Allowing for Sunk Costs and Financial Capital Maintenance in Productivity-based Regulation

Presentation to AEMC TFP Design Workshop

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Presentation outline

- Joint work with Erwin Diewert and John Fallon for the NZ Commerce Commission
- Motivated by desire to reconcile productivity-based and building blocks approaches and to better reflect the characteristics of the industry
- Traditional productivity-based regulation
- Divergences and gaps in the theory of regulation
- Allowing for sunk costs and financial capital maintenance
- A new productivity-based approach
- Implications for asset valuation methods
- Specification issues

Traditional approach

- Aim of mimicking competitive markets
- $\Delta P_O \equiv \Delta P_I - \Delta TFP$
- Regulation by price caps (CPI-X):
  - industry average price prevails;
  - not based on own costs;
  - response to efficiency and other changes gradual
- High power but also high risk (under or over earning)
- Innovation encouraged, less scope to 'game' system
- Delinks prices and own costs, low regulatory costs
- $X \equiv [\Delta TFP - \Delta TFP_E] - [\Delta W - \Delta W_E] - \Delta M$
- But in attempting to mimic competitive markets, traditional approach often assumes competitive characteristics apply to what is a very non-competitive industry

Divergences and gaps

- Traditional productivity-based approaches have not explicitly recognised financial capital maintenance (FCM)
- User cost of capital has used Jorgenson approach:

$$u = \underbrace{rP}_{\text{interest cost}} + \underbrace{\delta(1+\rho)P}_{\text{depreciation cost}} - \underbrace{\rho P}_{\text{capital gains}}$$

- No recognition of sunk costs – implicitly assume contestability
- Usual user cost methodology and input price differential terms are not valid when there are significant sunk costs
- Replacement cost versus historic cost asset valuation methods and implications for defining excess returns
- 'One size fits all' X factor versus more tailored approaches

Unified theory of regulation

- Develop unified theory of regulation in the presence of sunk costs in the technical report for the Commerce Commission
- Start with simple general equilibrium model
- End up with nearly 350 equations – but message is simple!
- Validate some common results, eg to improve economic welfare regulators need to move regulated prices closer to their corresponding marginal costs and provide incentives for the regulated firm to improve its productivity performance
- Information required to implement optimal regulation is difficult to obtain and so simpler methods like price cap regulation will have to be used in practice
- Price cap regulation can be modified to accommodate both sunk costs and financial capital maintenance

Sunk costs

- Sunk assets, by definition, cannot be freely traded in a second–hand market
- In developing the theory, change to using opex cost function
- This minimises the variable input costs associated with producing an output target, conditional on the availability of a fixed quantity of capital stock components
- Cannot treat capital stocks as freely variable
- Now have user benefit defined as the negative of the change in the opex cost function in response to a change in the sunk cost capital stock
- User benefit is the marginal saving in opex that could be obtained by increasing sunk capital by one unit while holding output constant
- In equilibrium the (discounted) sum of these anticipated user benefit terms equals the purchase price of the capital input

Notation used in equations

Δ = proportional change in

p = output price

β = target rate of change in profits

w = opex price

z = opex quantity

P_k = approved amortisation price

k = capital input quantity

τ = rate of technical change

C_z = opex

μ = marginal output cost

y = output quantity

π = user benefit of capital inputs

R = revenue

Π = profits

D = Divisia index

T = TFP

s = share in total cost

E = economy-wide

Single firm regulation

$$\Delta p = \beta + \{\Delta w \cdot z + \Delta P_k \cdot k - \tau C_z - [p - \mu] \cdot \Delta y + [P_k - \pi] \cdot \Delta k\}/R$$

- In the presence of sunk costs, full price cap regulation requires information on opex price changes, changes in the amortisation schedule for sunk costs allowed by the regulator, the rate of technical progress, the deviation of prices from marginal costs, the deviation of allowed amortisation charges from corresponding user benefits, changes in outputs and sunk assets, opex costs and revenue, and the desired change in excess profits
- Allowed amortisation charges replace the capital goods price index in the price cap formula when there are sunk costs.

Single firm regulation - simplification

$$\Delta p = [C_z/R]\Delta w_D + [C_k/R]\Delta P_{kD} - [C_z/R]\tau$$

- If excess profits are close to zero, implementation of the price cap can be simplified to the sum of the rate of opex price change weighted by the share of opex costs in revenue and the change in approved amortisation charges weighted by the share of amortisation charges in revenue less the rate of technical progress weighted by the opex share in revenue
- There is no guarantee that future rates of technical progress will mirror past rates.
- Note this is IPI-X rather than CPI-X
- In practice TFP usually used instead of technical change

Using the CPI and productivity

- Conventional TFP growth depends not only on technical progress but also on variables that are controlled by the regulator including profits, the selling prices of regulated products and allowable amortisation charges

$$\Delta p = \Delta P_E - \{[C/R]\Delta T - \Delta T_E\} + \{[C/R](s_z \Delta w_D + s_k \Delta P_{kD}) - \Delta W_E\}$$
$$+ [\Delta \Pi/R] - [\Pi/R]\Delta y_D$$

- The X factor now involves the difference between the firm's TFP growth weighted by its costs relative to its revenue and the economy–wide TFP growth rate plus the difference between economy–wide input price change and the sum of the firm's opex price growth and amortisation charges growth each weighted by the respective shares of their cost in revenue plus a nonzero profits adjustment term less a rate of change in regulated profits term

Comparing the old and new Xs

- Traditional X factor formula:

$$X \equiv [\Delta TFP - \Delta TFP_E] - [\Delta W - \Delta W_E] - \Delta M$$

- New X factor formula:

$$X \equiv \{[C/R]\,\Delta TFP - \Delta TFP_E\} + \{\Delta W_E - [C/R](s_X \Delta w_X + s_K \Delta P_{kD})\} + [\Pi/R]\,\Delta Y - \Delta \Pi/R$$

= TFP differential growth rate term + input price differential growth rate term + nonzero profits adjustment term – rate of change of regulated profits term.

Note role of amortisation charges instead of former CGPI

Regulation of multiple firms

- If a common TFP rate is used then the measurement of this rates becomes critical
- Use of average TFP growth rates across a number of regulated firms can create an uneven playing field since the ingredients which go into TFP growth can contain terms which are beyond the control of the individual regulated firm
- The output measure should capture as fully as possible what regulated services are being provided by the firms in the group, independently of the institutional and historical factors that determine how the firms happen to charge consumers
- 'Functional' outputs versus 'billable' outputs
- Ideally need to go with functional outputs but then need to allow for deviations between prices and marginal costs

Allowing for FCM

- With sunk costs, the appropriate annual cost of capital inputs becomes the amortisation charges approved by the regulator
- These should ideally be the marginal user benefits from the sunk capital (ie opex savings from an increase in sunk capital)
- The charges can be readily structured to achieve FCM
- Approach to measuring asset values in productivity–based regulation in the presence of sunk costs and the achievement of FCM is now similar to that used in building blocks regulation
- A range of asset valuation methodologies can be consistent with FCM (provided amortisation charges are set to ensure NPV=0)
- Amortisation charges based on CPI indexed historic cost and the use of a real return to capital are likely to be the most consistent with the concept of user pays and intertemporal efficiency

Specification issues

- Functional versus billable outputs?
- To what extent is there marginal cost pricing?
- How can we estimate marginal costs?
- How can we proxy functional and billable output quantities (eg peak demand is a poor proxy for purchased capacity)?
- What asset valuation method should be used?
- Can the earliest reliable DORC be used as a proxy for historical cost at that time?
- What is the role for P_0 adjustments?
- Is it reasonable to assume R=C?
- What is the service potential profile for distribution assets (ie does it decay rapidly or stay relatively constant)?