The Tension between Incentive Regulation and Investments in Network Industries

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Introduction

Network industries face non-trivial investment challenges, due to lumpiness and sunkness of capacity additions. These factors make investments particularly risky, something that has become more obvious in recent years, as former monopoly markets have been opened to competition. This opening has gone along with two main regulatory changes affecting investments. First, public ownership and rate-of-return regulation have been replaced by private ownership and incentive regulation. Second, the focus of regulation has moved from end-user services to wholesale access of new competitors to the bottleneck infrastructure (essential facilities) of the incumbents. This regulatory restructuring has added competitive and regulatory risks to the demand and cost risks that already existed under monopolies. In the US the dominant view until well into the 1980s was that the prevailing rate-of-return regulation led to excessive investments and too high prices. Its replacement by incentive regulation and competition was seen as a correction towards more efficient prices, costs and investments. More recently, however, incentive regulation has been accused of leading to too little investment from a welfare perspective.

A careful reading of the theoretical literature on the relationship between regulation and investment shows that both under rate-of-return regulation and under incentive regulation the investment effects depend heavily on the way each type of regulation is handled in practice.[1] Quite generally, tight regulation that runs a substantial risk of failing to cover the firm's costs will lead to suboptimal investment levels, usually below those realized by unconstrained monopolists. Excessive investments under rate-of-return regulation only occur for rates of return above the cost of capital and below the unconstrained monopoly return. Softening incentive regulation at some point leads to investments above the unconstrained monopoly levels, but it usually stays below the welfare optimum (which may therefore not be reachable in practice). Early empirical work on the relationship between telecommunications infrastructure investment and rate-of-return vs. incentive regulation found investments under incentive regulation to be higher (Greenstein, McMaster and Spiller 1995; Ai and Sappington 2002). Newer work on telecommunications mostly shows investments to be negatively influenced by regulation, but Cambini and Rondi (2010) estimate that in European gas and electricity markets incentive regulation leads to higher investment than rate-of-return regulation.

By enabling competitor access to bottleneck facilities of incumbents, wholesale access regulation increases the feasibility of competition that makes end-user regulation superfluous. The network investments affected by regulated access prices can concern bottlenecks or complementary infrastructure downstream or upstream of the bottleneck. In both cases the investor can either be the regulated incumbent or unregulated competitors. The term "bottleneck" is used in the sense of an essential facility, which is a necessary input (fixed proportions) that is owned by an incumbent and cannot be duplicated economically by potential entrants (natural monopoly property). Examples of such bottlenecks include electricity transmission and distribution networks that are necessary for competing electricity generators to reach potential customers. They also include local loops in fixed telephone networks that local and long-distance carriers need in order to originate and terminate calls.

To the extent that competition-enhancing access regulation is successful it may increase investment by alternative competitors at the expense of the incumbent. Total investment may thereby diminish or increase depending on which effect is larger.

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[1] See Vogelsang (2010) for a short literature review. A more extensive literature review is provided by Cambini and Jiang (2009).

Effects of regulation on investment developed in the literature

The concern of the literature on the relationship between wholesale access regulation and bottleneck investment is predominantly with access prices based on "Long-Run Average Incremental Cost" (LRAIC).[2] Opponents of LRAIC argue that access prices (and prices for unbundled network elements) that do not cover all costs of investment would stifle investments. Proponents of the LRAIC approach argue that by definition this cost concept includes all costs of expansion investments in new infrastructure. Thus, any shortfall in (expected) coverage of investment costs would have to come from cost measurement errors or mistakes in the underlying models. Potential errors particularly concern modeling of the cost of capital with sunk costs and uncertainty. Thus, the claim that access regulation leads to lower bottleneck investments is again based on the way the regulation is handled.

A second large part of the access-related literature addresses the incentive effects of wholesale access obligations and their prices on competitors' investments. It specifically centers on the stepping-stone or ladder-of-investment hypothesis (described and justified in Cave 2006), which claims that entry by alternative providers in a market dominated by an incumbent is hindered by the necessity to acquire assets with a range of bottleneck properties. As time goes by, as entrants learn and as they grow in size (thereby availing themselves of economies of scale), they can climb an investment ladder with increasing bottleneck properties. In anticipation of that development the regulator should, according to this approach, begin by forcing the incumbent to make all bottleneck inputs available at attractive prices thereby enabling entry. However, the regulator should, in addition, commit to reducing the attractiveness of regulated access over time, beginning with inputs with fewer bottleneck properties. This is meant to increase incentives for alternative providers to actually invest in assets with increasing bottleneck properties because regulated access becomes less and less attractive.

The ladder-of-investment hypothesis has been embraced by European telecommunications regulators but has been criticized in the literature. Bourreau and Doğan (2006) point out that with increasing availability of alternative or bypass infrastructure the incumbent would voluntarily provide bottleneck access at attractive terms for the alternative competitors, thereby retarding bypass. Thus, instead of increasing regulated access prices as bypass becomes more and more available, the regulator should prohibit unbundled access, once bypass becomes economical because otherwise bypass would come too late. However, a major problem with both the ladder-of-investment approach and the Bourreau and Doğan suggestion is that the regulator will generally not know, when and where bypass is sufficiently feasible.

The ladder-of-investment approach assumes that bypass investments use the legacy technology of the incumbent. In reality, however, bypass usually occurs through a new technology or improvement of another technology that is different from the legacy infrastructure of the incumbent. Examples of the former could be fiber access close to the home, through which the bypass opportunities may deteriorate. An example of the latter is a cable TV network that competes with the telephone/DSL network of the incumbent and of entrants using the incumbent's technology. The ladder-of-investment approach does not work here because (a) the entrants cannot effectively duplicate the incumbent's local loops and (b) the cable TV company investments may be jeopardized by any boost given to the incumbent by selling access to the entrants (Pindyck 2007).

Overall, the working of the ladder-of-investment approach appears to be strongly depending on the circumstances of the industry as well as on the way it is implemented by the regulator.

In contrast to the ladder-of-investment hypothesis our interest is in investment by both incumbent and entrants. Thus, access prices as a single instrument have to fulfill two objectives. To the extent that the two objectives do not run parallel, compromises have to be reached.[3] In particular, initially low access charges for access to strong bottlenecks may prevent investments by the incumbent because those bottlenecks usually are particularly sunk. Accordingly, for such sunk bottleneck access the risk of bypass would justify initial surcharges on conventional LRAIC calculations but

[2] LRAIC are usually measured in analytical cost models and are therefore independent of the firm's actual costs. While in addition price caps, yardstick regulation and the efficient component pricing rule (ECPR) have been used or suggested for bottleneck pricing, there appears to be little specific literature linking them to bottleneck investment.

[3] In practice, investment is often pursued by regulators as a separate objective with separate instruments. For more on such "repair models", see Vogelsang (2010).

these would no longer be feasible, once bypass occurs, thus leading to a declining path of access prices, contrary to the ladder of investment.

The case for intermediate regulation

We now present simple arguments for the relationships between bottleneck access prices and (a) incumbent's bottleneck investments, (b) entrants' bottleneck bypass investments and (c) entrants' investments upstream/downstream of the bottleneck.

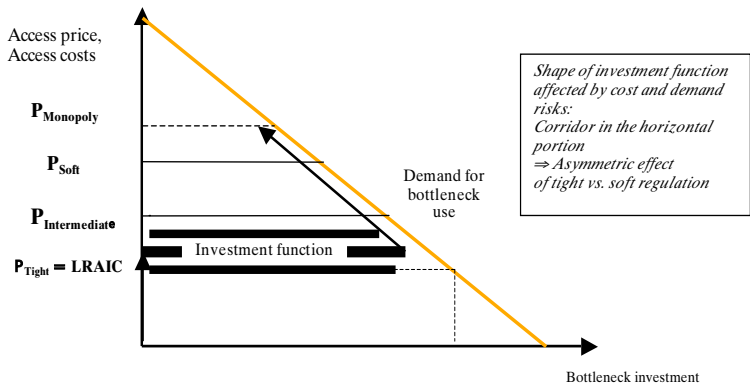
Consider first the relationship between the regulated (bottleneck) price and the incumbent's infrastructure investment, as depicted in Figure 1. The simplified view illustrated by the investment function (correspondence) combines two constraints on investment. The first constraint is that the firm will only invest if it expects to cover its costs. Thus, the regulated price has to exceed average costs, as perceived by the firm (and by its sources of finance). The second constraint arises due to the quantity demanded at the regulated price. Under certainty about costs the investment will equal the demanded quantity at regulated prices between p_{Tight} and $p_{Monopoly}$. Above $p_{Monopoly}$ the investment would stay constant because the regulatory price constraint would no longer be binding. Under uncertainty of the regulator (and possibly the regulated firm) about costs there would be a range of prices, at which the firm would only invest with some probability. Assume, for example, that average costs (AC) are evenly distributed between AC_{min} and AC_{max}. In this case, the regulator can only be sure of the investment at price $p = AC_{max}$. Weighted by its probability the expected amount of investment will therefore increase within some range between $p = AC_{min}$ and $p = AC_{max}$ and decline thereafter (until $p_{Monopoly}$).[4]

Assuming that the regulated firm takes the regulated price as given, the supply function for investment in Figure 1 will be affected by cost and demand risks. In particular, the risk results in a thick corridor in the horizontal portion. This leads to asymmetric effects of tight vs. soft regulation. Tight regulation can potentially lead to high investment, due to the implied large demanded quantity. However, it could also lead to zero investment if the regulated firm (or the capital market) views the investment as being too risky at that price. In contrast, a price increase to the level of soft regulation implies no regulatory risk (under full commitment), but leads (most certainly) to a fairly small investment. Intermediate regulation leads to substantially higher investment that can also be virtually assured. The view exposed in this argumentation contrasts with most of the literature, which largely neglects any demand-side effects from lower prices.

The regulatory restructuring is based on the premise that regulation can assist new technical and market developments in abolishing or reducing bottlenecks over time. Figure 2 provides a stylized supply function for the bypass investments of entrants as a function of the bottleneck access price. The function is mainly driven by the relationship between the bottleneck access price and the costs of bypass represented by the range of bold horizontal lines. If the access price is below the cost range there is going to be little or no bypass. Bypass will increase with increasing access prices within the range of bypass costs because bypass becomes cheaper relative to the alternative of bottleneck access.[5] This happens even if bottle-

Figure 1

A Simplified View of the Incumbent's Bottleneck Investment as a Function of Price: Soft vs. Tight Regulation



[4] Depending on the regulator's risk aversion it now becomes optimal for the regulator to choose a regulated price that assures investment with a high probability. If the regulator is not risk-averse and maximizes expected consumer surplus E(V(p)) for cost distribution F(AC) with density f(AC), then $dE(V)/dp = f(p)V(p) - F(p)q(p)$, implying a f.o.c. $f(p)/F(p) = q(p)/V(p)$.

[5] In contrast, Sappington (2005) argues that tight regulation is accompanied by aggressive downstream competition, while soft regulation would be accompanied by more collusive behaviour. As a result, in Sappington's model the alternative competitors will only invest in bottleneck bypass if they can do so more cheaply than the incumbent and that will be independent of the regulated bottleneck access charge. Mandy (2009), however, finds that input prices generally matter for the efficient make-or-buy decision.

Figure 2

A Simplified View of the Entrants' Bypass Investment as a Function of Bottleneck Access Price: Soft vs. Tight Regulation

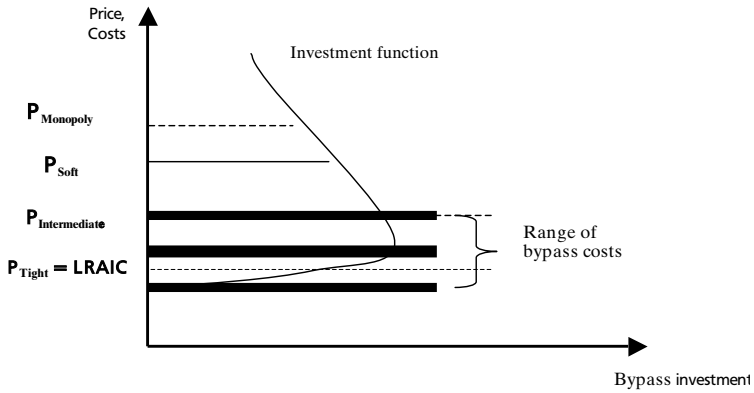
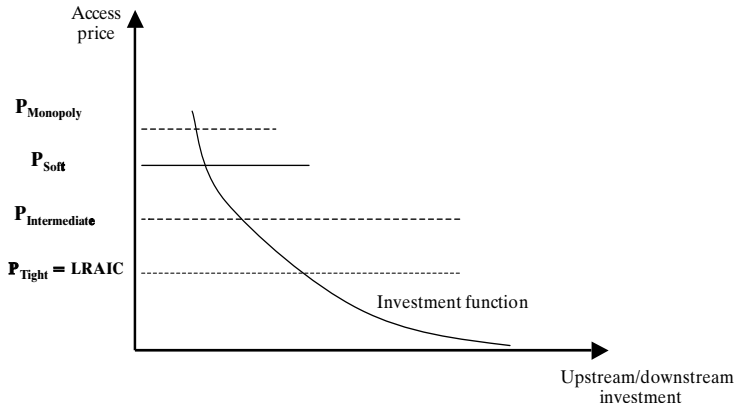


Figure 3

A Simplified View of the Entrants' Upstream/Downstream Investment as a Function of Bottleneck Access Price: Soft vs. Tight Regulation



neck access is slightly cheaper. Bypass provides the entrants with more and better quality options and more independence (however, more risks as well). Although the bottleneck access alternative becomes even less attractive at higher access prices, the entrants may have a hard time fully bypassing the incumbent's bottleneck and therefore bypass may decline with further access charge increases.

The next type of infrastructure concerns investments downstream or upstream of the bottleneck and is generally not regulated. In Figure 3 we are considering only the alternative competitors' infrastructure which by assumption is no bottleneck.[6] At low access prices entrants will have low overall costs and expand, leading to high upstream/downstream investments. At high access prices overall costs of entrants will be higher in absolute terms and relative to those of the incumbent. In spite of some bypass, entrants will lose market share and the total market quantity will be lower.

Implementation issues

With the exception of entrants' upstream/downstream investments, intermediate or even soft regulation is likely to provide better investment incentives than tight regulation. Incentive regulation, however, seems to call for a tight approach. How then can soft/intermediate regulation provide efficiency incentives?

Assuming that firms maximize profits and therefore fully respond to incentives instead of incurring X-inefficiency there should be no tension between intermediate/soft regulation and strong productivity incentives. For example, soft price-cap regulation means a higher cap than under tight regulation. Generally, the cost-reducing incentives are deemed largely independent of the price-cap level so that incentives would be preserved. In contrast, investment incentives would be increased.

However, how can intermediate regulation be implemented? Criteria for tight regulation are usually quite precise and can be framed in regulatory rules/laws. In contrast, soft/intermediate regulation may require regulatory discretion.[7] Verifiable criteria for "intermediate" are hard to come by.

As an example of intermediate regulation the German Telecommunications Act of 2003 contains a combination of ex post regulation and the application of competition law criteria. This approach gives the incumbent some flexibility because he/she does not have to get permission first before setting prices. At the same time, the criterion for regulatory intervention is not based on efficient costs (which are the criterion for

[6] We leave out upstream/downstream investments of incumbents.

[7] The commitment problem is treated below.

ex ante regulation in the same law) but rather on non-abusive prices.[8] A second proposal consists of a more explicit modeling of cost uncertainty for purposes of determining regulated prices. This includes the inclusion of real options but goes beyond by establishing cost ranges rather than just point estimates. Regulated prices could then be characterized as tight at the expected value of costs, as intermediate at one standard deviation above and as soft at two standard deviations above expected cost levels.[9] Benchmarking regulation based on averages rather than on frontier costs would be another example for intermediate regulation. This would be a pricing approach where clear differentiation of criteria is possible.

My reading from the empirical and theoretical literature is that, initially, the move from rate-of-return regulation to incentive regulation or from state-owned ("unregulated") to privatized incentive-regulated enterprises has involved quite soft regulation. This happened both because of inexperience and cautiousness of the regulators, who are afraid of service interruptions, and because of large potentials for efficiency improvements. After some time, this cautiousness and potential productivity improvements diminished and regulation became tighter. That may be the reason why Greenstein et al. (1995) and Ai and Sappington (2002) found positive relationships between the introduction of incentive regulation and investment. It may also be the reason why incumbents today complain about the lack of investment incentives. Cambini and Rondi (2010) estimate that softer incentive regulation (with lower x-factor and higher WACC) leads to higher investment. All this would suggest a return to "softer" regulation.

The issue of regulatory commitment

Regulatory commitment or the lack thereof is one of the most important features shaping the relationship between regulation and investment. One of the most interesting results in the new empirical literature on regulation and investment is therefore the finding by Grajek and Röller (2009) that regulators respond to increased infrastructure investments on the part of incumbents by tightening regulation. Anticipating this regulatory response, the incumbents will reduce investments from the very beginning.

How is the above discussion of the tightness of regulation affected by the issue of regulatory commitment? First, regulation that is too soft is likely to lead to excess profits over time. Because such profits tend to be unacceptable to the public and hence to regulators, they shorten the commitment period. Second, conversely, regulation that is too tight is likely to lead to losses over time. Losses are also unacceptable to regulators and therefore also shorten the commitment period. In contrast to both, intermediate regulation will less likely lead to either excessive profits or excessive losses and will therefore more likely be viable for longer periods than either soft or tight regulation. As a consequence, intermediate regulation enhances the commitment power and investment incentives.

As argued in Vogelsang (2010) the infeasibility of unlimited commitment requires a restriction of incentive regulation to time spans of 3–5 years.[10] Regulation then would have to be revisited under non-incentive criteria, such as rate-of-return regulation. This could be augmented by a used-and-useful criterion for including assets in the rate base. This may counter any Averch-Johnson type overcapitalization tendencies. According to Gilbert and Newbery (1994), it provides for an efficient approach to investing. At the same time, in the US, rate-of-return regulation represents a credible commitment because of Supreme Court decisions (in particular, the "Hope" decision of 1944[11]). Although the used-and-useful criterion has been subject to extensive court review there, it may introduce new regulatory uncertainties that could reduce investment incentives and increase the cost of capital (Baumol and Sidak 2002).

While at first blush this suggestion appears to be tailor-made for the US only, it has to be kept in mind that current updates of price-cap regulation outside the US also rely heavily on rate-of-return criteria (in the form of actual and permissible WACC).

Conclusions

There are two main regulatory concerns for investment in network industries. They are uncertainty and the lack of regulatory commitment over a long time horizon associated with investment. Both these concerns favor intermediate regulation. In addition, the

[8] Non-abusive prices include normal (workably-competitive) markups on the firm's actual costs (rather than prices equal efficient costs).
[9] Based on an error analysis, according to which the error of no investment weighs heavier than the error of too high prices.

[10] This time span may also be sufficient for spurring productivity-increasing investments that do not increase capacity.
[11] U.S. Supreme Court, Federal Power Commission v. HopeNatural Gas Co., 32D U.S. 591 (1944).

commitment issue favors a regulatory review cycle with true-ups based on actual costs and rate-of-return criteria.

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