Issues in the Design and Implementation of Price and Revenue Cap Regulation and Hybrid Mechanisms

Developed by

David Sappington

University of Florida

Modified and Presented by

Paul Sotkiewicz

Public Utility Research Center

University of Florida

Outline of Presentation

- Design of price cap regulation
  - Inflation index
  - Choosing an X-factor (efficiency target)
  - Averaging regulated prices of different services
  - Choosing an initial price P_0
  - Accounting for service quality
  - Structuring rate reviews
  - Time between rate reviews
  - Accounting for needed capital investment and exogenous shocks.

Outline of Presentation

- Designing revenue caps
  - Many of the same issues arise as in price caps
- Hybrid Mechanisms
  - Sharing plans
    - Profits (earnings)
    - Revenues
    - Costs
  - Mixing and matching different mechanisms
  - Menu of regulatory options

Why Choose Price Cap Regulation?

- By regulating prices (not earnings) and by not continually adjusting prices to reflect costs, PCR can provide strong incentives for cost reduction.

Some Cautions with Price Cap Regulation

- The firm may earn very high or very low profit.
- The potential for significant earnings variation may raise the firm's cost of capital.
  - This has been observed by comparing betas between US and UK electric utilities

The Over-Arching Restriction in Price Cap Regulation

- After setting prices initially to generate a fair rate of return, prices are permitted to rise, on average, at the rate of inflation (RPI), less an offset for efficiency/productivity gains (X).

$$\left((P_{t+1} - P_t)/P_t = RPI - X\right)$$

The Over-Arching Restriction in Revenue Cap Regulation

- This is really no different from price cap regulation except the restriction is on revenue which is price multiplied by quantity.
- To set the initial price, a good and reasonable forecast of quantity is necessary.
- Quantity could be per unit (per kWh), or per customer not based on units consumed.

$$\left((R_{t+1} - R_t)/R_t = RPI - X\right)$$

Initial Question:
How do Prices Change in a Competitive Economy?

- In a competitive economy, prices reflect production costs.
  - Prices rise to the extent that unavoidable cost increase are incurred.
  - Prices decline to the extent that productivity gains are achieved.

$$\text{Productivity} = \frac{\text{Outputs}}{\text{Inputs}}$$

- **Consequently, in a competitive economy, the economy-wide inflation rate reflects unavoidable cost increases, after accounting for productivity gains.**

Implication for Including Inflation in the Price Change

- If the regulated firm is no different from the average firm in a competitive economy, then the firm's profits will not change if its prices are permitted to rise at the economy-wide rate of price inflation.

Implication for Including Productivity Gains in the Price Change

- Therefore, if the regulated firm is likely to face unavoidable cost increases and potential productivity gains similar to those faced by other firms in the economy, an *X* factor of zero would replicate the discipline of competitive markets.

Observation

A policy that links allowed prices to realized inflation adjusts automatically for economy wide variations in cost increases and productivity gains.

- **The regulator need not speculate about the *absolute levels* of likely cost increases and productivity gains.**
- **The regulator need only posit likely *differences* in cost increases and productivity gains between the regulated firm and the rest of the economy.**

Choosing the Inflation Index (*RPI*)

- The inflation rate for a given year is often approximated by the realized inflation rate in the previous year.
- A reliable forecast of inflation can also be employed.
- However, one must account for the idea that the firm's input prices may not rise by the same amount as inflation.
  - Inputs may not be represented in inflation index
  - There may be pre determined escalator clauses for input prices

Desirable Characteristics of *RPI*

- Reflects general price movements in the economy.
  - Not focused on a particular segment of the economy. [*CPI* vs. *GDPPI*].
- Reliable indicator.
  - Based on reliable data.
- Available in a timely manner.
- Not subject to frequent revision of the actual rate or the market basket on which the prices are based.

Can the *X* Factor Differ From Zero?

- If the regulated firm is deemed capable of achieving more rapid productivity growth than is typical in the economy, then the *X* -factor should be positive to reflect this superior ability to reduce prices profitably.
- Conversely, if the firm is not capable of achieving the same productivity gains as the economy, then the *X*-factor can be negative.
  - This would imply a price increase in real terms

Considering Input Prices May Not Track Inflation

- If the prices of the regulated firm's inputs are rising less rapidly than the input prices of other firms, then, again, *X* should be positive to reflect this increased ability of the regulated firm to keep its product prices low.

The X-Factor: A Summary

- In summary, the *X* factor should be a number that reflects the extent to which the regulated firm's productivity is expected to increase more rapidly and its input prices are expected to increase less rapidly than the typical firm in the economy.

Example

Economy Wide Data

Productivity growth rate = 2%

Input price growth rate = 1%

Reasonable Expectations for Regulated Firm

Productivity growth rate = 3%

Input price growth rate = 0.5%

X factor = [3 – 2] + [1 – 0.5]

= 1.5

Observations

1. The chosen level of X determines a productivity hurdle that the regulated firm must surpass if it is to earn "above target profits".

2. The essence of PCR is to choose an X that provides reasonable expected benefits for consumers while posing a significant, but reasonable, challenge for the firm.

3. If $X < RPI$, then PCR allows prices to rise.

$$\left((P_{t+1} - P_t)/P_t = RPI - X > 0\right)$$

4. If $X > RPI$, then PCR requires prices to fall.

$$\left((P_{t+1} - P_t)/P_t = RPI - X < 0\right)$$

Possible Approaches to Setting X

1. **Purely Historical Approach.**
   - Set X equal to X_0 , the average historic difference between the firm's and the economy's productivity (less input price) growth rates.
   - This approach uses the past as the best indicator of the future.
   - This approach requires significant data.

2. Modified Historical Approach.

- Set X equal to X_0 + S.
- S is a “stretch factor” that accounts for the stifling effects of historic regulation and/or anticipated changes in industry conditions.

Examples of Explicit Stretch Factors in Telecoms

- FCC for LECs: 0.5%
- Pennsylvania: 0.2%
- Illinois: 1.0%
- Canada (LECs) 1998: 1.0%
- Canada (LECs) 2002: 0.0%

- **Stretch factors are often implicit:**
  - **The selected *X* factor exceeds historical productivity trends, but the excess is not explicitly called a stretch factor.**

3. Draw From Experience Elsewhere.

- Set X equal to the level that appears to have worked well in other jurisdictions.

4. Additional Possibilities.

- Set X equal to zero and let the firm reveal its true potential to you
  - Argentina did this in natural gas.
- Set X equal to the productivity differential achieved by other firms in the industry.
- Allow X to vary as key input prices vary.
  - Fuel adjustment clauses.

4. Additional Possibilities (Continued).

- Examine historical price changes relative to inflation, and require similar ongoing changes (perhaps with a stretch factor adjustment).
- Develop a model of the efficient firm (as in Chile), and set X to match the price movement of the hypothetical efficient firm.
- Benchmark firms against each other and set X for each firm based on its relative position to the most efficient firm.
  - This is done in UK electricity distribution

Examples of *X*-Factors in Telecoms

- U.S. Local Rates: 2.7%.
- U.S. Access Prices: 6.5%.
- Hong Kong: 4.0%.
- Great Britain (1997): 4.5%.
- Great Britain (2002): RPI.

X-Factors in Brazil

Service	1999	2001	2003	2005
Local Calls	0	1	1	1
Local Access	0	5	15	20

Source: Anatel.

Average Price Change = Weighted Average

- Price changes on services that affect many customers (or involve more output) should be counted more heavily than identical price changes on services that affect few customers (involve less output).

- To do so, a weighted average of price changes is employed to measure the percentage change in regulated prices.

- The weight placed on a change in the price of service *i* is the fraction of total revenue accounted for by service *i*.

Example

- Three services (or customer classes): A, B, C.
- Revenue from service A = 60.
- Revenue from service B = 30.
- Revenue from service C = 10.
- Suppose the price of service A declines by 10%, and the price of services B and C each rise by 10%.

- **The (weighted) average price increase is:**

$$\frac{60}{100}[-10] + \frac{30}{100}[+10] + \frac{10}{100}[+10]$$

$$= -\frac{200}{100} = -2\%.$$

Choosing the Initial Price Level, P_0

- If the price cap is being implemented for the first time, perhaps setting the initial price at the prevailing price is the best option.
  - As was done with natural gas pipelines in Argentina
- Or, if the price cap regime is moving into another period, using the price during the last period is the place to start.
- With either of these cases, the implementation is simple and does not require time or resources.

Choosing the Initial Price Level, P_0

- If the regulator wishes to have a full accounting of costs at the time of implementation, the regulator could choose a "target rate of return" and include all prudently incurred costs to arrive at P_O.
- $P_0 = (B \times r + E + d + T) / Q_0$
- There may also be a desire to capture upfront many of the benefits of productivity gains for consumers so that the initial price is "far below" the price in the previous period.
  - This has become known as the P_0 Adjustment in the UK.

Service Quality Regulation.

- By providing enhanced rewards for cost reduction, *PCR* may provide incentives to reduce the delivery of (costly) service quality.
- Since *PCR* allows suppliers to retain the increased revenues that arise because of higher service quality, *PCR* can enhance incentives for service quality.
- The predominant effect will depend on the sensitivity of consumer demand to service quality.

Methods of Promoting Service Quality

- Monitoring, with financial rewards and penalties for superior/inferior service quality.
- Penalties can be imposed in the form of targeted rebates to affected customers.
  - Penalties for interrupted or delayed service.
- Penalties can also be imposed in the form of a higher *X* factor.

Evidence From the U.S. in Telecoms

- Despite anecdotes about serious declines in quality under incentive regulation, careful empirical studies reveal little decline, if any.
- However, these studies have not controlled adequately for ancillary policies to ensure desired levels of quality.

The Structure of Reviews.

A. If reviews are employed primarily to reset future requirements to reflect recent accomplishments by the firm, then PCR will function much like RORR.
   - Key difference will be an exogenous, and perhaps longer, regulatory lag.

B. Such profit reviews limit incentives for superior performance, but ensure that earnings do not diverge from target levels for too long a period of time.

C. Alternatives to firm-specific profit reviews are possible in some settings.

- The *X* factor may be reset to reflect industry performance.

D. In settings with emerging competition, reviews should also assess carefully the status of industry competition.

- Competition reviews are designed to determine if some or all price cap constraints can be eliminated.

The Time Between Reviews.

The ideal review lag depends upon:

A. The nature of the review.

- **If the review is a profit review, a longer period between reviews creates greater incentive for superior performance.**
- **If the review is designed to update the *X* factor for a firm without employing the firm's individual performance excessively, then a short period between reviews can ensure an appropriate *X* factor without dulling incentives.**

B. Uncertainty about future industry conditions.

- The need to update initial cost and demand projections is less pronounced in a stable setting with little uncertainty.

C. The nature of the price cap plan.

- If stringent limits on changes in politically-sensitive prices are in place, the need for frequent reviews of the plan is less pronounced.

Financing New Investment: Q and K Factors

- Ensuring that new investments get made, it is possible to reduce the X-factor to allow the firm sufficient revenues to undertake the investment.
  - This is done implicitly in the UK electricity sector during price reviews

- This can also be explicity accounted for in water are called Q-factors (UK Water) or K-factors (Argentina Gas)

Exogenous Factors

Question.

Should PCR plans include automatic adjustments for the financial implications of unanticipated industry shocks?

Answer.

Such adjustments can be advisable, if they are employed sparingly.

Accounting for Exogenous Events: The Z Factor

- $(P_{t+1} - P_t)/P_t = I - X + Z.$
- **The Z factor reflects the financial impact of unanticipated, exogenous shocks.**
- **A positive Z factor reflects an adjustment for higher costs or lower revenues.**
- **A negative Z factor reflects an adjustment for lower costs or higher revenues.**

Characteristics of Events that Should Trigger Adjustments to the Price Cap

1. Exogenous.
   - The event is beyond the control of management.
   - The financial impact of the event should also be largely beyond management's control.
2. Pronounced magnitude.
   - To prevent excessive regulatory hearings.
3. Affect regulated suppliers disproportionately.
   - Avoids double counting.
   - Economy-wide shocks are reflected in I.

Examples of Exogenous Factors

1. Taxes imposed by the government that fall disproportionately on the regulated firm.
   - A special profit tax on the regulated firm.

2. Investment mandates imposed by the regulator.
   - Infrastructure modernization.

3. Pronounced change in input prices for crucial factors of production.

- Automatic fuel adjustment clauses can be designed to avoid frequent regulatory hearings in the electric power industry.

- Full pass through of actual cost changes is not recommended, in order to provide incentives to search for lower input prices (and to avoid double counting).

  - Link pass through to world prices.

The Basic Trade-Off

- By excluding corrections for most or all exogenous factors, the regulatory process can be streamlined, and the regulated firm can be forced to become accustomed to the harsh realities of the marketplace.

- By including corrections for relevant exogenous factors, the regulatory process becomes more like rate-of-return regulation, but the firm does not suffer or gain because of events that are beyond its control.

Summary on Exogenous Factors

- Adjustments for a limited set of important exogenous factors can capture some of the advantages of RORR without introducing too many of its disadvantages.
- The range of possible exogenous factors should be extremely limited, to prevent excessive regulatory hearings.

Designing Hybrid Plans

A. Consider modifications to pure price cap regulation (PCR) that may improve its performance.
   - Earnings sharing.
   - Revenue sharing.
   - Allowing corrections for unanticipated, exogenous shocks.

B. Examine the merits of presenting the firm with a choice among regulatory plans.

Modifying Pure Price Cap Regulation

1. Unlike PCR, rate of return regulation (RORR) can facilitate:
   - Earnings stability; and
   - Ongoing corrections to inaccurate initial forecasts.
2. It is possible to build these attractive features of RORR into PCR.
   - Doing so is not costless, as the disadvantages of RORR accompany the advantages.
   - Disadvantages include reduced incentives for cost reduction, higher regulatory costs, etc.

Earnings Sharing

A Common Formulation

- A band is established around the target rate of return.
  - All earnings within this band accrue to the firm.
  - The band is often 200 – 300 basis points above and below the target rate of return.

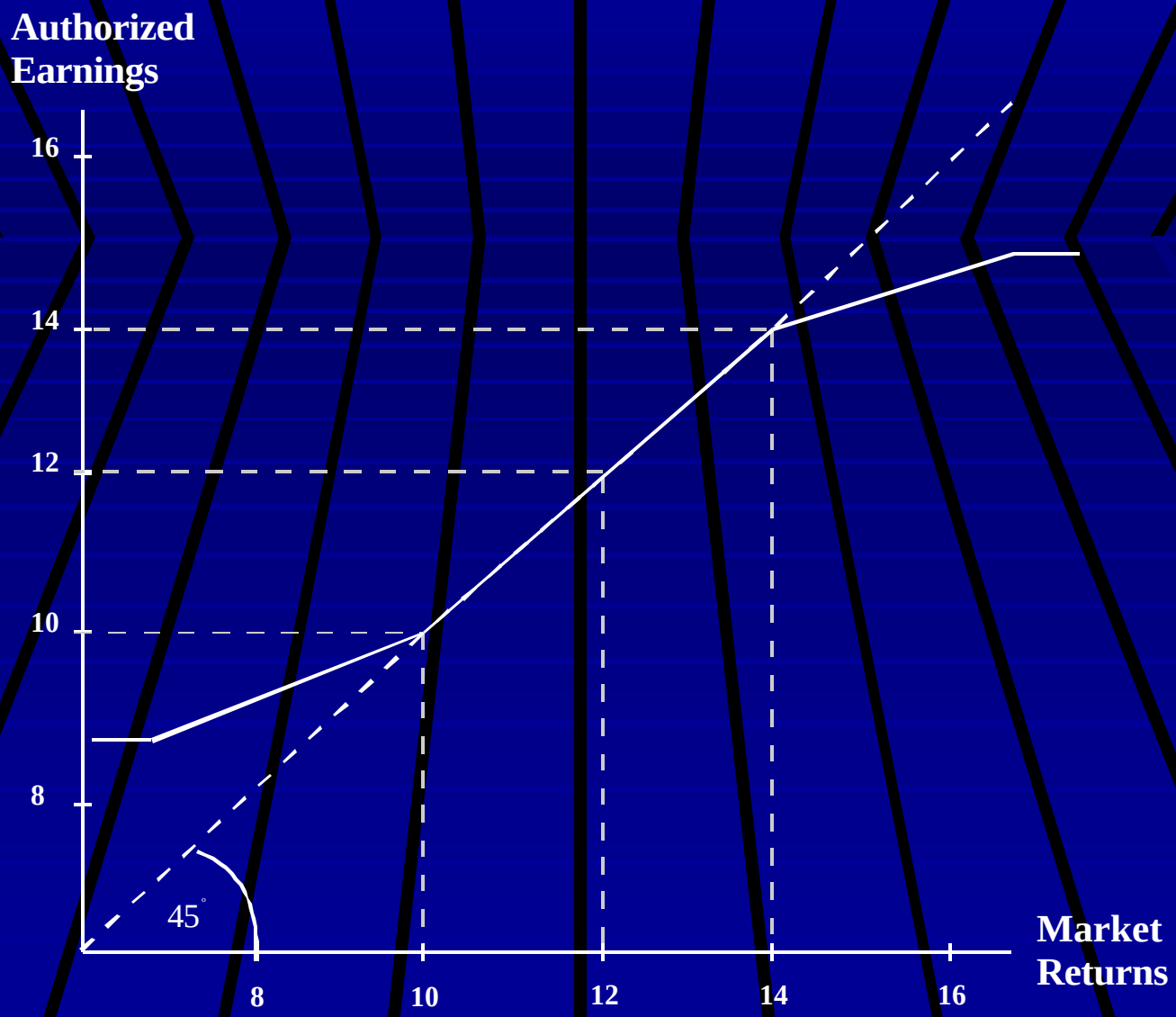


Figure 1. A Common Earnings Sharing Plan.

How Can the Sharing be Implemented?

1. Direct annual payments to customers.
   - "Dividend checks".
2. Price adjustments.
3. Network expansion.
4. Network modernization and service quality improvement.

Benefits and Costs of Earnings Sharing

Benefits.

- Guards against exceptionally high or low earnings.

Costs.

- Dulls incentives for cost reduction and innovation.
- Can provide incentives for shifting costs from unregulated to regulated activities.
- Requires earnings monitoring.

Revenue Sharing

1. Can ensure more stable earnings without reducing incentives to minimize production costs.
2. Can limit incentives for demand-enhancing activities, such as quality improvement.
3. Entails the sharing of revenues, rather than earnings, above a specified level.

Examples:

A. Chile: Road concessions.
B. Oregon: Telecommunications industry.

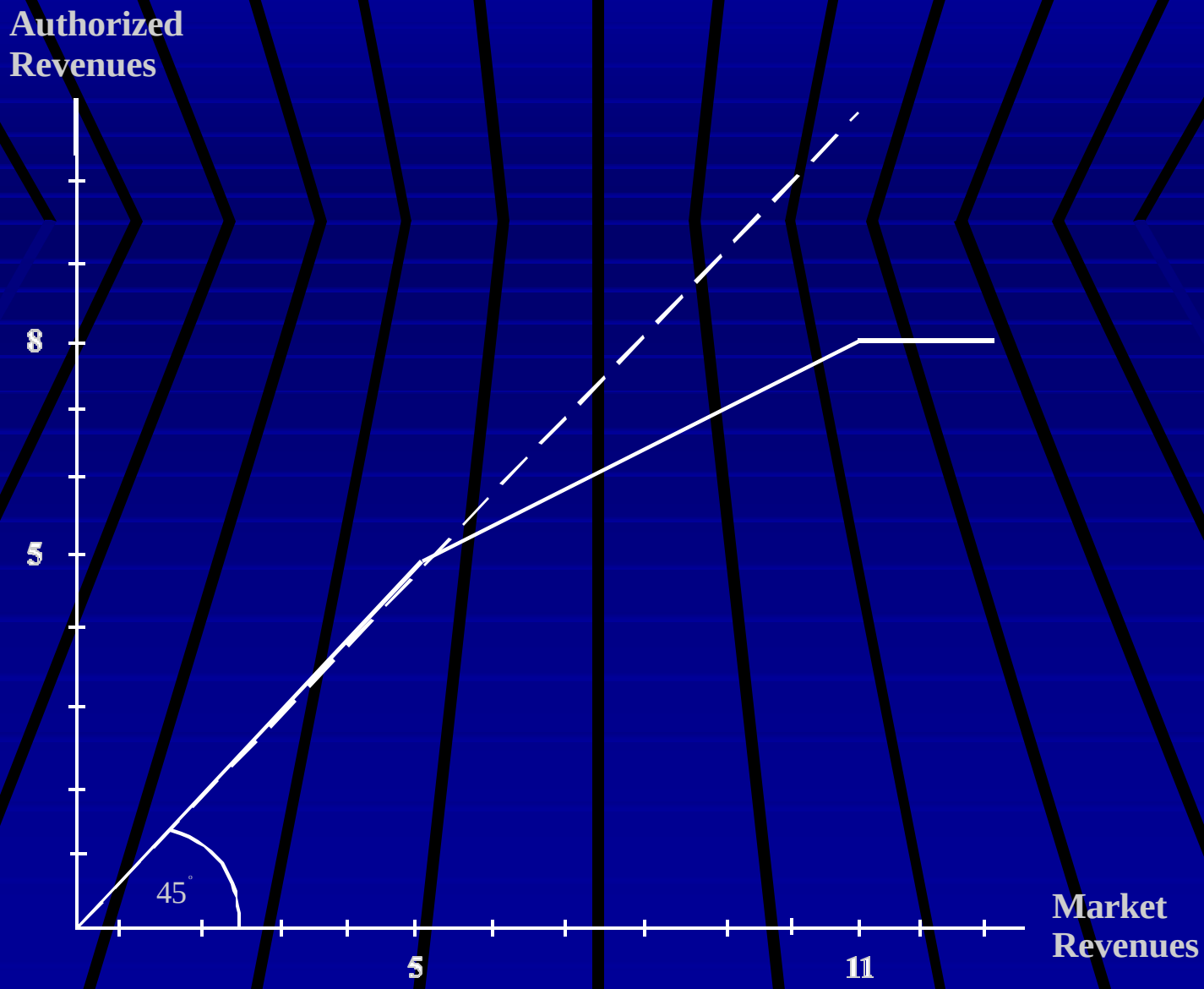


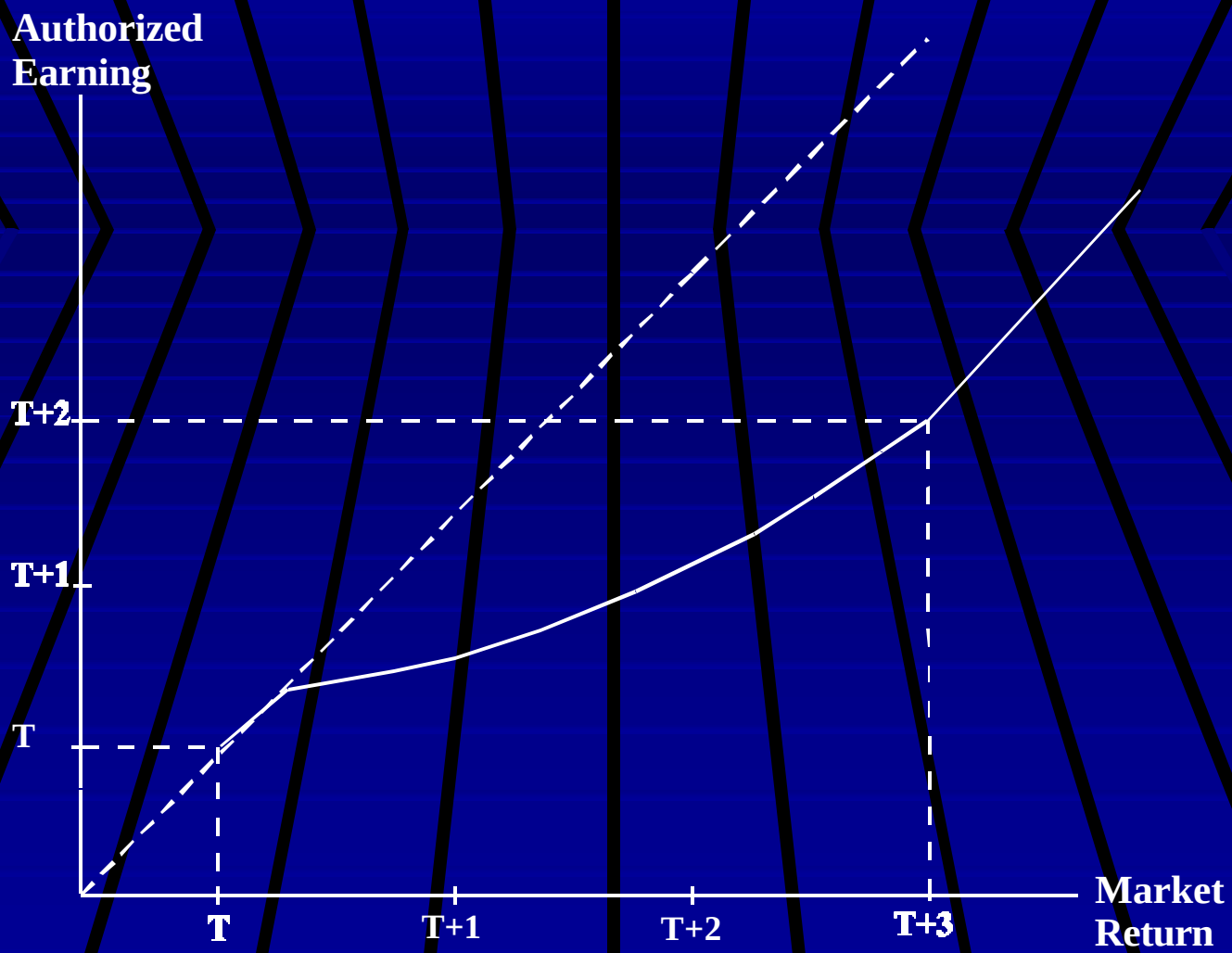
Figure 2. Revenue Sharing.

Earnings Sharing with a Reverse Taper.

- Providing the firm with a diminishing share of incremental earnings can be politically attractive.
- But a diminishing share of incremental earnings for the firm can discourage large cost reductions.
- Earnings sharing plans that give the firm an increasing share of incremental earnings have been implemented.

Basis Points Above Approved Rate of Return	Company/Customer Split
0 - 25	100% / 0%
25 - 75	25% / 75%
75 - 100	35% / 65%
100 - 125	45% / 55%
125 - 150	55% / 45%
150 - 175	65% / 35%
175 - 200	75% / 25%
200 - 250	85% / 15%
250 - 300	95% / 5%
> 300	100% / 0%

Table 1: Earnings Sharing Plan for SDGE.



T = Target Rate of Return

Figure 4. The SDGE Earnings Sharing Plan.

Summary

- Implementing price cap, revenue cap, or hybrid sharing systems is not formulaic…that is there is no right or wrong answer *per se.*
- Choosing parameters is often as much art as science.
- The kind of mechanism implemented (and parameters chosen) will depend heavily upon political concerns (profit or price variability) and the incentives that regulators want to give to utilities.