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Depreciation & Capital Charge under Tilted Annuity, Replacement Cost and Historic Cost Approaches

Introduction

This note provides an explanation of the 'steady state' relationships between alternative approaches to calculating capital recoveries (the sum of depreciation and WACC charges) on investments in fixed assets. The note should be read in conjunction with the working examples set out in the Excel workbook 'Supporting workbook capital recoveries explanation paper 22 March 2016.xlsx'.

Some submissions to the Commission have expressed a view that the depreciation amounts calculated using the tilted annuity methodology and deducted as a cost in calculating the milk price are 'too low', inasmuch as even in steady state[1] (with inflation) the approach generates depreciation charges that are lower than the charges calculated under a more traditional (from an accounting perspective) historic cost methodology. The Commission has also queried why steady state depreciation recoveries under the two approaches are different.

Underlying Principles

The primary objective of any capital recovery methodology in a regulatory context is to allow for a reasonable expectation of the full recovery of capital costs, comprising both the initial purchase cost and a WACC recovery on unrecovered capital balances, over the expected life of an asset.[2] So long as a WACC charge is applied to the unrecovered balance (or opening book value) at the start of each period, *any* phasing of depreciation deductions will satisfy this primary objective.

In choosing between depreciation approaches, it is therefore necessary to have regard to relevant secondary objectives. In the milk price context, we have selected the following secondary objectives:

- Annual capital recovery amounts for a particular year on assets of a specific category should be largely independent of each asset's acquisition date. This objective was considered important as it broadly means that any initial allocation of assumed acquisition dates will generate the same (or similar) capital recoveries, and therefore meant the initial, inevitably arbitrary, asset allocation did not have a significant impact on the quantum of the initial capital recoveries. It also meant that, by 'spreading back' the initial asset base, we could assume the asset base was progressively updated over time for new technology.
- Similarly, it is appropriate to assume the asset base has been (more or less) in a steady state since the implementation of the milk price methodology. Among other things, it would arguably not have made sense to factor in the initial depreciation advantages available to a

[1] 'Steady state' in this context means the business is maintaining a constant level of capacity, with assets that reach the end of their economic lives being replaced with a new asset with equal capacity.

[2] This objective can equivalently be expressed as one where the present value of future after-tax capital recoveries in respect of a particular asset, when discounted at an appropriate WACC, should equal the asset's initial cost.

new entrant in the early years of the regime, only to have these phased out over time (implying a structural decrease in the milk price) as the regime matured. This means, however, that at least on this dimension, the methodology will generate a lower price than the milk price that could be paid by a new entrant.

Analysis

The supporting workbook models three capital recovery regimes (tilted annuity, historic cost and replacement cost[3]) over three stylised phases of a business's life: ramp-up to steady state, with one asset being added each year, until steady state is reached in the year corresponding to the asset life (e.g., year 30 for assets with a 30 year life), a steady state period, where one asset is added each year while one asset drops off, and a 'ramp down' period, during which no assets are acquired and the asset base therefore decreases by one asset per year until all assets have dropped off.

Our focus on these three stages enables us to isolate the structural impact of assuming in the milk price methodology (a) a tilted annuity methodology and (b) that steady state was reached prior to inception of the methodology, relative to alternative assumptions.

Results

The results presented below reflect the following common assumptions:

- A firm life of 100 years, and an initial (nominal) asset cost of $100.
- Each asset has a life of 30 years,[4] and has identical capacity, so the first 30 years comprise the 'ramp-up' phase, where the number of assets on hand increases by one each year, years 31 – 70 are 'steady state' years, and years 71 – 100 are 'ramp-down' years, where the number of assets decreases by one each year.
- A real WACC of 5%. (Holding the real rather than nominal WACC constant means we can isolate the 'true' implications of inflation, rather than apparent impacts due to differences across scenarios in real required rates of return.)

[3] It is unusual to see an historic cost methodology employed in a regulatory context. We would more typically observe a replacement cost methodology, where depreciation is calculated on the current replacement cost but 'revaluation' gains are added back as, in effect, negative depreciation.

[4] The weighted average economic life assumed for the milk price asset base is approximately 31 years.

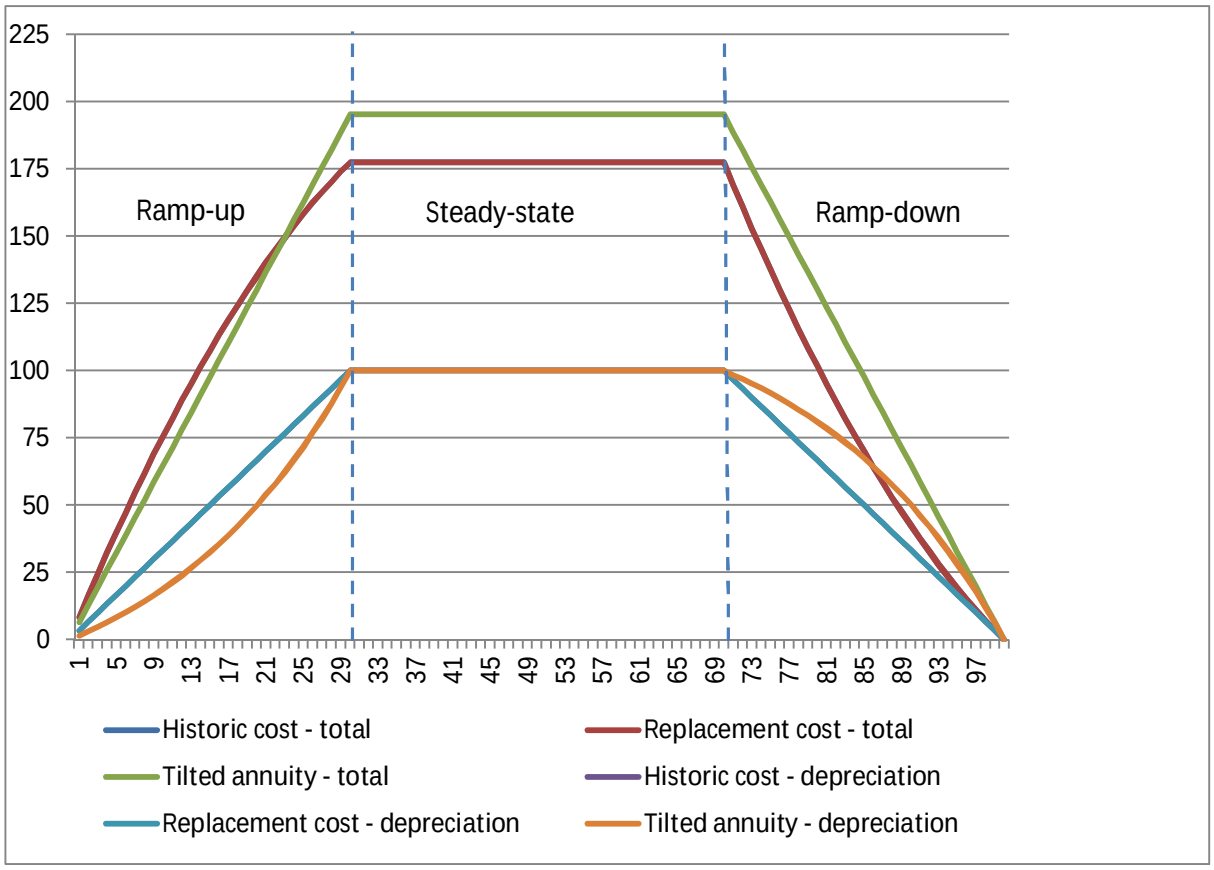
Scenario 1: Nil inflation

	Present values				Nominal values		
Total Ramp-Up Values	Depreciation	WACC	Depn + WACC	% lifetime total	Depreciation	WACC	Depn + WACC
1. Historic cost	590	647	1,238	60.9%	1,450	1,498	2,948
2. Replacement cost	590	647	1,238	60.9%	1,450	1,498	2,948
3. Tilted annuity	417	735	1,152	56.7%	1,097	1,733	2,830
Total steady state values							
1. Historic cost	420	326	746	36.7%	4,100	3,178	7,278
2. Replacement cost	420	326	746	36.7%	4,100	3,178	7,278
3. Tilted annuity	420	400	820	40.4%	4,100	3,901	8,001
Total Ramp-down Values							
1. Historic cost	30	17	48	2.3%	1,450	749	2,199
2. Replacement cost	30	17	48	2.3%	1,450	749	2,199
3. Tilted annuity	36	23	59	2.9%	1,803	1,027	2,830
Lifetime totals							
1. Historic cost	1,041	990	2,031		7,000	5,425	12,425
2. Replacement cost	1,041	990	2,031		7,000	5,425	12,425
3. Tilted annuity	873	1,158	2,031		7,000	6,661	13,661

From the table above:

- Since one asset costing $100 each is acquired in each of years 1 – 70, total asset purchase costs are $7000, and total depreciation over the 100 year timeframe is therefore also $7000.
- The present values of depreciation and WACC allowances in each of the three phases are calculated as at Year 0.
- At nil inflation, the nominal and present values of steady state depreciation are the same under all three approaches. (And because inflation is nil, the historic cost and replacement cost approaches generate identical results.)
- However, even at nil inflation, depreciation is deferred under the tilted annuity approach relative to historic cost and replacement cost. Consequently, the undepreciated balances (opening book values) are always higher under tilted annuity, and steady-state WACC charges are higher, as shown in Figure 1. In the ramp-up period these higher WACC charges are more than offset by lower depreciation charges, so total capital recoveries under tilted annuity are lower in this period. Since the tilted annuity approach is used in the milk price methodology, the implied milk price would be higher during the ramp-up phase than it would be if historic or replacement cost was used.
- In the steady-state phase, WACC charges under the tilted annuity approach are 23% higher than under historic / replacement cost (and 34% higher in the ramp-down period). It follows that, since we have in effect ignored the ramp-up phase with respect to the initial milk price asset base, the milk price will be structurally lower over the approximately 30 years until the initial asset base is assumed to be fully depreciated that it would have been if either (a) we had assumed the initial asset base was all installed in 2008, or (b) we had still assumed the initial asset base was spread back, but had instead used a replacement or historic cost depreciation methodology.

Figure 1: Capital recoveries profile at nil inflation



Scenario 2: 3% inflation

	Present values				Nominal values		
Total Ramp-Up Values	Depreciation	WACC	Depn + WACC	% lifetime total	Depreciation	WACC	Depn + WACC
1. Historic cost	460	865	1,325	65.2%	1,953	3,409	5,361
2. Replacement cost	213	1,024	1,238	60.9%	1,105	4,187	5,292
3. Tilted annuity -	11	1,162	1,152	56.7%	273	4,891	5,164
Total steady state values							
1. Historic cost	275	396	670	33.0%	12,475	17,981	30,456
2. Replacement cost	230	515	746	36.7%	10,474	23,418	33,891
3. Tilted annuity	187	633	820	40.4%	8,510	28,752	37,262
Total Ramp-down Values							
1. Historic cost	17	18	36	1.8%	8,632	7,740	16,372
2. Replacement cost	20	27	48	2.3%	11,481	12,076	23,557
3. Tilted annuity	23	37	59	2.9%	14,277	16,804	31,080
Lifetime totals							
1. Historic cost	751	1,279	2,031		23,059	29,130	52,189
2. Replacement cost	464	1,567	2,031		23,059	39,681	62,740
3. Tilted annuity	199	1,832	2,031		23,059	50,447	73,506

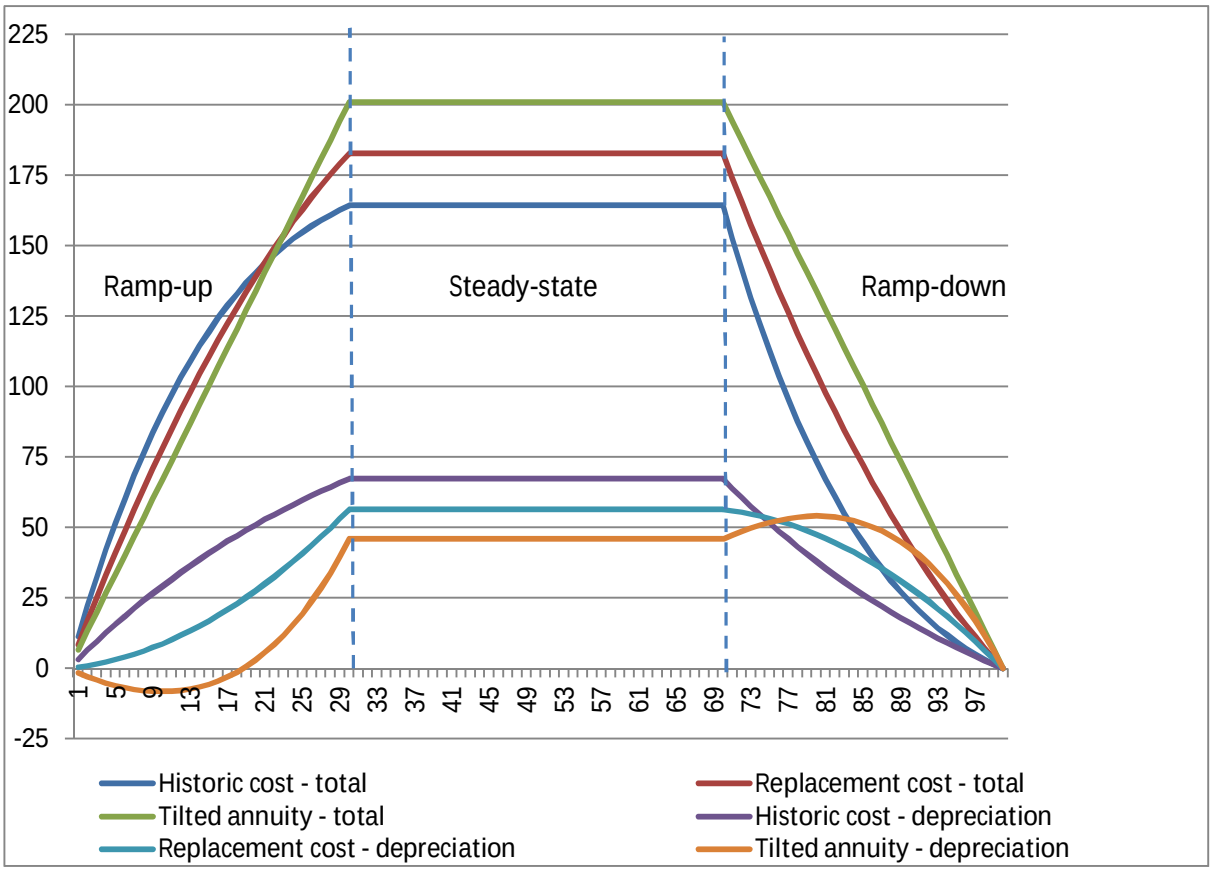
The table above shows the present and nominal values of depreciation and WACC recoveries in each phase in the presence of inflation. The table below compares these results in percentage terms to the 'nil inflation' results.

Relative to 0% inflation	Present values				Nominal values		
Total Ramp-Up Values	Depreciation	WACC	Depn + WACC	% lifetime total	Depreciation	WACC	Depn + WACC
1. Historic cost	78%	134%	107%	60.9%	135%	227%	182%
2. Replacement cost	36%	158%	100%	60.9%	76%	279%	179%
3. Tilted annuity	-3%	158%	100%	56.7%	25%	282%	182%
Total steady state values							
1. Historic cost	65%	122%	90%	36.7%	304%	566%	418%
2. Replacement cost	55%	158%	100%	36.7%	255%	737%	466%
3. Tilted annuity	45%	158%	100%	40.4%	208%	737%	466%
Total Ramp-down Values							
1. Historic cost	57%	107%	75%	2.3%	595%	1033%	744%
2. Replacement cost	67%	158%	100%	2.3%	792%	1612%	1071%
3. Tilted annuity	62%	158%	100%	2.9%	792%	1637%	1098%
Lifetime totals							
1. Historic cost	72%	129%	100%		329%	537%	420%
2. Replacement cost	45%	158%	100%		329%	731%	505%
3. Tilted annuity	23%	158%	100%		329%	757%	538%

From these tables:

- The 'tilt' factor in the tilted annuity approach results in the annuity stream increasing with inflation, but because we also increase the discount rate by inflation this does not result in any change in the allocation of aggregate tilted annuity capital recoveries between periods, relative to the nil inflation counterfactual. Similarly, the inflation adjustments in the replacement cost approach also result in allocations between periods not changing under this approach. Allocations do, however, change materially under the historic cost approach, with capital recoveries now being relatively more 'front-loaded' toward the ramp-up period.
- The addition of inflation also changes the composition of capital recoveries under all approaches, putting an increasing weight on WACC recoveries (as expected, given the increase in the nominal WACC). Relative to a historic cost benchmark, this change in composition is more pronounced for replacement cost than historic cost, and more pronounced again for tilted annuity. Whereas depreciation accounts for 51% of the present value of steady state tilted annuity capital recoveries at nil inflation, it only accounts for 23% at 3% inflation. In contrast, the corresponding ratios for historic cost are 56% (nil inflation) and 41% (3% inflation) and 56% / 31% for replacement cost.
- Figure 2 shows the net impact of all this, with the ratio of total steady state capital recoveries under tilted annuity to historic cost increasing with inflation, but the ratio of steady-state depreciation to historic depreciation decreasing with inflation. (Note that the capital recovery amounts shown in the table are inflation-adjusted, to facilitate comparison with Figure 1.)

Figure 2: Capital recoveries profile (real) at 3% inflation



Concluding comments

1. It is necessary to focus on the profile of total capital recoveries (depreciation and WACC charges) rather than on any individual component when considering the adequacy and reasonableness of milk price capital charges.
2. In the presence of inflation, 'steady state' depreciation will be systematically lower under the tilted annuity approach than under either a historic or replacement cost methodology.
3. The lower depreciation profile will, however, be more than offset by higher steady state WACC recoveries.
4. Even at nil inflation, total steady state capital recoveries will be higher (and the milk price therefore lower) under tilted annuity compared to the alternatives.
5. Ordinarily, this impact will be precisely offset (in present value terms) through lower capital recoveries during the 'ramp up' phase, as capacity is built up. However, by setting the initial asset base 'as if' the notional milk price business was already in a steady state in the first year of operation we have foregone this offset, and by selecting the tilted annuity approach have imposed, in effect, a systematic overstatement of capital recoveries / understatement of the milk price with respect to the initial asset base. (This conclusion does not however extend to the additional capacity we have added to the model since inception.)