

Incentive Regulation: Asset Valuation and Investment in Advance

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Seminar based on:

Evans, Lewis T. and Guthrie, Graeme A., “Incentive Regulation of Prices when Costs are Sunk” (January 9, 2005). <http://ssrn.com/abstract=467660>

Introduction

- How should we regulate prices?
- Keywords:
 - Incentive regulation
 - Uncertainty
 - Investment: irreversible; economies of scale
- Practical importance:
 - US and elsewhere: TELRIC
 - NZ: ODV, TSO

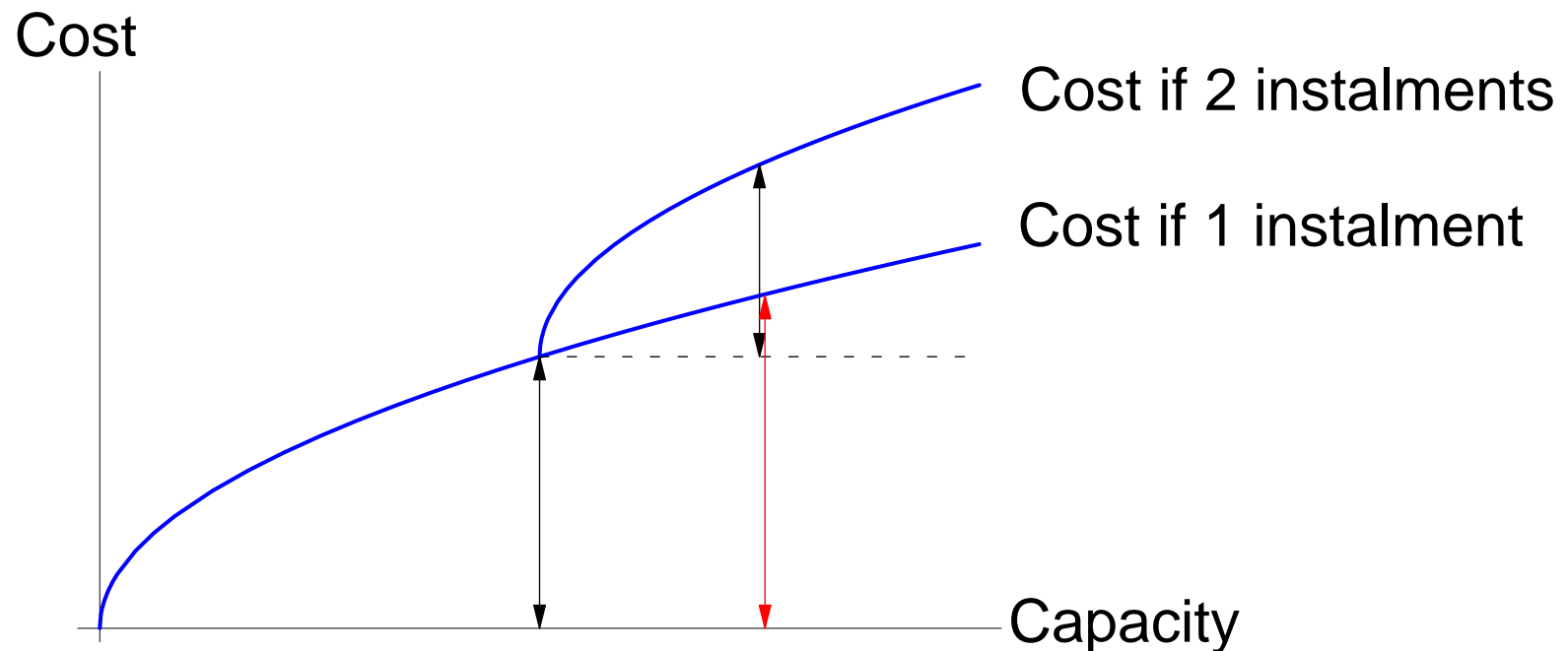
Outline

- A simple example
- Describe model structure
- Cost-minimizing investment
- Regulated firm's cost structure
- What level of revenue is reasonable revenue?
- Implication for firm's investment incentives
- Conclusion

A simple example

Investment with scale economies

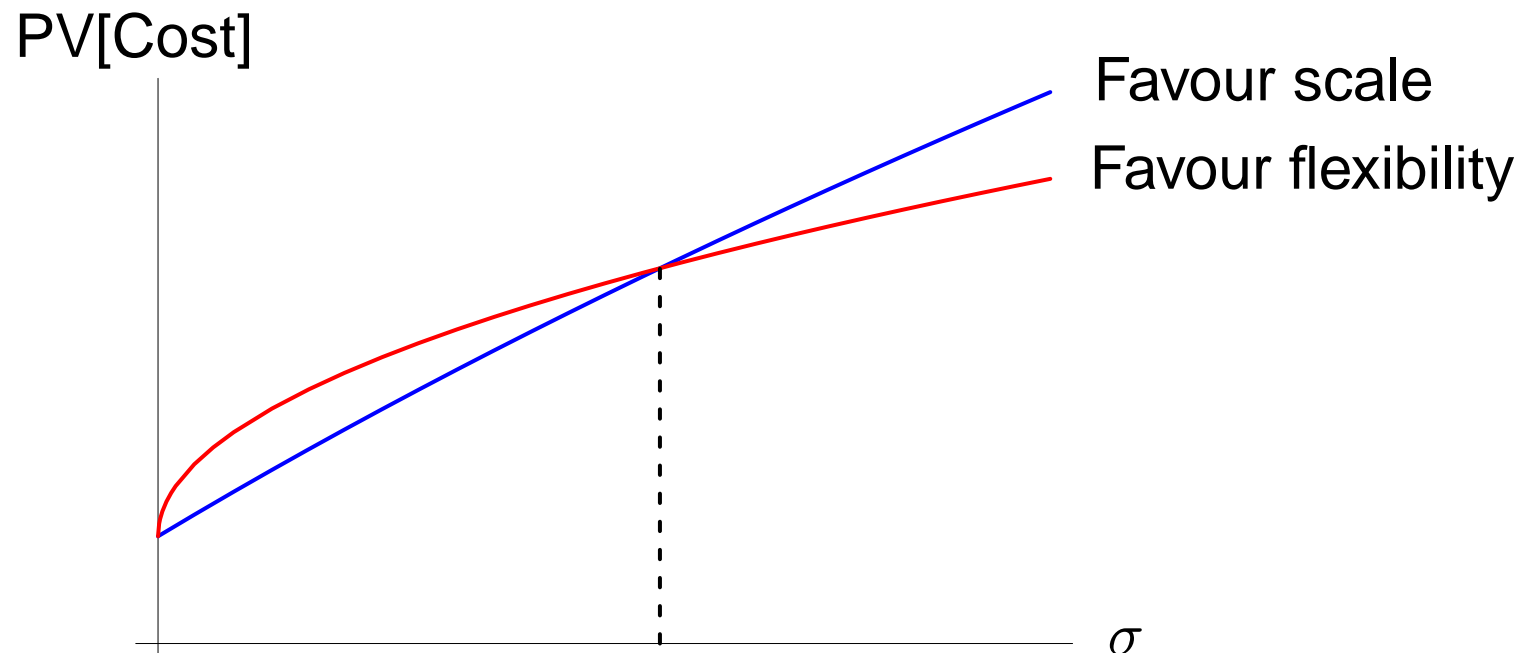
- The one-period interest rate is r
- Customers demand 1 unit of capacity this period
- Demand equals $1 \pm \sigma$ units next period
- It costs \sqrt{s} dollars to build s new units of capacity



A simple example: Investment

- Suppose a firm must meet demand in *both periods*
 - It can build $1 + \sigma$ units now, costing $\sqrt{1 + \sigma}$
 - It can build 1 unit now, and only expand if needed

$$PV[\text{cost}] = 1 + \frac{1}{2} \frac{\sqrt{\sigma}}{1 + r}$$



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$$PV[\text{cost}] = 1 + \frac{1}{2} \frac{\sqrt{\sigma}}{1 + r}$$

- The cost to the firm is the smaller of

$$\sqrt{1 + \sigma} \text{ and } 1 + \frac{1}{2} \frac{\sqrt{\sigma}}{1 + r}$$

A simple example: Incentive regulation

- The revenue which the existing firm is allowed to collect is often based on the cost structure of a *hypothetical replacement firm*
- Contrast *optimized replacement cost* (ORC) and *historical cost* (HC)
- Consider a replacement firm next period
 - If demand is *high*, a replacement firm builds $1 + \sigma$ units, costing

$$ORC_h = \sqrt{1 + \sigma}$$

- If demand is *low*, a replacement firm builds $1 - \sigma$ units, costing

$$ORC_l = \sqrt{1 - \sigma}$$

It has an informational advantage

A simple example: Incentive regulation

- If the existing firm locked in the economies of scale last period,

$$HC_h = HC_l = \sqrt{1 + \sigma}$$

and

$$HC_h = ORC_h \quad HC_l > ORC_l$$

- If the existing firm retained flexibility last period,

$$HC_l = 1, \quad HC_h = 1 + \sqrt{\sigma}$$

and

$$HC_h > ORC_h \quad HC_l > ORC_l$$

- The hypothetical replacement firm faces lower costs. Why?

A simple example: Lessons

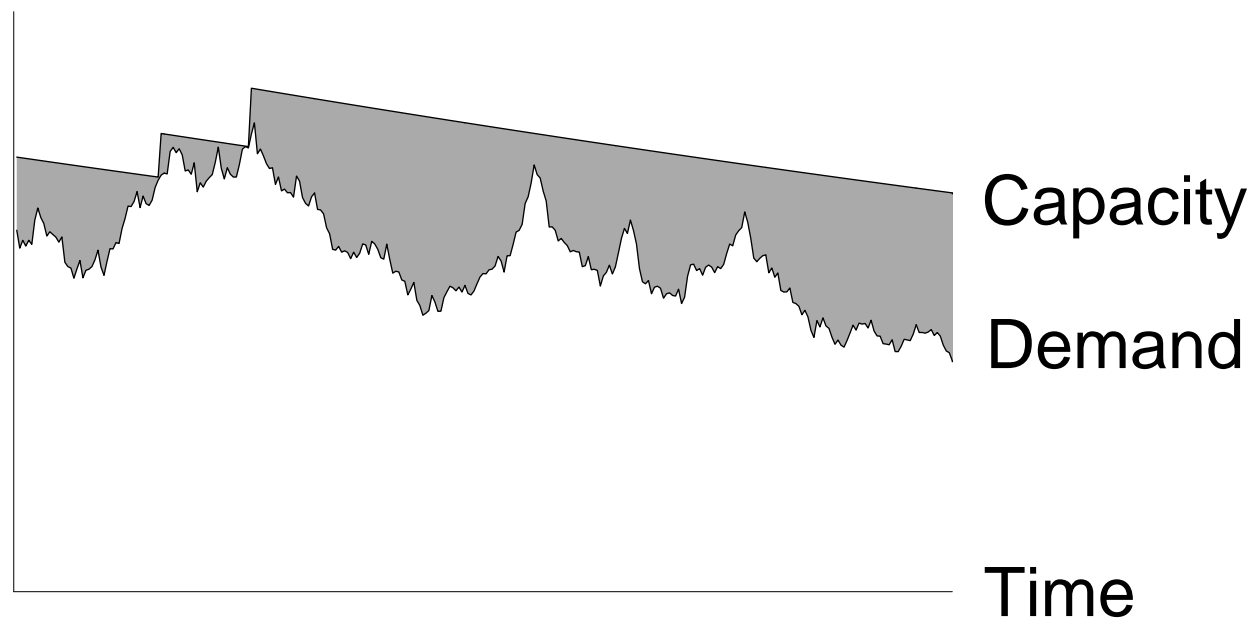
- Lessons so far
 - Sometimes it is best to invest ahead of demand
 - Sometimes it is best to retain flexibility (i.e. not invest too far ahead of demand)
 - Hypothetical replacement firm has a cost and informational advantage

Model set-up

- A firm
 - faces uncertain future demand and capital prices
 - must satisfy all demand
- Investment in capacity
 - irreversible
 - economies of scale
 - physical depreciation
- The firm's allowed revenue is set by a regulator
- Key issue: What revenue is 'reasonable' under a scheme of incentive regulation?

The implications of irreversibility

- Cost-minimizing investment policy
 - Existing firm: wait until it has no excess capacity, and then increase capacity to $g \times$ demand for some $g > 1$
 - Replacement firm: invest in capacity of $h \times$ demand for some $h > g$, then follow the policy above
- The consequences:



The implications of irreversibility

- Cost-minimizing investment policy
 - Existing firm: wait until it has no excess capacity, and then increase capacity to $g \times$ demand for some $g > 1$
 - Replacement firm: invest in capacity of $h \times$ demand for some $h > g$, then follow the policy above
- Optimal investment is lumpy, builds excess capacity
- A new firm has an informational advantage and can exploit more economies of scale than the existing firm

Cost functions

- We are interested in three different measures of cost
 - Cost of *continuing* in business:

$$PV[\text{Future invt expenditure}]$$

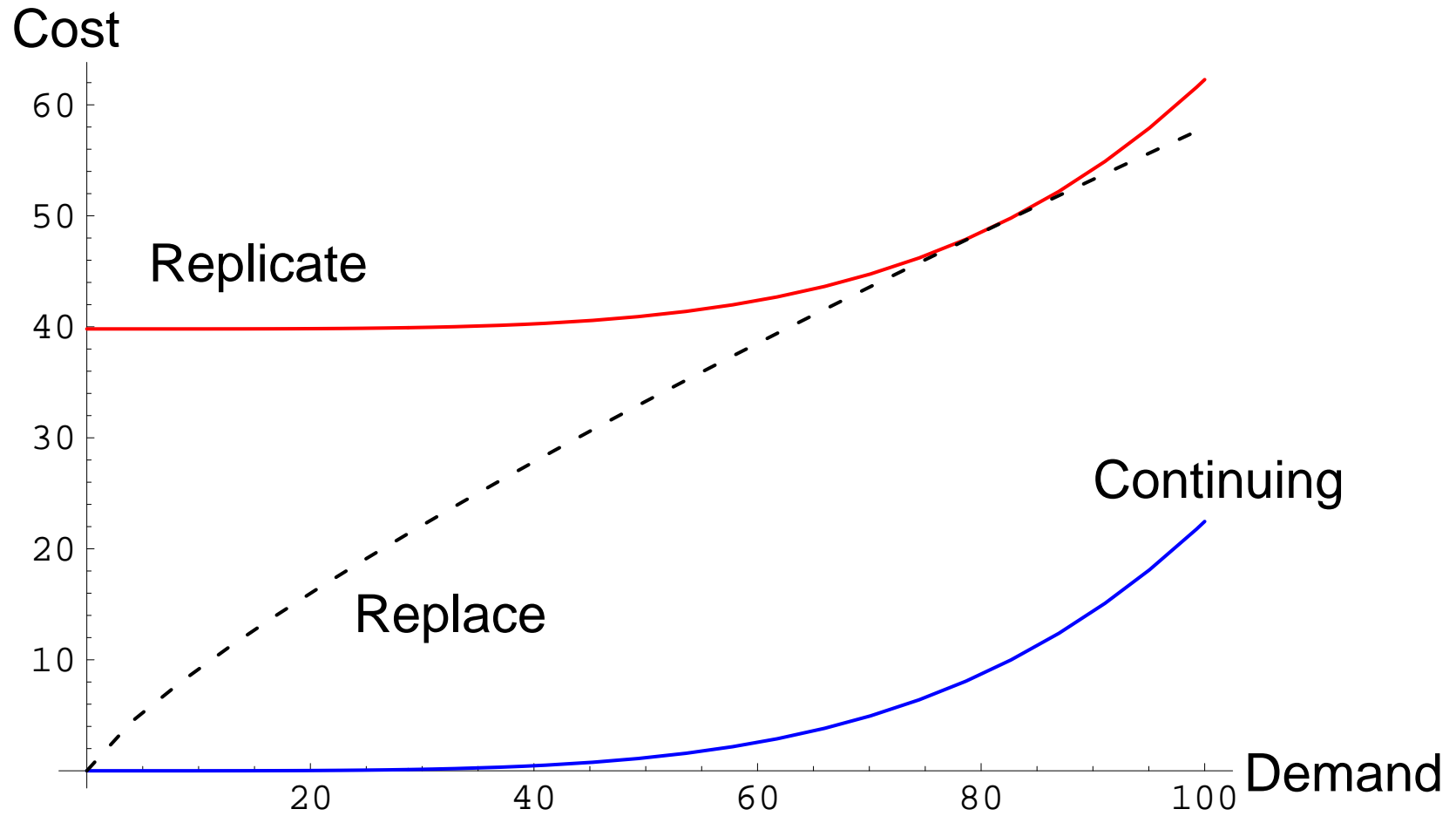
- Cost of *replicating* the network (with one which is identical):

$$RC + PV[\text{Future invt expenditure}]$$

- Cost of *replacing* the network (with one which is efficiently configured):

$$ORC + PV[\text{Future invt expenditure}^*]$$

Cost functions



What revenue is 'reasonable'?

- 'Reasonable' *rate of return regulation*:

$$PV[\text{Revenue}] = \text{historical cost of existing assets} \\ + PV[\text{Future costs}]$$

Regulated firm is guaranteed cost recovery

- 'Reasonable' *incentive regulation*?

- Form of revenue function:

$$PV[\text{Revenue}] = R(\text{independent of firm's} \\ \text{past and future decisions})$$

- Firm has incentive to minimize cost
- What form should R take?

Incentive regulation: Possibility #1

- Requirement: Firm must be willing to *continue* in business

$$\begin{aligned} & PV[\text{Future revenue}] \\ & \geq PV[\text{Future total costs of regulated firm}] \end{aligned}$$

- Minimum rate of return allowed on ORC is

$$\begin{aligned} & (\text{Irreversibility multiplier \#1}) \times \\ & (\text{riskfree rate} + \text{ORC sys. risk premium} - \text{ORC trend}) \end{aligned}$$

Incentive regulation: Possibility #1

- Since

$$\begin{aligned} & PV[\text{Future total costs of regulated firm}] \\ & < PV[\text{Future total costs of replacement firm}] \end{aligned}$$

if the regulator allows the minimum possible revenue, then

$$\begin{aligned} & PV[\text{Future revenue}] \\ & = PV[\text{Future total costs of regulated firm}] \\ & < PV[\text{Future total costs of replacement firm}] \end{aligned}$$

- But this means that the firm would not start business in the first place, or regard future revenue rules as assured

Incentive regulation: Possibility #2

- Requirement: Firm must be willing to *start* in business

$$\begin{aligned} & PV[\text{Future revenue}] \\ & \geq PV[\text{Future total costs of replacement firm}] \end{aligned}$$

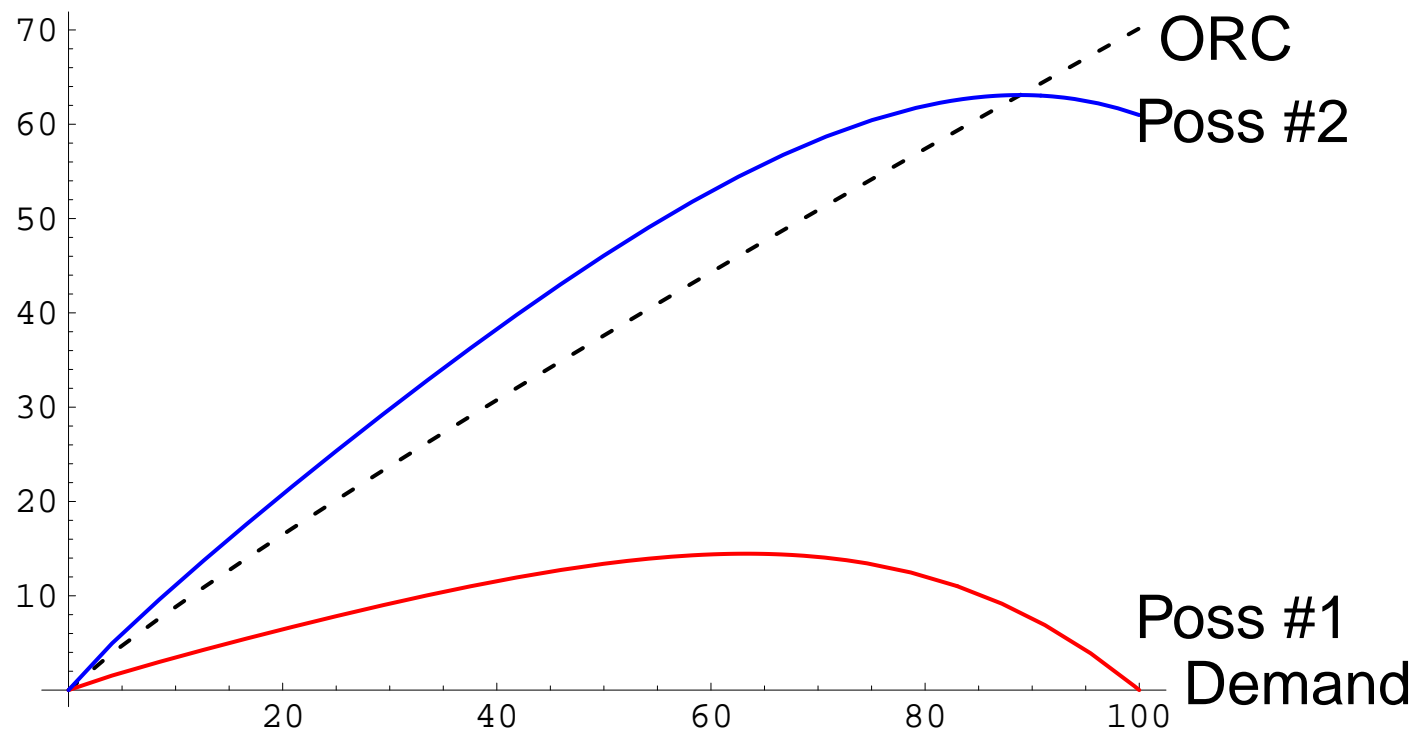
- Minimum rate of return allowed on ORC is

$$\begin{aligned} & (\text{Irreversibility multiplier \#2}) \times \\ & (\text{riskfree rate} + \text{ORC sys. risk premium} - \text{ORC trend}) \end{aligned}$$

Incentive regulation: Possibility #2

- The value of the regulated firm is

$$\begin{aligned} & PV[\text{Future revenue}] - PV[\text{Future total costs of regulated firm}] \\ &= PV[\text{Future total costs of replacement firm}] \\ &\quad - PV[\text{Future total costs of regulated firm}] \end{aligned}$$



Incentive regulation: Possibility #2

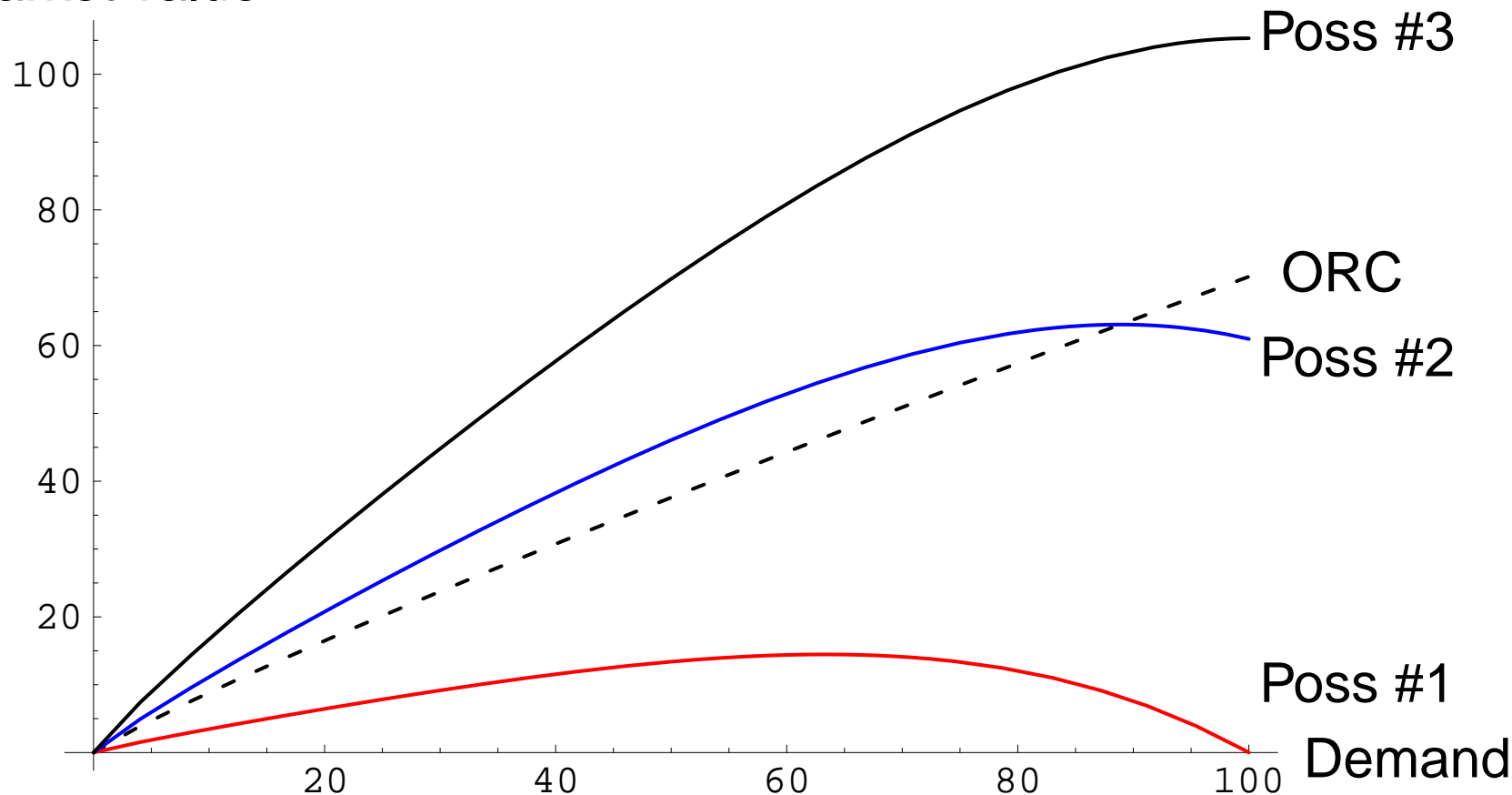
- The value of the regulated firm falls as capacity runs out
 - Cash inflows increase, while there are no cash outflows, so why does firm value fall?
 - Investment becomes more likely as capacity runs out
 - The firm must be making an expected loss whenever it has to invest
- Explanation: The firm's revenue is based on the cost structure of a hypothetical replacement firm, which has a fundamental cost advantage
- Perverse incentives: Firm wants to avoid investment
- Implication: Allowed rate of return on ORC needs to be higher to compensate for the 'low' value of ORC

Incentive regulation: Possibility #3

- Requirement: Firm must at least *break-even* whenever it has to invest
- Minimum rate of return allowed on ORC is
(Irreversibility multiplier #3) ×
(riskfree rate + ORC sys. risk premium – ORC trend)

What is the firm worth?

Market value



Concluding remarks

- Results appropriate for rate of return regulation or reversible investment do not necessarily apply to firms subject to incentive regulation
- Optimized replacement cost is artificially low as a cost measure, due to
 - uncertainty
 - irreversibility
 - economies of scale
- The allowed rate of return applied to ORC must be increased accordingly
- Speculative comment: The allowed rate of return may be lowered if the firm can delay satisfying demand