledge, skills and ethics. Nevertheless, there are things that regulators cannot and probably should not do. Among them is taking responsibility for infrastructure investment decisions and for innovations.
- My approach is to use simple economics for extracting some fairly general properties and to come up with a few rough-and-ready rules. They may do injustice to the individual case but are more likely to be feasible for implementation and less subject to commitment problems than more specific case-dependent rules.

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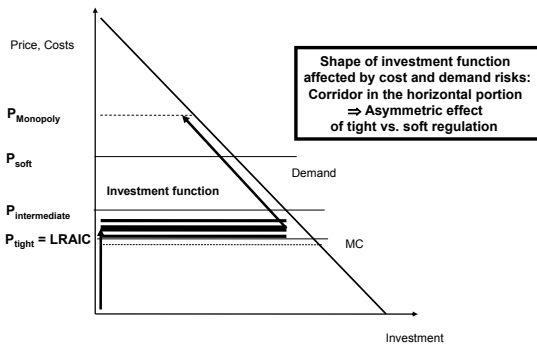
Two types of infrastructure investment and two types of regulation

- **Investment**
 - **Bottleneck**
 - Legacy and innovative infrastructures of incumbent
 - Bypass infrastructure
 - Ladder-of-investment aspect (Cave)
 - Replacement effect (Burreau and Dogan, Hori and Mizuno)
 - **Downstream/upstream of bottleneck**
 - Incumbent infrastructure
 - Competitors' infrastructure
 - Access-related infrastructure
- **Regulation**
 - **Bottleneck**
 - **End-user**

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A simplified view of infrastructure investment as a function of price: Soft vs. tight regulation



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Effects of tightness of bottleneck regulation on infrastructure investment in absence of retail regulation

Investment Type	Incumbent Bottleneck	Competitive Bypass (Make or Buy) ^{*)}	Incumbent Downstream	Competitive Downstream
tight	-(+)	- Sappington: 0	-(+)	+
intermediate	+	0 Sappington: 0	+	0
soft	+(-)	+(-) Sappington: 0	+(-)	-

13 ^{*)} Competitors tend to have higher cost for bypass investment.

Effects of tightness of end-user regulation on infrastructure investment

Investment Type	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 bottleneck regulation can increase price-squeeze problem.
 - Assessment in line with view that end-user markets should be deregulated first.

How can soft regulation provide efficiency incentives?

- Profit-sharing regulation
 - Soft definition of (excess) profit: Preserves incentives
 - Soft = more sharing → rate-of-return regulation: Reduces incentives
 - Soft = asymmetric in favor of firm → distortions (?)
- Price-cap regulation
 - Cost-reducing incentives largely independent of price-cap level
 - End-user regulation: Allocative inefficiency balanced by competitive pressure
 - Bottleneck regulation: Reduced downstream competition balanced by bypass incentives
- Regulation based on analytical cost model
 - Intrinsic efficiency incentive if model independent of incumbent's costs
 - Soft regulation via built-in rate of return (more than risk surcharge?)
 - Uncertainty from replacement cost approach (Evans, Guthrie)
- Benchmarking (Yardstick)
 - Allow pre-set distance from efficiency frontier
 - Base on \emptyset rather than frontier
- Bayesian regulation: Allow for positive profit at participation constraint → Similar incentives but higher expected profits

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How can soft/intermediate regulation be implemented?

- Soft/intermediate regulation may require regulatory discretion: Commitment problem treated later
- Verifiable criteria hard to come by
- Two-step procedure (soft/intermediate \approx light regulation = step in direction of deregulation)
 - Step 1: Establish and apply criteria for applicability of tight vs. soft/intermediate regulation
 - Step 2: Choose specific type of soft/intermediate regulation
 - Ex post regulation
 - Apply competition law criteria (German Telecommunications Act of 2003)
 - Efficient Component Pricing Rule (ECPR)
 - Use pricing approach where clear differentiation of criteria is possible (e.g., benchmarking)
- Choice of pro-industry regulator (Evans, Levine and Trillas)

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Ordinary investments vs. innovative investments

- Ordinary investments: Legacy infrastructure
 - Known costs: LRAIC applicable
 - Known demands: LRAIC predictable
 - Nevertheless, some problem of sunk costs → surcharge for real options?
 - Unbundling and competitive network access feasible → downstream competition + downstream deregulation
- Innovative investments: New type of infrastructure
 - Costs highly uncertain
 - Risk of low penetration
 - Low capacity utilization → high average costs
 - Penetration pricing problem
 - Unbundling and access regulation inherently difficult
 - More likely case of symmetry between market players → possible race for investment

⇒ • Innovative investments as case for deregulation?

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Properties of regulation

Properties of regulation	Advantages	Drawbacks
• Ex ante remedies	• Immediacy, precision, dependability, prevention	• Reduction of freedom to compete, too much intervention
• Specialized agency	• Specialized knowledge, speed of intervention	• Influence of interest groups, (too little or) too much intervention
• Prescriptive intervention (affirmative duties) <ul style="list-style-type: none"> • Pricing • Quality 	• Strong influence on desired behavior, precision	• Reduction of freedom to compete, inefficient prescriptions because of asymmetric information; too much intervention

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Inappropriateness of general competition law

Property of competition law	Competition law inappropriate if...	Relevant for...
• Requirement to show violation	• Large, irreparable damages • Difficult to prove abuses, e.g. Denial of access hidden by slowing down negotiations • Frequent and repeated abuses	• Access to monopolistic bottlenecks • Predation against competitors
• Inability to set prices	• Lack of comparable markets • Economies of scale and scope • Long duration of intervention in a changing environment	• Access to monopolistic bottlenecks • Market dominance in access market • Monopoly in end-user market
• Inability of supervision	• Considerable information requirements • Continuous supervision requirements	• Access requirements • Price regulation

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Investment and technological change

- **Choice between sector-specific regulation and general competition policy involves tradeoffs.**
 - Advantages of regulation and disadvantages of competition policy less relevant if the alternative is no/insufficient innovation
 - Advantage from specialized regulatory agency may not hold in Australia.
- **Two arguments for deregulation of or regulatory holidays for innovative infrastructure:**
 - Patent argument: You get more innovation, and that is more valuable than the potential deadweight loss from monopoly pricing.
 - Error argument: Regulation of innovative infrastructure is inherently more complicated than regulation of legacy infrastructure. Also, potential benefits from innovation are much higher than benefits from regulation. The error from false and distorting regulation is therefore more likely and more severe than in the case of legacy infrastructure.
- **How to distinguish ordinary and innovative investments?**
 - The notion of "emerging markets" under the EU communications framework takes an extremely narrow view of innovations ("Three-criteria test cannot be applied.")
 - Weaker concept: Creation of new market

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Incentive regulation and investment: The role of commitment

- **Inability to commit**
 - Legal constraints on commitment
 - Change in regulatory personnel
 - Impossibility of complete contracts
- **Sub-optimality of commitment**
 - Value of flexibility in a changing environment: Learn from mistakes
 - Inability under commitment to adapt to new situation
- **Lack of commitment**
 - Exogenous – Change in outside variables: Inflation, political elections
 - Endogenous – Change in regulatory variables: Profit, investments (Grajek/Roeller)
 - Potential drivers for the effects of lack of commitment: Efficiency, fairness, political influence

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Relationships between investment and commitment

- **Commitment can be good for investment:**
 - Provides a reliable basis, overcomes dynamic inconsistency
 - Prevents ex post bias against profits
 - Particularly relevant for infrastructure innovations with potential for high profits or high losses
 - Example: Symmetric profit and loss sharing can overcome the regulatory truncation problem. However, loss sharing cannot fully insure the firm (because consumers can opt out).
 - Relevant for cost-reducing incentives that potentially increase profits
- **Lack of commitment can be good for investment**
 - The effects of lack of commitment depend on political/legal environment ("institutional endowment"). In a culture of symmetric fairness regulated firms may be shielded against large losses.
 - Lack of commitment can deal with unexpected technological/market changes and can correct mistakes.
- **Commitment needs balancing with sensible flexibility/incentives**

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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 is in doubt

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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
 - Length of long-term contracts
 - Almost full commitment feasible inside a long period
- **Beyond the long period**
 - Infrastructure investments go beyond several long periods
 - Only very basic regulatory commitment possible beyond a long period
 - Little or no cost-reducing regulatory incentives feasible beyond a long period

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Tightness of regulation and the two-period framework

- **Too soft regulation likely to lead to excess profits over time → Reduces length of commitment period**
- **Too 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**
- **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
 - However: *How can regulators commit to “intermediate regulation” in the first place?*

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Examples of intermediate regulation with some commitment

- In the U.S. rate-of-return regulation has provided strong commitment for many decades (with allowed rate of return \geq cost of capital; Evans/Garber).
- 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
 - Gilbert/Newbery: Efficient approach
- Rate-of-return regulation need only be applied to RPI-X updates or to other incentive-regulation updates. → Some incentives and flexibility
- Use of historic cost standards to reduce investment risks (with downward flexibility through price caps)?

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Examples of intermediate regulation with some commitment

- LRAIC/TELRIC approach to access pricing has provided a credible cost standard
 - LRAIC >> Marginal costs
 - LRAIC/TELRIC follow progress in state-of-the-art risk evaluation
 - Inclusion of input price changes (Mandy/Sharkey)
 - Inclusion of real options in WACC (Hausman; Pindyck)?
 - Adjustment of rate base for excess capacity (Evans, Guthrie)?
 - Problem with forward-looking approach: Takes new technology as given

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Examples of intermediate regulation with some commitment

- 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
 - Unless they provide incumbent with an insurmountable lead
 - Regulatory holidays could be combined with intermediate regulation after holidays expire. Combination of intermediate regulation with regulatory holidays could spur investment.
 - Verifiable standards for regulatory holidays needed
 - Example: Non-applicability of EU communications framework three-criteria test

^{*)} Peruvian regulator Thornberry: What is that? I have not had a holiday in 2 ½ years!

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Other solutions to the commitment problem

- **Basic question: To what extent does regulation of infrastructure access change the overall risk of innovative infrastructure investments (rather than only its distribution)? Applicability of Modigliani-Miller theorem?**
- **Infrastructure sharing between incumbent and access seekers**
 - Infrastructure sharing commitments can cover the investment period.
 - Genuine risk sharing ex ante
 - Reduces ex ante (first-mover) competition
 - More or less competition ex post?
 - Complex transaction with monitoring and collusion problems
- **Long-term contracts (ex ante) between incumbent and access seekers**
 - Mandated short-term access = risk-free options for access seekers → long-term contracts desirable or surcharge for short-term access
 - Long-term supply contracts probably cannot cover the investment period.

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Other solutions to the commitment problem

- **Deregulation of innovations and particularly risky infrastructure investments**
 - Problem of criteria for such deregulation (≈ regulatory holiday)
 - Sunset clauses raise commitment issues.
 - No credible commitment against re-regulation. However, long lag is likely.
- **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 by proponents to have increased fiber deployment

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Other solutions to the commitment problem

- **Repair models for insufficient investments under regulation**
 - Widespread universal service subsidies in telecommunications; now under discussion for broadband access
 - 2009 stimulus packages for broadband access in several countries
 - 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 electricity generation spot pricing

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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**
- **Intermediate regulation enhances commitment ability but requires commitment itself**
 - Rate-of-return regulation applied to incentive-regulation updates
 - Fairly general applicability, except for genuine innovations
 - LRAIC/TELRIC with state-of-the-art adaptations for risk surcharges
 - Weaker investment incentives, higher cost-reducing incentives than rate-of-return regulation
 - Regulatory holidays
 - Only applicable to innovative/high-risk investments

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Conclusions

- **The best balance of commitment and flexibility/incentives depends on a country's institutional endowment, for example on its due process rules (North, Levy/Spiller)**
- **Genuine innovations should not be regulated**
 - Strict and verifiable standards needed for deregulation and regulatory holidays
- **Under weaker criteria innovative infrastructure should be regulated lightly**
 - Example for weak criteria: first applicability of EU communications framework three-criteria test
 - Threat of (light-handed) regulation may not be credible (Haucap et al.)
 - Examples for light regulation
 - Ex-post approach
 - Applying competition policy standards
 - *Anything else that Steve Littlechild will talk about in the next session*

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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

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Reserve 2: 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

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Reserve 3: 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?

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Reserve 4: 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 fairly stable and thereby allows for financing of investment and increases regulatory commitment.
- Two-part tariffs can reduce price truncation problem under uncertain demand.
- Price-cap weights substantially affect marginal price and average revenue (revenue/usage quantity)
- At wholesale level two-part tariffs have economies-of-scale effects that can distort competition (e.g., under imputation, compared to the incumbent)
- One-off charges not as flexible as two-part tariffs, but can reduce financing problems.

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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

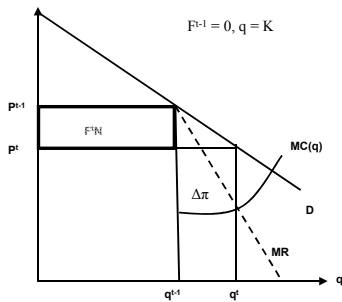
Weights of the price-cap index

- Quantities of the previous period (chained Laspeyres price index)
- Projected quantities (idealized weights)
- Average of Laspeyres and Paasche (\approx ISS; Sappington/Sibley)

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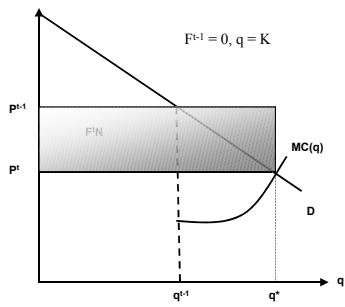
Reserve 6: Price cap with Laspeyres index: $q^w = q^{t-1}$



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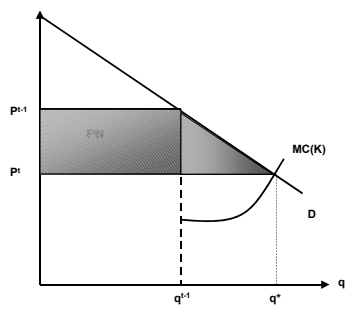
Reserve 7: Price cap with idealized weights ($q^w = q^*$)



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Reserve 8: Price cap with averaged Laspeyres/Pasche weights



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