



**NEW ZEALAND INSTITUTE FOR THE STUDY
OF COMPETITION AND REGULATION INC.**

Sunk Investment, Regulation and the Cost of Capital

**Prepared for the ISCR Seminar:
*Calculating the Cost of Capital: a revisionist approach***

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Outline

- Background
- Regulating for earlier (more) investment when the firm chooses the amount of its investment
- Regulating the incumbent when it is forced to supply
 - Traditional rate of return regulation
 - Incentive regulation
 - Stranding, investment in advance and the value of the regulated firm
- Conclusions



Background

- Infrastructure: high proportion of cost are *sunk*, equivalently much investment is *irreversible*
- Future infrastructure costs are uncertain
- Future demand/surplus (welfare) is uncertain
- Modern regulation seeks to facilitate competition



Regulation and the incumbent

- Regulation seeks to induce
 - The right timing (quantity of investment)
- Reasonable Regulation seeks :
 - Financial viability i.e.
 - expected net return from investment should not be negative
 - Lowest cost provision: rate base
 - Replacement cost or
 - Historical cost
- Incumbent firm may under regulation
 - A Choose the timing of investment, or
 - B Have its timing constrained (universal service)



Regulation A: firm is free to choose investment timing

- Applicable to an extent in all regulation: asymmetric information, eg maintenance
- In the environment of
 - Uncertainty about future total consumer and producer benefits
 - Uncertainty about future network costs
 - Irreversible investment
 - The regulator selecting historical or replacement cost rate base
 - An incumbent with no competition

we reach the following conclusions



Regulation A: firm free to choose

- Generally the regulator seeks earlier investment
- Variation in demand and cost really matter with irreversible investment
- Whether replacement cost or historical cost is desirable depends on the industry
 - Little variation in costs suggests preference for replacement cost
 - Much variation in cost, and cost declines associated with increased consumer benefits, suggest preference for historical cost
- The appropriate allowed rate of return is higher with replacement (vs. historical) cost regulation: higher than standard WACC
- Setting the allowed rate of return too low leads to very substantial reductions in consumer benefits as compared to setting it too high



Regulation B: firm forced to supply

- The firm has no options: must supply
- Future demand is uncertain (uncertain cost will also matter)
- Regulation
 - Seeks financial viability & lowest cost
 - May be Rate-of-Return or Incentive Regulation
- First case: reversible investment
Second case: irreversibility



How much “profit” is “reasonable”?

Required to supply: reversible

C1 “*Traditional*” regulation: revenue based on historical cost

Revenue Requirement = rate of return times cost at the beginning of the period

$$E_0[R_1] = (1 + r)P_0S_0 - P_0S_0 = rP_0S_0$$



How much “profit” is “reasonable”?

Required to supply: reversible

C2 “*Incentive*” regulation: revenue based on replacement cost

Revenue Requirement = rate of return times cost at the beginning of the period, adjusted for expected capital gain or loss over the period

$$\begin{aligned} E_0[R_1] &= (1 + r)P_0S_0 - E_0[P_1S_0] \\ &= rP_0S_0 + P_0S_0 - E_0[P_1S_0] \end{aligned}$$



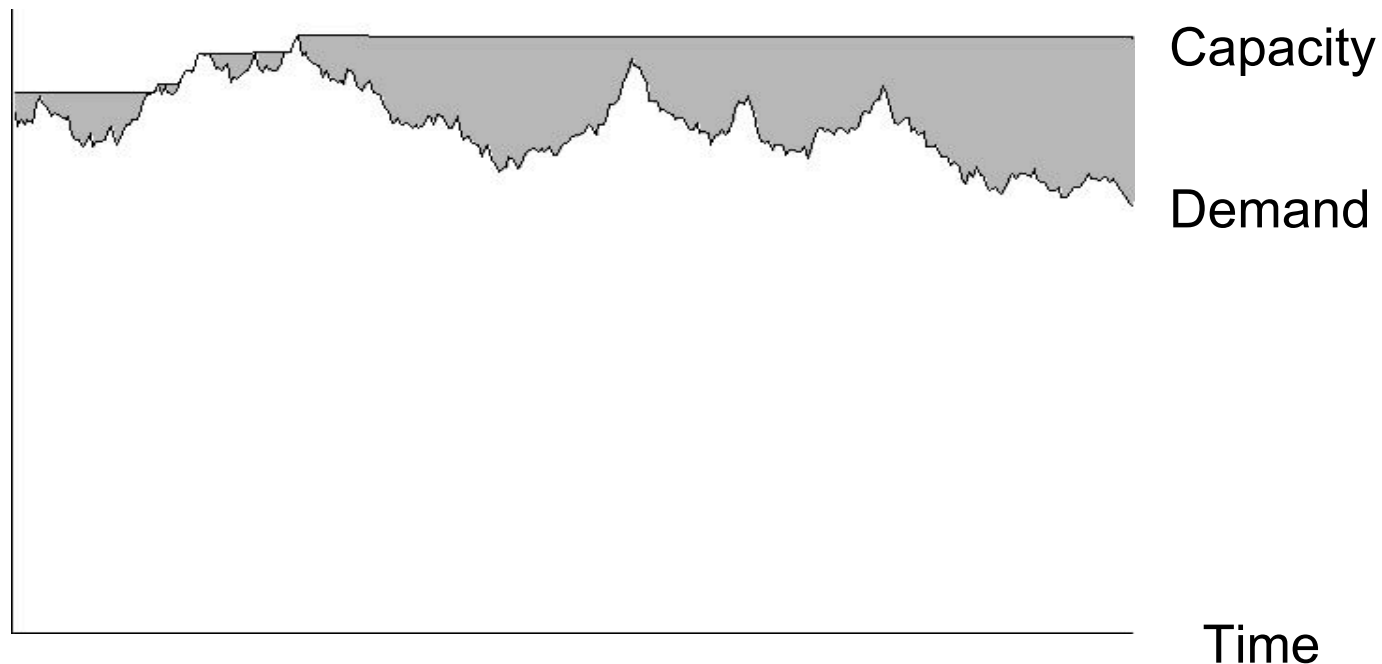
Irreversibility Required to supply

- Capacity
 - Can never fall
 - Expands when required to meet demand
- Leads to stranding possibilities
- Distinguish between capacity and demand (number of subscribers):

i.e. Capacity (S) at least as large as Demand (X)



Adjusting the capacity of the regulated network under irreversibility when demand must be served



Demand volatility

- Typical volatility in “demand”: growth rates
- Telecom NZ Ltd (residential customer numbers)
Average: 1.5%, variation (std. dev.): 6.1%
- Electricity distribution networks (volume)
Average: 2.0%, variation (std. dev.): 4.5%



Reasonable return when costs are sunk required to supply

C3 Revenue Requirement

Revenue Requirement is:

- a) Historical cost times the risk adjusted rate, plus
- b) Adjustment for expected capital gains/losses resulting from price and/or demand reductions

$$E_0[R_1] = (1 + r)P_0S_0 - E_0[P_1 \min \{S_0, X_1\}]$$



Reasonable regulation when costs are sunk

incentive regulation when required to supply (C3, again)

$$E_0[R_1] = (1 + r)P_0S_0 - E_0[P_1 \min\{S_0, X_1\}]$$

- Depend upon view of the future
- “Reasonable” allowed rate of return depends on
 - Systematic risk (in profit, replacement cost, demand)
 - Uncertainty in technology and prices
 - Uncertainty in demand
- Lowest cost of “what” ?(present & future customers ?)
- Allowed rate of return on “what”? (rate base?)



Reasonable regulation when costs are sunk

incentive regulation when required to supply (C3, yet again)

- For historical cost ratebase

Allowed rate of return $r + (1 - \frac{E_0[P_1 \min\{S_0, X_1\}]}{P_0 S_0})$

may be much above r

- Form of regulation/rate of return/reset period must be jointly determined
- Value of the incumbent may be greater than optimised replacement cost



Asset Stranding Potentiality: summary

- Traditional regulation
 - Customers absorb the risk, firm does not
 - Prices vary over time
 - Reasonable return may be as low as risk-free rate
- Incentive regulation
 - Firm absorbs the risk
 - Prices constant over time
 - Reasonable return exceeds risk-free rate
- Social ranking
 - Incentive regulation preferred to Traditional regulation



Reasonable rates of return

- Risk-free rate is 5%
- No systematic risk

		Standard Deviation		
		0.000	0.050	0.100
Trend	-0.020	0.070*	0.074	0.083
	0.000	0.050	0.059	0.069
	0.020	0.050	0.053	0.060

* i.e. tilted annuity adds 2%



Examples

- Telecom NZ Ltd (residential customer numbers)
 - Average growth rate: 1.5%, Std dev growth rate: 6.1%
 - Reasonable rate of return requires 50 basis point premium
- Electricity distribution networks (volume)
 - Average growth rate: 2.0%, Std dev growth rate: 4.5%
 - Reasonable rate of return requires 24 basis point premium

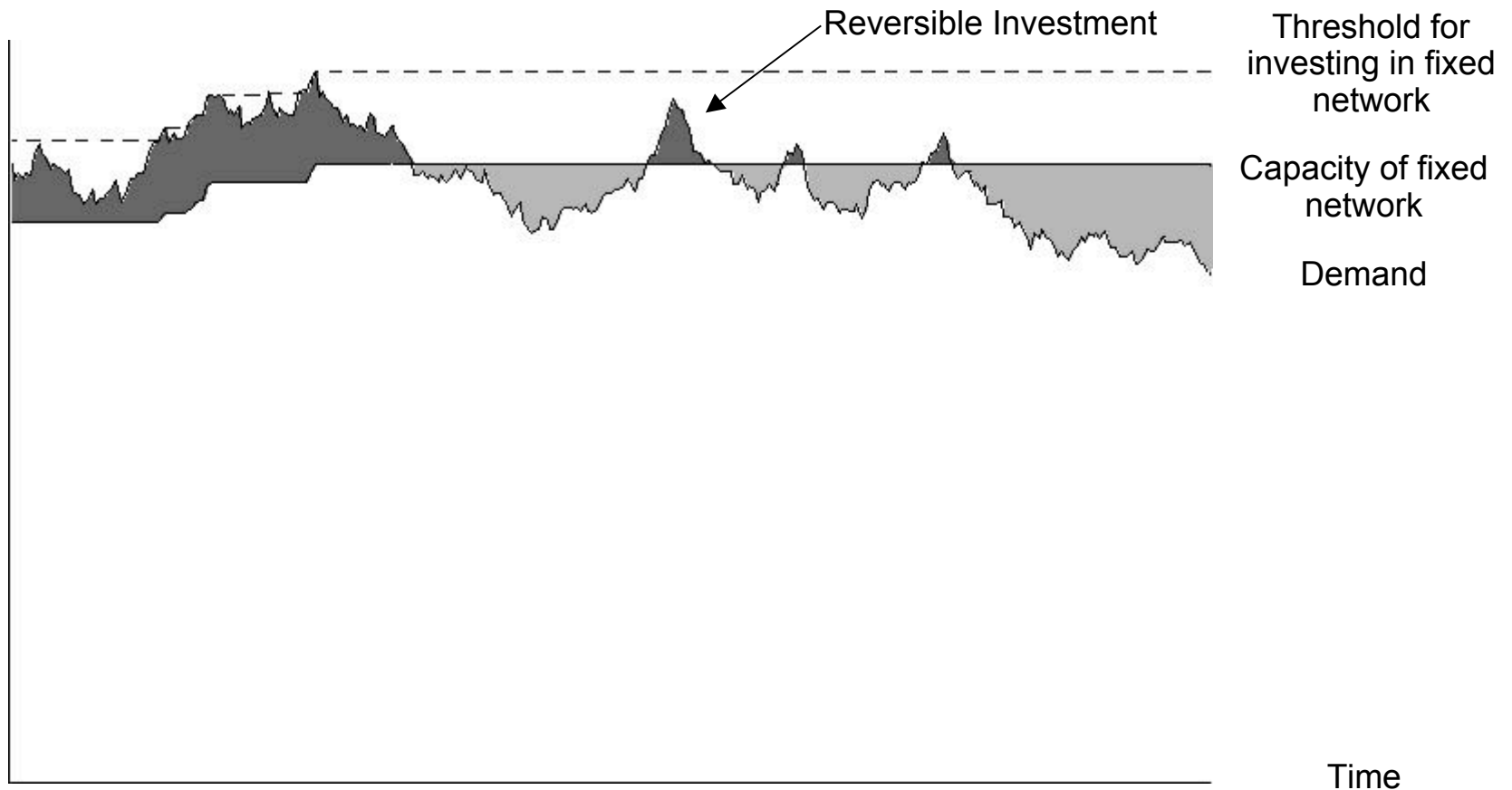


Regulation and Competing Technologies

- Mixture of technologies
 1. Flexible, but expensive
 2. Inflexible, but cheap
- E.g. mobile generation and maintenance
- Technology mix can be used to manage future demand risk



Adjusting network composition over time



Regulation effects: technology mix

- Traditional regulation
 - Either
 - All flexible technology
 - Or all inflexible technology
- Incentive regulation
 - Optimal mix of two technologies
- Information requirements for regulation
 - Lower for incentive regulation



Summary: when firm must supply

- Traditional regulation:
 - Inefficient risk allocation
 - Inefficient investment mix
 - Low required rate of return
- Incentive regulation
 - Efficient risk allocation
 - Efficient investment mix
 - Higher required rate of return



Conclusion: *sunk investment* affects the cost of capital

- Where the firm is free to choose the allowed return is asymmetric in its effects: too low is costly
- Rate-base, allowed return, reset periods interact and should be determined jointly
- Uncertainty and variation matters: specific risks importantly affect systematic risk, raise allowed rates of return under reasonable regulation.
- Reasonable regulation does not imply the value of the firm is its optimised replacement cost
- The standard WACC is but an element of the investment decision: relevant risks should be recognised in the calculation of the allowed rate of return (and the WACC).

