

# **Historic Cost and Replacement Cost: Efficiency Implications of their Use in Price Setting**

Tony van Zijl and Timothy Irwin

14 August 2001



# Table of Contents

<b>1</b>	<b>INTRODUCTION AND SUMMARY .....</b>	<b>3</b>
<b>2</b>	<b>THE COMMISSION'S DRAFT VIEWS.....</b>	<b>4</b>
<b>3</b>	<b>ASSET VALUATION, PRICING, AND EFFICIENCY.....</b>	<b>5</b>
<b>4</b>	<b>THE ALTERNATIVES UNDER CONSIDERATION.....</b>	<b>6</b>
4.1	THE HISTORIC-COST APPROACH.....	6
4.2	THE ODRC APPROACH.....	6
<b>5</b>	<b>STARTING VALUES, TRANSFERS OF WEALTH, AND THE IMPORTANCE OF STABILITY.....</b>	<b>7</b>
5.1	CHOOSING BETWEEN HISTORIC COST AND ODRC BEFORE INVESTMENT IS UNDERTAKEN	7
5.2	CHOOSING BETWEEN HISTORIC COST AND ODRC MIDSTREAM.....	8
5.3	IMPORTANCE OF STABILITY FOR EFFICIENCY.....	8
<b>6</b>	<b>EQUATING EXPECTED REVENUES AND COSTS.....</b>	<b>8</b>
6.1	HISTORIC-COST AND ODRC APPROACHES COMPARED.....	9
6.2	EFFICIENCY IMPLICATIONS .....	9
<b>7</b>	<b>THE TIME PROFILE OF REVENUES .....</b>	<b>10</b>
7.1	HISTORIC-COST AND ODRC APPROACHES COMPARED.....	10
7.2	EFFICIENCY IMPLICATIONS .....	11
<b>8</b>	<b>RISKS AND THEIR ALLOCATION.....</b>	<b>11</b>
8.1	TYPES OF RISK.....	11
8.2	INFLATION RISK.....	12
8.3	RELATIVE-PRICE RISK.....	13
8.4	DEMAND RISK .....	13
8.5	MEASUREMENT RISK .....	14
8.6	VALUATION-METHODOLOGY RISK.....	16
<b>9</b>	<b>CONCLUSIONS ON THE COMMISSION'S REASONING .....</b>	<b>16</b>
	<b>ANNEX: ANALYSIS OF HISTORIC-COST AND ODRC APPROACHES.....</b>	<b>18</b>

# 1 Introduction and Summary

In its draft report on price control of airfield activities, the Commerce Commission has proposed that “specialised airfield assets”, such as runways, should be valued at historic cost instead of optimised depreciated replacement cost (ODRC). The proposal is significant because it changes the Commission’s estimate of the airports’ average costs and hence its assessment of their returns relative to their costs. That in turn affects its estimates of the benefits to acquirers and of the overall efficiency of price control. Further, if the approach were adopted it would also affect the future evolution of prices. In this report, we assess the efficiency of the Commission’s proposal and evaluate the reasoning underlying it.

We note that asset valuation does not affect efficiency *per se*. Rather, it affects efficiency through its effect on the prices that airports charge now and in the future. In comparing ODRC and historic cost, we therefore have to make assumptions about price setting, as well as the particular approach to historic and replacement cost under consideration. We compare the following specific approaches:

- *ODRC approach.* Setting prices on the basis of costs, where the cost of assets is measured by their optimised depreciated *replacement* cost (ODRC) and prices take into account expected changes in replacement cost.
- *Historic-cost approach.* Setting prices on the basis of costs, where the cost of assets is measured by their (optimised) depreciated *historic* cost.

We draw the following conclusions:

- Properly implemented, both the historic-cost and ODRC approaches can equate the expected present value of an airport’s costs and revenues. Used consistently over time, both can preserve incentives to invest.
- In real terms, historic-cost prices tend to fall over time, until new investment is undertaken. Then they rise again. ODRC prices tend to track the real replacement cost of assets and will tend therefore to change less over time in real terms. (The difference is not related to “pre-financing”.) Although the relative efficiency of the time profiles will depend on the circumstances, the ODRC profile would appear to be more efficient in most cases.
- The approaches tend to lead to different allocations of risk between an airport and its customers. With fixed prices, for example, the ODRC approach tends to shelter the airport from inflation risk but expose it to demand risk. The efficiency of the approaches cannot, however, be fully evaluated in isolation from the formulas or principles that govern changes in prices over time.
- For the purpose of financial reporting, historic cost can usually be measured more reliably than ODRC. The use of *optimised* depreciated historic cost *for pricing purposes*, however, creates measurement problems not present in historic-cost financial reporting.

- Stability of the valuation approach over time—and perceptions of its stability—are likely to be the most important issue for efficiency. Switching midstream from ODRC to historic cost will increase perceptions of regulatory risk, discourage investment, and may be very detrimental to efficiency.

While the Commission’s discussion of asset valuation refers to many relevant issues—including the importance of allowing investors to earn a return on sunk investments—its apparent reasons for preferring historic cost to ODRC are flawed:

- It argues against ODRC on the grounds that it “explicitly involves an element of pre-financing”. The conclusion is unwarranted: the difference in the time profile of revenues under the ODRC and historic-cost approaches does not relate to pre-financing.
- In addition, while the Commission argues correctly that the historic-cost approach can preserve incentives to invest, it appears incorrectly to accept arguments that the ODRC approach cannot.
- Further, the Commission appears to underestimate the measurement and administrative complications created by the use of an *optimised* historic-cost approach for price setting.

Most important, it appears not to have appreciated the risk created by “midstream” changes in valuation approach—that is, changes in the valuation approach applied to investments already made. The arguments for choosing between historic-cost and ODRC approaches at the outset of an investment in a sunk asset are subtle, and different approaches might reasonably be chosen in different circumstances. But the arguments against *changing* approach midstream are strong.

## 2 The Commission’s Draft Views

In considering how specialised airfield assets should be valued for the purpose of cost-based pricing, the Commission states

The cost of specialised assets [is] sunk and cannot be recovered if the service is discontinued. For such assets, opportunity costs are zero. However, valuing the assets at zero may affect the long-term viability of owner of the assets (paragraph 7.38).

As a result, the Commission rejects valuing the assets at opportunity cost and considers whether to value them at replacement or historic cost.

The Commission presents lengthy tables of arguments for and against the use of historic cost and ODRC. It is difficult to draw conclusions from the collection of arguments in the tables, and the Commission’s discussion focuses instead on only a few. It writes (paragraph 7.41):

ODRC is argued by its proponents to have efficiency advantages in terms of:

- Mirroring conditions in a competitive or contestable market inasmuch as the firm does not make a return on inefficient investments arising from choosing not to reconfigure assets to reflect best commercial practice.
- Minimising the likelihood of a significant shock to the tariff when it comes time to replace the assets.

The Commission goes on to state that its tables of arguments suggest that ODRC does not have any clear advantages over historic cost and then states

While the use of ODRC smoothes prices (to some extent), it explicitly involves an element of pre-financing. In accepting ODRC, today's consumers will pay for some of tomorrow's costs. However, there is no guarantee that any pre-financing of future replacement is set aside and kept for that purpose and current users have no guaranteed rights in the future. Given that pre-financing (of the replacement of current used assets) is seen as undesirable, then HC is probably the preferable approach. The Commission considers that HC provides investors with a return on the amounts previously invested and preserves incentives to invest in the future (paragraph. 7.43).

It is difficult to confidently summarise the Commission's argument, but its central contentions seem to be that

- The historic-cost approach achieves the primary goal of providing investors with a return on their investments, whereas ODRC may not: the tables include the claim that "ODRC is *not* sustainable where technological improvements are lowering the cost of modern equivalent assets."
- Unlike ODRC, the historic-cost approach does not involve "pre-financing" or current users paying for assets used only by future users.

We examine these and other considerations later in the report. First, we consider how the choice of asset valuation approach should be made and the precise nature of the historic-cost and ODRC approaches under consideration.

### **3 Asset Valuation, Pricing, and Efficiency**

In this report, we compare the historic-cost and ODRC approaches in terms of their expected effects on efficiency. It is important to note, however, that asset valuation approaches used in price setting are relevant to efficiency only through their influences on prices. In cost-based price-setting models, sometimes referred to as "building-block" models, asset values affect current and expected future prices. Current prices affect consumption decisions and, in particular, the allocative efficiency of airlines' decisions about how many planes to land at an airport. And expected future prices affect the productive or dynamic efficiency of investment decisions.

To form a view of the efficiency effects of different asset valuation approaches, it is therefore necessary to make assumptions about how prices are derived and changed over time. One and the same approach may have different effects, depending on other features of the price-setting process. In making our assessments, we will

assume that asset valuation enters into a conventional “building-block” approach to pricing. We will note where details of the pricing model affect the answers.

## 4 The Alternatives under Consideration

### 4.1 The Historic-Cost Approach

The historic-cost approach sets prices on the basis of, *inter alia*, depreciated historic costs. In particular, we assume that under the historic-cost approach prices are set so that expected revenue is equal each year to accounting depreciation (based on historic cost) plus WACC on assets at their historic cost:

$$\text{Price} \times \text{quantity} = (\text{historic-cost asset value} \times \text{WACC}) + \text{historic-cost depreciation.}^1$$

There is a question of whether optimisation would be incorporated in the Commission’s approach and, if so, how. The Commission does not address this question in any detail, but parts of the draft report suggest it has this possibility in mind. In Table 22 on historic cost, it states, “Book values could be adjusted to ‘optimise out’ uneconomic or redundant assets”. Further, it considers that runways, as specialised assets, should be valued at historic cost and (in paragraph 7.51) states, “Clearly, any runway area surplus to requirements should be optimised out.”

If the proposed valuation method is indeed optimised depreciated historic cost, there arises the question of how optimisation would work. Would it be all or nothing, so that a runway, for example, was either in the asset base or not; or would it admit of degrees, so that a runway that was considered twice as long as necessary was written down in value, but not written off completely? Second, would the optimisation reduce the value of assets that were considered “over-designed” given information available *now*? Or would optimisation lead only to the writing down of assets that, given information available at the time, could have been known to be inefficient.<sup>2</sup> We raise these issues below when they impinge upon the analysis.

### 4.2 The ODRC Approach

The ODRC approach sets prices on the basis of, *inter alia*, optimised depreciated replacement cost. Within this broad approach, variants can be distinguished according to the way revaluations are treated. The ODRC approach we focus on is

---

<sup>1</sup> The equations simplify by assuming a one-year pricing period and by ignoring operating costs and tax. Tax does influence the analysis, however, because it depends on historic cost, even if prices are set on the basis of ODRC. The numerical modelling that illustrates some of the points made in this report does include the effect of historic-cost-based tax.

<sup>2</sup> Some of the arguments presented by the Commission suggest it would prefer the second (ex-ante) form of optimisation: see argument “A2” against ODRC in Table 23. On the other hand, the discussion of the optimisation of runways appears to consider whether the runways are appropriately sized given information available now (an ex-post approach).

one in which expected future revaluations are taken into account in setting prices, so that expected positive revaluations are treated as forecast revenue and reduce the revenue that must be derived from customers. Similarly, expected negative revaluations increase the revenue that must be derived from customers. In particular, prices are set in this model so that

$$\text{Price} \times \text{quantity} = (\text{ODRC} \times \text{WACC}) + \text{ODRC depreciation} - \text{forecast revaluations.}^3$$

A further choice under the broad heading of the ODRC approach is the treatment of *unexpected* revaluations—that is, revaluations that were not forecast at the time prices were set. Under the ODRC approach we consider in this report, unexpected revaluations are not passed on. That is, the airport keeps the benefit or absorbs the cost of any unexpected revaluations—the airport does not offer any reduction in charges when assets are revalued up by more than expected; and it doesn't increase charges as a result of unexpected downward revaluations.

Consider the following example. The ODRC of assets is \$100 and WACC is 10%. To keep things simple, there is no depreciation. Because of inflation, however, the ODRC of assets is expected to increase by \$1. Quantity is 1. Under the ODRC approach we consider, price would be set at \$9 (= \$10 + \$0 - \$1). At the end of the year, suppose that the ODRC of assets was in fact still \$100. No adjustment would be made for the variance between the forecast and the outcome. The airport's accounting rate of profit would be 9%, compared with a cost of capital of 10%. Likewise, if the ODRC of assets rose to \$102, the airport would not give back to the airlines the extra dollar of appreciation and the airport's accounting rate of profit would be 11%.<sup>4</sup>

## **5 Starting Values, Transfers of Wealth, and the Importance of Stability**

### **5.1 Choosing Between Historic Cost and ODRC Before Investment Is Undertaken**

We show below that the choice of asset valuation approach affects efficiency. In the case of a start-up airport, where no investment had yet been undertaken, and in which the airport and airlines were considering whether prices should be set on the basis of historic cost or ODRC, the airports and airlines could both be expected to prefer the more efficient approach. They might disagree on which approach was in fact more efficient, and they would still have reason to argue over the sharing of the efficiency gains created by the use of the more efficient approach; but at least as a first

---

<sup>3</sup> The structure of this equation, with the inclusion of forecast revaluations, can be used for pricing on the basis of other valuation methodologies. The historic-cost approach can be put in this form, for example, but because forecast revaluations are always zero the revaluation term drops out.

<sup>4</sup> We assume that the revaluation takes place at the end of the period. The WACC of 10% is the expected cost of capital at the beginning of the year.

approximation neither the airport nor the airlines could be expected to benefit from choosing the less efficient approach.<sup>5</sup> Before investment is undertaken, then, efficiency is the dominant consideration in choosing an asset valuation approach.

## **5.2 Choosing Between Historic Cost and ODRC Midstream**

In the present case, in which the choice between historic cost and ODRC is being made after significant investments have occurred, the choice also has major implications for the distribution of value between the airport and the airlines. The Commerce Commission estimates that the historic cost of each of the airport's specialised airfield assets is lower than their ODRC. The total estimated difference in asset values is about \$90 million. If the estimate is correct, the (sustained) adoption of the Commission's approach to price setting would transfer about \$90 million from the airports to the airlines.

In this case, then, efficiency considerations can no longer be expected to dominate the airports' and airlines' choice of approach. The efficiency gains available from choosing the more efficient approach may well be outweighed by the redistributive implications of the choice.

## **5.3 Importance of Stability for Efficiency**

A regulatory regime in which the asset valuation method changes unexpectedly is likely to generate considerably less efficient outcomes than one in which either historic cost or ODRC is used consistently and predictably. Without predictability, airports can have no assurance that they will be able to recoup the cost of investments over time. Thus they are much less likely to risk making long-term investments.

A consequence of the value of stability is that regulators should be very cautious about changing the approach. In efficiency terms, the change will be beneficial if and only the cost of increasing perceived regulatory risk (specifically, regulatory-valuation-methodology risk) outweighs any efficiency benefits of the preferred approach taking starting values as given.

# **6 Equating Expected Revenues and Costs**

We now compare the two approaches and assess their expected effects on efficiency. We begin by considering the extent to which they allow investors in a start-up airport to recoup their costs. The Annex sets out some of the analysis underlying the comparisons.

---

<sup>5</sup> In practice, it is possible that strategic behaviour, or externally imposed constraints, might prevent the parties from agreeing on the efficient approach.

## 6.1 Historic-Cost and ODRC Approaches Compared

If properly implemented, both the historic-cost and ODRC approaches will equate expected revenues and expected costs and hence generate zero expected net present value. That is, if the inputs such as WACC and depreciation are estimated correctly, and the valuation approaches are expected to be used indefinitely, the approaches will allow investors to recover the cost of their investment.

In the historic-cost approach, an expected zero net present value is achieved by setting target revenue so that the company earns its expected cost of capital on any actual cash expenditures.

In the ODRC approach, the result is achieved by adjusting cash revenues for expected revaluations. Expected positive revaluations are treated as revenue; and expected negative revaluations as costs.

Upward revaluations can be thought of as reductions in the depreciation charge; downward revaluations as increases. Once this is recognised, it can be seen why the argument presented by the Commission that “ODRC is *not* sustainable where technological improvements are lowering the cost of modern equivalent assets” is not correct. Under the ODRC approach we consider, the conclusion is false because the level of expected revaluations (or depreciation, if it is preferred) takes into account expected reductions in value that result from expected technological obsolescence.

The same issues would arise under the historic cost approach if it incorporated optimisation. The historic-cost depreciation allowances would have to align with the chosen form of optimisation. If, as would seem likely, the effect of optimisation was asymmetric, so that it could lead to reductions but not to increases in depreciated historic cost, the depreciation allowances would have to take this into account.<sup>6</sup>

Under either approach, if the risks associated with optimisation are systematic, greater exposure to those risks will also increase the company’s cost of capital.

## 6.2 Efficiency Implications

As the Commission notes, it is crucial from the point of efficiency that airports can expect to recover the costs of efficient investments. If they could not, they would not invest. Similarly, allocative efficiency may be enhanced if the asset valuation method leads to prices that equal average costs.<sup>7</sup> The Commission correctly concludes that

---

<sup>6</sup> The asymmetry of optimisation means that depreciation allowances have to exceed the *probable* decline in the value of the asset, since the expected future asset value lies below its most probable (no optimisation) value. Ignoring the effect of changes in replacement cost, which can go up as well as down, the same is true for the ODRC approach.

<sup>7</sup> Note, however, that allocative efficiency depends as much on the structure of prices as their average level: allocative efficiency is maximised where the price of the last unit equals marginal cost.

the historic-cost approach satisfies this requirement. But the ODRC approach does as well.<sup>8</sup>

There are, however, significant differences between the approaches. First, although both approaches equate the *expected* present value of revenues and costs, neither guarantees that the present value of actual revenues will equal the present value of actual costs. That is, both subject the airport to risk.

Second, they create different time profiles of revenues.

## 7 The Time Profile of Revenues

In this section we consider those time profiles and the Commission's argument about "pre-financing".

### 7.1 Historic-Cost and ODRC Approaches Compared

Use of the historic-cost approach tends to lead to decreasing real revenue streams over the life of an investment. The ODRC approach, by contrast, leads to revenue streams that vary in real terms with changes in the real value of assets. If the value of assets is expected to remain constant in real terms, the approach leads to roughly constant expected revenue in real terms.<sup>9</sup> If real asset values are expected to increase over time, real revenues are also expected to increase with time.

Figure 1 illustrates the effects of the two approaches on the time profile of real revenues, assuming that the ODRC of assets is constant in real terms over time. The Figure is based on an illustrative numerical model of an airport and its revenues.<sup>10</sup>

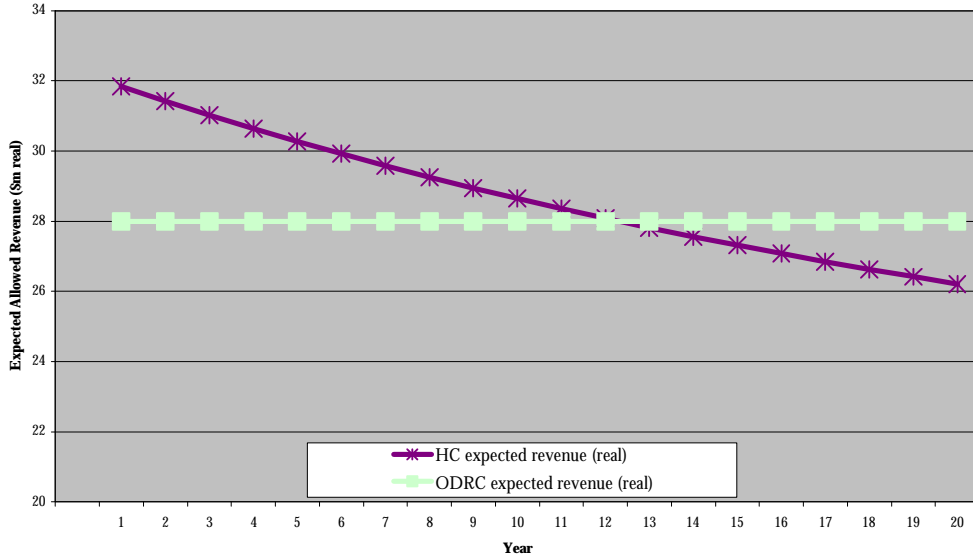
---

<sup>8</sup> In fact, even the opportunity-cost approach will equate the expected present value of costs and revenues, so long as a revenue-setting equation of the form used for the ODRC approach is employed. When the assets are sunk, the expected downward revaluation in the period after investment is equal to the entire value of the investment. Thus the revenue-setting equation for opportunity-cost pricing would require users to pay for the entire cost of a sunk investment in the year in which the investment was made.

<sup>9</sup> Expected prices would be exactly level in the approach we consider if it were not for the effect of taxes, which depend on the depreciation of assets at historic cost.

<sup>10</sup> The graph assumes the following (hypothetical) case: the firm has assets with a value of \$200 million, half of which depreciate at a rate of 4% per year, half of which (say, land) retain a constant real value; the expected inflation rate is 2%; the assumed real WACC is 7%; and operating costs are \$10 million per year, increasing with the rate of inflation. The graph is derived using pricing intervals of only one year, so that prices rise in nominal terms each year with inflation. The corporate-tax rate is set at zero. The present value of the two revenue streams and terminal asset values are equal.

**Figure 1: Allowed Revenues under Historic- and Replacement-Cost Approaches:  
Real Values**



Although both approaches generate expected zero net present value,<sup>11</sup> the graph shows that the approaches can lead to quite different time profiles of revenues.

Note that the graph shows expected allowed revenue. If volumes change over time, the profile of prices will differ from that of revenues. If volumes are increasing, for example, the ODRC price curve will slope down and the historic-cost price curve will slope down more steeply.

Notice also that the difference in the time profile of returns is not related to “pre-financing” or current users paying for assets that they are not using. It is true that the use of historic cost can lead to large changes in prices when assets are replaced, while the use of ODRC approach tends not to. And it is also true that the ODRC approach may lead to higher prices later in an asset’s life than does the historic-cost approach. Yet this does not have anything to do with the accumulation of cash to pay for the asset’s replacement; rather it reflects lower payments earlier in the asset’s life.

<sup>11</sup> Given a common discount rate.

## **7.2 Efficiency Implications**

Which price path is more efficient depends on the circumstances, but there are two points to note. First, the price profile will have an effect on allocative efficiency. If demand increases over time, so that marginal cost is initially low but capacity constraints develop later in the asset's life, a price profile that declines over time will be less efficient than one that is flat. Since increasing demand is the typical case, the ODRC price profile will usually be more efficient than the historic-cost price profile. Second, the ODRC approach exposes the airport to greater risk of unexpected change in regulation since it defers revenue (we discuss this further below).

## **8 Risks and their Allocation**

A second difference between the historic-cost and ODRC approaches lies in the way they allocate and, sometimes, create risks. In this Section, we identify some of the risks, describe their allocation under each of the two approaches, and comment on the expected efficiency benefits of those allocations.

### **8.1 Types of Risk**

We consider the following five types of risk:

- General price-level inflation is greater or lower than expected (inflation risk)
- Even though overall inflation is no higher than expected, the cost of the inputs specific to the provision of airport services increases more or less than expected (relative-price risk)
- The demand for the airport's services is higher or lower than expected (demand risk)
- The measure of asset value actually used differs from the true value according to the concept—for example, the estimate of ODRC exceeds true ODRC (measurement risk)
- A regulatory or other change leads to the adoption of a new valuation approach that generates a different asset value (valuation-methodology risk).

### **8.2 Inflation Risk**

As we noted earlier, asset valuation approaches affect outcomes only when combined with other inputs to generate current and expected future prices. The effect of asset valuation on the allocation of inflation risk is an example: formulas that link the airport's prices to inflation also influence the allocation of inflation risk. We consider the effect of asset valuation, assuming that prices are fixed in nominal terms between price resets, a reasonable approximation of arrangements under WIAL's Deed.

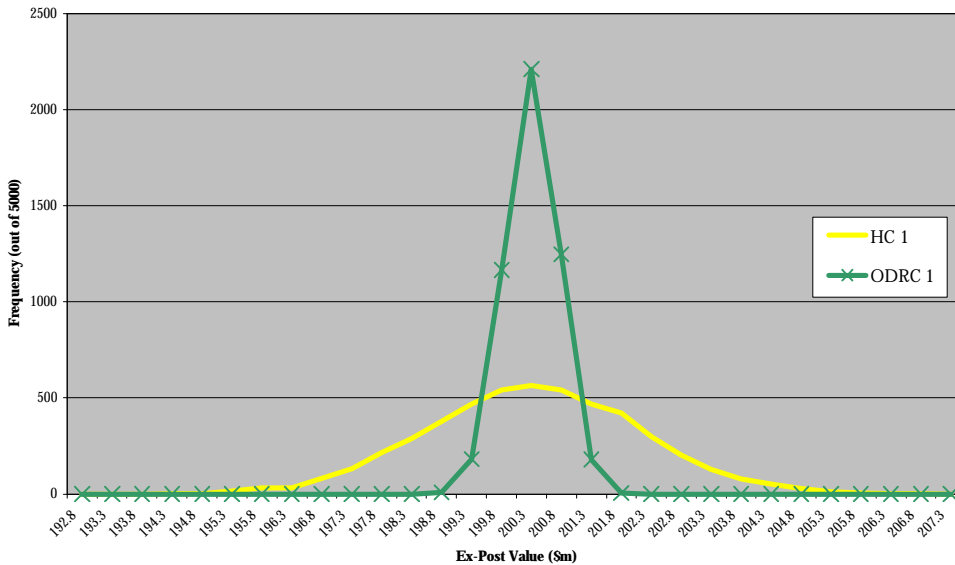
In the Executive Summary of its Report, the Commission states, “Historic cost is consistent with the fundamental principles adopted by the Commission.... Investors are compensated for inflation through the use of a nominal WACC (paragraph 43).” This isn’t strictly correct. The nominal WACC compensates investors for expected inflation. It does not compensate them for unexpected inflation between price revisions.

Thus, under the historic-cost approach, the airport’s actual value will vary according to inflation. If inflation is higher than expected, the real value of the fixed nominal cashflows it receives, and hence its value, will be lower than expected. If inflation is lower than expected, on the other hand, the airport’s actual value will be higher than expected.

So long as the period between price resets is not too long, the ODRC approach reduces the airport’s exposure to inflation risk. Higher-than-expected inflation leads to unexpected positive revaluations and consequently higher prices at the next price reset, partially compensating the airport for the effects of inflation.

Figure 2 illustrates, using the spreadsheet model. In the model, the airport’s initial value is \$200 million. Its ex-post value depends on actual inflation, which is assumed to vary randomly around a mean of 2%. The tighter dispersion of ex-post value under the ODRC approach shows the airports face less inflation risk under this approach.

**Figure 2: Inflation Risk under Historic-Cost and ODRC Approaches**



If prices are set in nominal terms, then, the ODRC approach allocates a greater proportion of the risk of unexpected inflation to airlines. That is, general increases in

prices are more fully passed on to customers under the ODRC approach. In general, this is likely to be efficient.

### **8.3 Relative-Price Risk**

As in the case of general price inflation, under the ODRC approach, the airport's asset value increases if the relative price of the inputs into the airport's services (e.g. the price of concrete) increases. Under the historic-cost approach, recorded asset values are unaffected by such changes.

If specialised assets are completely sunk, there is no difference in the incentive implications of the choice. Further, the use of replacement cost will create some variability in prices that has no beneficial effect. If specialised assets are not entirely sunk, however, the historic-cost approach can create adverse incentives. If the asset is not sunk and its replacement cost rises, the airport may have an incentive to sell it instead of keeping it in the asset base at historic cost.

### **8.4 Demand Risk**

The difference in the way the two approaches allocate risks associated with changes in demand for the service provided by an asset depends on the answers to the questions posed earlier about the operation of optimisation under the proposed historic-cost approach.

Under the ODRC approach, investors may be strongly exposed to demand risk. If they build a runway that turns out to be too long given demand, they cannot expect to recoup their costs. Similarly, if demand turns out to be as good or better than expected, they will recover slightly more than their costs.<sup>12</sup>

Under the interpretation of the historic-cost approach in which assets are optimised in roughly the same way they are under ODRC, investors' exposure to demand risk would be similar. Other possibilities, however, are that optimisation is "all or nothing" or takes into account only information available at the time of investment and not the benefit of hindsight—or indeed that there is no optimisation at all. In any of these cases, the airport would be exposed to less demand risk under historic cost than ODRC.

Other things equal, allocating demand risk to the airport has an efficiency benefit: it motivates the airport not to overbuild. This benefit is realised under the ODRC approach and the historic-cost approach to the extent that it includes optimisation. While allocating some demand risk to the airport will be beneficial, if demand risk is large and the airport's ability to forecast demand is small, both the airport and the airlines will benefit from an arrangement in which the airport's exposure to this risk is reduced.

---

<sup>12</sup> We assume that, because of the asymmetry of optimisation, depreciation allowances exceed the most probable (no optimisation) declines in value.

## 8.5 Measurement Risk

It is generally accepted that historic cost is subject to less measurement error than ODRC, but the Commission's proposal to use an *optimised* version of depreciated historic cost *for the purpose of price setting* raises measurement problems not present in financial reporting on the basis of historic costs. Neither historic cost nor ODRC can be measured perfectly and deviations in recorded values from the true conceptual values create an additional source of risk.

### 8.5.1 *Depreciated Replacement Cost and Depreciated Historic Cost in Financial Reporting*

Historic cost can usually be measured for the purpose of financial reporting without great ambiguity. It is based on transactions for which there are usually recorded prices (if the assets are very old, however, the case may be different). The measurement of ODRC, however, often requires judgements about the nature of the asset available now that would provide the same level of service as the actual asset and about the current cost of that asset. Sometimes, these judgements are straightforward; at other times they necessarily have a subjective element.

The calculation of appropriate depreciation rates is generally subjective under historic cost accounting, but no more so than under replacement cost accounting. And, under the ODRC pricing approach we consider, the forecasting of revaluations is also subject to error.

Many commentators have argued against current-cost accounting in general-purpose financial reporting on the grounds of subjectivity and measurement costs. The problems are also present in the use of ODRC for price-setting purposes. Witness for example the debates between airports and airlines over the appropriate ODRC valuation of airports' assets and the Government's recent call for standardised ODV (and hence ODRC) valuations in the electricity sector. Similar debates occur in Australia, the United Kingdom, and the United States when current cost valuation approaches are used in regulation.<sup>13</sup> Yet the fact that current-cost approaches are frequently used suggest the measurement problems are not overwhelming. In New Zealand, for example, ODRC is the standard valuation approach for specialised assets.

### 8.5.2 *Historic Cost for Cost-Based Price Setting*

Problems that exist in the use of historic cost for financial reporting increase in importance when their resolution affects prices as well as reporting. It becomes crucial, for example, whether the transaction is genuinely at arm's length. If assets are valued at historic cost, suppliers may have an incentive to purchase assets from related parties at inflated prices. This increases measurement problems related to determining whether the transaction was at arm's length. The problem does not arise under the ODRC approach.

---

<sup>13</sup> Historic-cost approaches are common in the United States, but ODRC-type approaches are sometimes used, such as for setting interconnection charges in telecommunications.

Second, the use of historic cost raises new problems. In financial reporting, an asset's historic cost may increase or fall if its ownership transfers from one party to another. If the transaction is at arm's length, an increase in value raises no problem of measurement error for the purposes of financial reporting. For the purpose of price setting, however, allowing the value to increase if the asset changes hands at a price higher than its carrying value is not in general a tenable position: suppliers would have incentives to transfer assets repeatedly for no reason other than to increase the historic cost of the assets.

Using historic cost for price setting is thus more problematic than using it for financial reporting.

### 8.5.3 *Optimised Historic Cost*

The Commission's apparent proposal to use *optimised* historic cost creates further measurement problems. Their extent depends on the details of the optimisation that would occur under the proposed approach.

As mentioned earlier, one possibility is that the optimisation is all or nothing. Either an asset is completely removed from the asset base or it remains in the asset base without any reduction in value. Some of the Commission's comments suggest, however, that it has in mind a type of optimisation similar to the optimisation in ODRC. How it would work is not clear, though. Suppose a runway is considered twice as long as necessary.<sup>14</sup> What happens to the historic-cost value of the runway? Would the optimised depreciated historic cost be considered to equal half of the depreciated historic cost? What if the cost of a runway is not proportional to its length? Should the optimised depreciated historic cost be considered to equal the hypothetical depreciated historic cost of the smaller runway, were that to have been built at the time the actual runway was built? If so, how would the hypothetical historic cost of the smaller runway be calculated or estimated? The measurement of partial optimisation appears problematic under the historic-cost approach.

### 8.5.4 *Implications for Efficiency*

If ODRC could be measured objectively and without error, there would appear from the foregoing to be little problem with its use and some efficiency advantages. Much of the concern with it stems from difficulty in reliably measuring it, which dulls its desirable efficiency properties and creates risk for both parties. (Value is transferred between the two parties just as a result of variation in measurement.)

Historic-cost as used in financial reporting can generally be measured with considerably less error than ODRC. Optimised depreciated historic cost of a type suitable for use in pricing would appear, however, to be subject to considerably more measurement error. And thus its use would also create risk for both parties. The extent would depend on the details of the Commission's proposed approach.

---

<sup>14</sup> Taking into account not only current use of the runway but also expected future use and the option value created by excess capacity.

## 8.6 Valuation-Methodology Risk

When prices are set on the basis of asset values, both airports and airlines are exposed to the risk that valuation methodologies may change in the future, whatever valuation approach is currently used.

Under the historic-cost approach, the airport gets more of its revenue “up front” than it does under the ODRC approach. Thus the airport loses from an unanticipated regulatory shift from ODRC to historic cost and gains from an unanticipated shift from historic cost to ODRC. The reverse holds true for airlines.

Figure 1 illustrates this point. To get an idea of the effect of valuation-methodology risk, suppose that the valuation methodology switches at the point where the historic-cost and ODRC revenue lines cross. If prices are initially based on ODRC, but the method switches to historic cost at the point of crossover, the airlines gain and the airport can no longer expect to recover the costs it had previously incurred. Conversely, if prices are initially set on the basis of historic cost but the method switches to ODRC at the point of crossover, the airport wins and the airlines lose.

Valuation-methodology risk is critical and should be minimised. Starting from scratch, before investments are sunk, it would be important to consider whether one method was more likely to be sustained than the other. Other things equal, the approach more likely to endure would be preferable.

Considered midstream, as in the present case, it is crucial to consider the extent to which a change now will reduce airports’ and airlines’ confidence in the stability of future valuation regimes. Unless ODRC is considered unsustainable (and we are not aware of any reason to think that it is), a change now to historic cost would increase perceived regulatory risk and discourage investment in infrastructure. The potential efficiency loss is large.

## 9 Conclusions on the Commission’s Reasoning

Given the analysis above, we can consider again the reasoning on which the Commission appears to rely in arriving at its preliminary view that specialised airfield assets should be valued at (optimised) depreciated historic cost.

While the Commission’s discussion of asset valuation refers to many relevant issues—including the importance of allowing investors to earn a return on sunk investments—its apparent reasons for preferring historic cost to ODRC are flawed:

- Its main argument against the use of ODRC appears to be that it “explicitly involves an element of pre-financing”. Yet, as we have seen, the difference in the time profile of revenues under the ODRC and historic-cost approaches does not relate to pre-financing.
- In addition, while the Commission argues correctly that the historic-cost approach can preserve incentives to invest, it appears incorrectly to accept arguments that the ODRC approach cannot.

- Further, the Commission appears to underestimate the measurement and administrative complications created by the use of an *optimised* historic-cost approach for price setting.

Most important, it appears not to have appreciated the risk created by midstream changes in valuation approach. The arguments for choosing between historic cost and ODRC at the outset of an investment in sunk assets are subtle, and different approaches might reasonably be chosen in different circumstances. The arguments against *changing* approach midstream are, however, strong.

## Annex: Analysis of Historic-Cost and ODRC Approaches

This annex considers the circumstances in which the historic-cost and ODRC approaches ensure that investors can expect to recover the cost of their investment. It also considers the circumstances in which the monitoring of returns on assets measured at their historic cost is equivalent to the monitoring of returns on assets measured at ODRC.

In addition to arguing for the use of historic cost as the valuation measure for specialised assets, the Commission states at paragraph 8.78 that it has adopted a nominal WACC rather than a real WACC. It claims in paragraph 8.77 that application of a nominal WACC to depreciated historic cost is equivalent to application of a nominal WACC to revalued assets provided asset revaluations are included in income. The Commission appears to base this claim on Treasury handbook on estimation of the cost of capital.<sup>15</sup> However, while the claim above is made in the Treasury handbook, it is based on analysis of a simple example and is in fact crucially dependent on certain simplifying features of the example.

Define

$E$  = accounting income

$B$  = book value of net assets

$D$  = net dividends (dividends net of share issues and repurchases)

$I_0$  = initial investment

$V_0$  = value, and

$r$  = cost of equity capital.

Value,  $V$ , is given by

$$V_0 = \frac{D_1}{1+r} + \frac{D_2}{(1+r)^2} + \dots + \frac{D_n}{(1+r)^n} + \frac{V_n}{(1+r)^n}$$

If the entity practices clean-surplus accounting, that is, all changes to equity are taken through the statement of financial performance (in particular, asset revaluations, if any, are taken to income), then

$$B_t = B_{t-1} + E_t - D_t$$

and therefore

---

<sup>15</sup> Treasury, *Estimating the Cost of Capital for Crown Entities and State-Owned Enterprises*, October 1997.

$$V_0 = \frac{E_1 - (B_1 - B_0)}{1+r} + \frac{E_2 - (B_2 - B_1)}{(1+r)^2} + \dots + \frac{E_n - (B_n - B_{n-1})}{(1+r)^n} + \frac{V_n}{(1+r)^n}$$

It is easily shown that this expression for  $V_0$  reduces to

$$V_0 = B_0 + \sum_{t=1}^n \frac{(E_t - rB_{t-1})}{(1+r)^t} + \frac{V_n - B_n}{(1+r)^n}$$

This result is sometimes referred to as the residual-income valuation model as the terms

$$E_t - rB_{t-1}$$

measure residual income,  $RI_t$ , in each year. The residual income may be restated as

$$RI_t = (y_t - r)B_{t-1}$$

where  $y_t$  is the rate of return on book value in year  $t$ .

It is important to note that the clean-surplus relation is simply a definition or tautology and therefore the valuation model derived holds whether historic cost, or ODRC, or other measure of cost is used as the system of accounting measurement and also for any system of depreciation.

Now  $NPV$ , net present value, is given by

$$NPV = V_0 - I_0$$

and thus, if

$$-(I_0 - B_0) + \sum_{t=1}^n \frac{(E_t - rB_{t-1})}{(1+r)^t} + \frac{V_n - B_n}{(1+r)^n} \geq 0$$

then under either the historic-cost or ODRC approaches investors would expect to recover the cost of their investment.

Obviously, both the reported income and reported residual-income streams will depend on the measurement and depreciation systems adopted. The reported stream under one set of choices of measurement and depreciation systems will be equivalent (in a present-value sense) to the stream under a different set of choices, only under certain conditions. If it is assumed that

- (i)  $I_0 = B_0$  that is, initial investment equals the book value of the investment,

and

(ii)  $V_n = B_n$  that is, economic value and book value at  $t = n$  are the same,

then

$$V_0 - I_0 = \sum_{t=1}^n \frac{(y_t - r)B_{t-1}}{(1+r)^t}$$

that is,

$$NPV = \sum_{t=1}^n \frac{(y_t - r)B_{t-1}}{(1+r)^t}$$

Thus, under these assumptions, NPV equals just the present value of the residual income stream. That is, income and residual income numbers reported under one set of choices of measurement and depreciation systems would have the same present value as the numbers reported under a different set of choices and it would thus be appropriate to assess performance by comparison of return on book value of net assets,  $y_t$ , and the cost of capital,  $r$ .

In particular, if the assumptions hold under both historic cost and ODRC then it would be appropriate to regard these two approaches as providing income and residual-income streams that are equivalent in terms of present values. Under both the historic-cost and ODRC approaches, prices set so that  $NPV = 0$  would equate the present value of revenues and costs.

The assumptions set out above hold in the example analysed in the Treasury handbook. The example has outlays equal to the initial book value, closing economic value equal to zero, and depreciation under each of historic cost and ODRC (current cost) is set so that the closing book value is also equal to zero. Each of historic cost and ODRC then produces income and residual income streams such that the PV of the residual income stream equals the project NPV (= 0).

However, for a continuing project it would, in general, be most unlikely that the closing economic value was the same as the closing book value under historic cost. Therefore,  $NPV$  would not be equal to the present value of the residual-income stream—rather it would be necessary to also take into consideration the difference between the closing economic and book values. Similarly for monitoring of performance. In contrast, under ODRC, closing book value should reasonably approximate closing economic value and thus  $NPV$  would be indicated by the present value of the residual income stream, and residual income would indicate performance.

For cost-based price setting, it would be necessary to ensure that economic value and book value were expected to be the same in the future. That is, the company must expect that prices will continue to be set in the same way until the asset's value declines to zero. The result will not hold if, for example, asset valuation methods are assumed to change between resets.