

**Response of Richard Schmalensee, Ph.D.**  
**In Response to Questions Posed on 6 September 2022**  
**By the Australian Energy Regulator**

**October 19, 2022**

**Introduction**

I am pleased to respond to the questions posed by the Australian Energy Regulator (AER) regarding Schmalensee (1989) and Schmalensee (2022) – hereafter S89 and S22 for brevity. I state four general, important points at the outset:

1. S22 should be understood as simply an attempt to explain some implications (and non-implications) of S89; it introduces no new concepts or assumptions.
2. Both S89 and S22 can be viewed as attempts to clarify (and in the case of S89 to prove) an assertion made much earlier by Professor Stewart Myers (1972, note 38):

If a regulatory commission decides to allow a return  $R$ , and adjusts the utility's prices frequently enough that the utility always earns  $R$  on a book basis, then the utility will always earn the same true return  $R$ .

Myers implicitly asserts that this statement is true regardless of how the commission determines “the true return  $R$ ” and how depreciation is assessed.

3. Nothing in S89 or S22 depends on the lengths of the periods involved. As footnote 4 in S89 indicates, the Invariance Proposition holds if the utility's earnings “on a book basis” are adjusted in continuous time so they always equal “the true return  $R$ .” In discrete time, a period is simply an interval for which the utility's prices can be adjusted by the regulator to affect its earnings on a book basis. The regulator may reset the utility's “true return  $R$ ” each period, or it may fix a value to hold for multiple periods.

4. My understanding of the AER's  $NPV=0$  principle is that it requires that the present value involved be computed using "an unbiased estimate of the expected efficient return, consistent with the relevant risks involved, in providing regulated network services" (AER 2022, p. 14). That is, the discount rate or discount rates involved should be unbiased estimates of the regulated firm's market-determined cost of capital. This is consistent with sound regulatory practice generally.

### **Question 1**

In an attempt to communicate some core concepts, S22 (pp. 2-3) presents a general definition of an investment's economic rate of return in equation (1). In this definition the quantity  $\rho$  is simply the economic rate of return implied by the initial investment and net cash flows in equation (1). The economic rate of return is contrasted with that same asset's period-specific accounting rates of return, the  $r_t$  in equation (3). As I tried to make clear in that discussion, these are general textbook definitions that have no necessary relation to regulation.

Throughout both S89 and S22 in the context of regulation,  $\rho$ , which may vary over time, is the economic rate of return the regulator allows the utility to earn – Myers' "true return R." It is labeled "the cost of capital" in S89 because, consistent with point 4 above, it is generally recognized that ideal regulation involves setting the allowed rate of return equal to the regulated firm's market-determined cost of capital. That is, under sound regulatory practice, the allowed return is set equal to the market-determined cost of capital, and in this case  $\rho$  is used to represent both.

Throughout both S89 and S22,  $r_t$  is the accounting rate of return that the utility actually earns in period  $t$  – what Myers refers to as its earnings "on a book basis." In its

analysis of the  $NPV=0$  condition, the AER appears to assume that the regulated firm will actually earn the allowed return, at least in expectation. In this case, the accounting rate of return and allowed return will be the same, in expectation.

### **Question 2**

Part 1: My association of  $\rho$  with the cost of capital in S89 seems to have been the source of some confusion. Nothing in S89 – or in Myers (1972) – depends on how the allowed rates of return, the  $\rho_t$ , are determined, and it is immediate that as a matter of elementary algebra, equation (\*\*) holds for any  $\rho_1$  and  $\rho_2$ . But unless  $\rho_1$  and  $\rho_2$  equal the corresponding costs of capital (or, in practice, equal to unbiased estimates of those quantities), we don't have  $NPV=0$  as that term seems to be used by the AER, per general point 4 above. That is,  $NPV=0$  is achieved by always setting the allowed return equal to the market-determined cost of capital.

Part 2: I fear I don't understand this part of the Question. Setting the actual earned accounting rates of return equal to the corresponding market-determined costs of capital (the allowed rates of return) just results in equation (\*\*) with slightly different notation and, indeed,  $NPV=0$  holds.

### **Question 3**

The AER (2022, p. 103) presents the following equation for an all-equity firm:

$$(1) \quad E[r_1] = \frac{E[V_1] - V_0 + E[CF_1]}{V_0}.$$

Following the AER (2022, p. 104),  $V_0$  is the known market value of regulated assets at the start of period 1,  $E[V_1]$  is the expected market value at the end of that period, and  $E[CF_1]$  is expected free cash flows during that period (implicitly assumed to be realized

at the end of the period). This equation correctly asserts that investors' expected rate of return on the regulated assets will be determined by expectations regarding with-in period free cash flows and end-of-period value, both of which will be importantly determined by the regulator. Thus  $E[r_I]$  may be above, below, or equal to the market-determined cost of capital,  $\rho$ . It holds, for instance, even in the extreme case in which the regulator is expected to seize the firm's assets, so that  $E[V_I] = 0$ .

The AER (2022, p. 104) re-arranges equation (1) to obtain

$$(2) \quad V_0 = \frac{E[CF_1] + E[V_1]}{1 + E[r_I]}.$$

Like equation (1), equation (2) is correct as long as  $E[r_I]$  is understood to reflect investors' expectations of regulators' actions. It has no necessary relation to the relevant cost of capital. For the  $NPV=0$  criterion to be satisfied, so that the present value on the right equals the initial investment on the left,  $E[r_I]$  should be equal to  $\rho$ , the market-determined cost of capital.

Critically, nothing in S89 (or S22) depends on the length of the periods involved, as footnote 4 in S89 should make clear. So nothing in S89 has implications for what data should be used to estimate the utility's cost of capital. Professor Lally (2021, pp. 7-8) *assumes* a one-year regulatory cycle in a world with only two periods and concludes that the allowed rate of return should be computed annually, using the one-year riskless rate. The AER (2022, p. 102) similarly concludes that *if* the regulatory period is  $N$  years, the allowed rate of return for each period should be computed using the  $N$ -year riskless rate. In fact, the AER/Lally argument implies that if the allowed rate of return were computed quarterly, only the interest rate on 90-day bills should be used.

There are two problems here. First, this argument does not support the choice of any particular regulatory period, since it takes the regulatory period as given. Second, since it doesn't support the choice of a five-year regulatory period, it certainly doesn't support restricting attention to the five-year riskless rate in estimating the cost of capital. Fundamentally, it is not apparent why the best way to estimate investors' required rate of return at any point in time should depend on how often *in the future* the regulator will again compute such estimates, assuming the estimation procedure is unbiased.

Equation (2) is only consistent with the  $NPV=0$  principle if investors expect the regulator to set an allowed return equal to the investors' required return. This cannot reasonably be achieved by setting the allowed return on the basis of an arbitrarily selected regulatory period.

As equation (1) makes clear, investors' expected returns in any period are affected by expectations regarding *future* regulatory decisions. In that example,  $V_1$  will be determined by regulatory decisions at the end of period 1. The allowed rate of return for period 2 and thus the firm's start-of-period market value,  $V_1$ , will be influenced by capital market conditions at the end of period 1. Thus,  $NPV=0$  is only achieved in Equation (2) if investors also expect the allowed return to be set equal to the market cost of capital at the end of period 1.

#### **Question 4**

The new concept introduced here by the AER (2022, p. 109) is "the long-term discount rate", which covers two periods in the AER's numerical example. In that example, the regulator determines that investors initially discount returns over two periods using a long-term discount rate, call it  $\rho_1$ . This is presumably the regulated firm's

cost of capital as of the start of period 1, estimated using two-period interest rates. (It is not clear what else it could be.) The regulator accordingly sets the earned accounting rate of return in period 1,  $r_1$ , equal to  $\rho_1$ , using the notation in the Question. (In the case where the regulated firm is assumed to actually earn the allowed return,  $r_1$  also represents the allowed return, as the AER defines it at the end of Question 4.)

By assumption, at the start of the second period, capital market conditions have changed, and the new “long-term discount rate” (i.e., cost of capital) is  $\rho_2 \neq \rho_1$ . The Question assumes that the earned accounting rate of return is changed to reflect this, so  $r_2 = \rho_2$ . The Question then assumes in equation (\*\*\*) that the relevant  $NPV$  must be computed using  $\rho_1$  to discount cash flows in period 2, even though by assumption the regulated firm’s cost of capital has changed to  $\rho_2$ . But it seems obvious that the period 2 cost of capital,  $\rho_2$ , should be used to discount cash flows during period 2. If that is done, the  $NPV=0$  condition is satisfied:

$$(3) \quad NPV = -I + \frac{\rho_1 I + D_1}{(1 + \rho_1)} + \frac{\rho_2(I - D_1) + (I - D_1)}{(1 + \rho_1)(1 + \rho_2)} = 0.$$

As this equation shows, it is simply not true as the AER assert that adjusting the earned accounting rate of return at the start of each period to align with changes in the cost of capital would mean that the  $NPV=0$  condition could not be satisfied. If the (estimated) cost of capital is revised in each period, the  $NPV$  criterion should be computed using each period’s (estimated) cost of capital to discount net cash flows.

### **Question 5**

Since nothing in S89 depends on the length of periods or how often the allowed rate of return is assessed, “period  $t$ ” is simply some typical period, and “one-period”

means one period. Two of the other three descriptors listed occur only in the passage quoted in the Question, where it is clear that “short-term” refers to a single period, and “long-term” and “T-period” refer to an interval including more than a single period. “Long-term” also occurs in the last paragraph of S89, where it has its usual meaning.

Throughout S89,  $\rho_t$  is simply the regulator-determined allowed rate of return in some typical period  $t$  for which the regulator can set prices to determine the utility’s actual earned accounting rate of return. There is no presumption that the allowed rate of return is re-set in every period, as the quotation from page 296 in the Question tries to make clear, and the Invariance Proposition does not depend on  $\rho_t$  actually equaling the utility’s market-determined cost of capital. Since regulators can only estimate that cost, it would have been clearer if at the top of p. 294 in S89 I had defined  $\rho_t$  as something like “regulator-estimated cost of capital in period  $t$ .”

The proposed interpretation is not quite right. In the proof of the Invariance Proposition in S89,  $\rho_t$  is simply the allowed economic rate of return in period  $t$ . For economically sound regulation, however, that allowed rate of return should be an unbiased estimate of the utility’s market-determined, risk-adjusted opportunity cost of capital in that period. Nothing in S89 depends on that estimate being exactly correct, as the interpretation seems to imply.

**Supplemental Question:** The ENA have asked me to respond to the following

supplemental question: *In S22 you advise:*

*The few places where determination of return via the cost of capital is mentioned briefly in passing in S89 have no implications for the decision-making of the AER or any other regulatory agency. S89 is an essay in economic theory, not a paper on estimating firms’ cost of capital in practice.*

*How should this advice be interpreted in the context of your additional observations in S22 around the importance of, and general principle of, a regulator setting a return consistent with that required by investors? What are the risks of departure from this principle?*

At its core, S89 is about the relation between the economic rate of return a utility provides for its investors and the accounting rates of return it is allowed to earn. As the second sentence in the quotation above indicates, it has no implications for how regulators should estimate a utility's cost of capital in practice. But there is surely no question among those concerned with regulation's promotion of the efficient use of resources about the objective of that estimation. As I said in S22 (p. 7): "It is a general principle that the allowed cost of capital should be an estimate of the relevant efficient expected return demanded by investors." It almost goes without saying that, per the AER (2022, p. 14), the aim should be to produce an unbiased estimate of the market-determined cost of capital.

The AER (2022, p 51) provide a good, though I think overly qualified, summary of the consequences of departing from this principle in either direction:

A rate of return that is too high may encourage overinvestment, while a rate of return that is too low may encourage underinvestment. Overinvestment may not be in the long-term interests of consumers with regard to price. Underinvestment may not be in the long-term interest of consumers with respect to quality of service.

I would replace "may" throughout with "will generally," and I would delete "long-term" in the second and third sentences. A firm can charge excessive prices or provide deficient service without needing to change its investment behavior.



## **References**

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