EXOGENOUS VS ENDOGENOUS RATES OF RETURN:

THE USER COST OF CAPITAL IN STATISTICS NZ'S MULTI-FACTOR PRODUCTIVITY MEASURES

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Abstract

The choice of methodology used to derive the user cost of capital services can have a significant impact on the relative weights assigned to the various assets providing an input into the production function of an industry. This paper presents an analysis of the differing methods that could be used to calculate the user cost of capital, and assesses each of the methods against a range of criteria. The analysis indicates that the use of an exogenous rate of return and excluding capital gains from the formulation of the user cost of capital provides superior results in the New Zealand context.

JEL Codes: D24, E22, O47

Keyword(s): Productivity: Capital Services: User Cost of Capital: Rates of Return

Introduction

In 2003 Statistics New Zealand received funding under the Government's Growth and innovation Framework (GIF) to develop official productivity measures for the New Zealand economy. In March 2006, Statistics NZ published the first official estimates of multi-factor productivity for New Zealand. These estimates were for a subset of the industries in New Zealand, referred to as the 'Measured Sector'. The original 'Measured Sector' comprised Australia New Zealand Standard Industrial Classification 1996 (ANZSIC96) divisions A to K plus P. In 2008, additional industries (ANZSIC96 divisions L (pt) and Q) were included in the scope of the 'Measured Sector'.

Presently, official productivity estimates are available for the 'Measured Sector' as an aggregate, and no official estimates are presented for individual industries. Explaining aggregate multi factor productivity growth is an essential part in understanding the performance of an economy.

A total factor productivity (TFP) residual can, in principle, be computed for every level of economic activity, from the plant floor to the total economy. These residuals are not independent of each other because, for example, the productivity of a firm reflects the productivity of its component plants. Similarly, industry residuals are related to those of the constituent firms, and productivity in the aggregate economy is determined at the industry level. As a result, productivity at the aggregate level will increase if productivity in each constituent industry rises, or if the markets share of the high productivity industry increases (and so on, down the aggregation hierarchy). A complete picture of the industrial dynamics of an economy would include a mutually consistent measure of the TFP residuals at each level in the hierarchy and of the linkages used to connect levels. (Hulten, 2001)

This paper provides a brief summary of the work which has been undertaken to date on productivity measurement in New Zealand, together with an investigation into the derivation of the user cost of capital and resulting methodology that is employed in the current measures. This work has developed as part of Statistics NZ's current work programme to produce industry level measures of multi-factor productivity.

Section 2 provides a brief background to productivity measurement, both in general and more specifically within Statistics NZ's productivity series. Section 3 provides a summary of the concepts underlying the user cost of capital, together with the variety of options for measurement and the range of assessment criteria which were used to assess the different scenarios. Section 4 presents an assessment of each of the scenarios, against the assessment criteria together with selected empirical results of calculating user cost of capital (and resulting asset weights), and compares and contrasts these. Section 5 summarises and concludes.

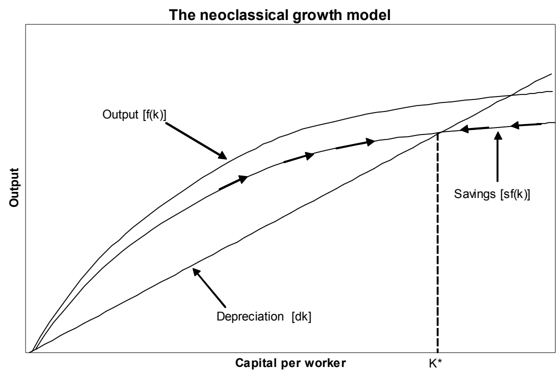
Background to Productivity Measurement

Introduction to Productivity Measures

Generally speaking, growth in output can be achieved through either factor accumulation (supplying more inputs) or through improvements in the efficiency with which those inputs are transformed into outputs.

Starting with an aggregate neoclassical production function exhibiting constant returns to scale, and assuming diminishing returns, an aggregate production function can be presented as illustrated below (illustration and example taken from Maré 2004). As capital input per worker increases, so too will output, albeit at a diminishing rate, while savings are assumed to be a fixed proportion of output. In order to maintain the existing stock of capital, the level of savings must equal the rate of depreciation of the capital stock (given by the straight line). If the level of savings is below that required to maintain the existing stock of capital (i.e. to the right of K*), then the stock of capital will reduce (capital shallowing). If the level of savings exceeds the date of depreciation, then the capital stock will increase (capital deepening).

An implication of this model is that growth (per worker) stops in the long run. What is required to increase output per worker is to shift the production function up (ideally continually). This upward movement in the production function equates to increased productivity (of either labour or capital), and is often referred to as "technical progress" or "total factor productivity".



In simple terms then, productivity measures the efficiency with which inputs are transformed into outputs. When all inputs used in the production process are considered relative to output produced, the resulting efficiency measure is termed Total Factor Productivity (TFP). In a measurement framework where a subset of inputs is considered, the resulting efficiency measure is termed Multi Factor Productivity (MFP). The MFP estimates were referred to by Abramovitz (1956) as a "measure of our ignorance", in that they represent not only technological improvements, but will also reflect such things as measurement error, omitted variables and model mis-specification.

MFP is of interest to policy makers and economists alike, as it is through improvements in productivity that an economy is able to produce more output with limited (or fixed) inputs, and therefore materially improve the well-being of the economy. Interest in productivity measurement (expressed as output per unit of input) dates back to the work of Copeland and Stigler mid 1930's, and existing productivity measurement methods derive themselves from the production function approach developed by Robert Solow in the late 1950's.

In essence, we begin with an aggregate production function (See Hulten (2001) for a detailed explanation of the derivation of TFP estimates):

$$Q_t = A_t F(K_t, L_t) \qquad (1)$$

Where Q_t = volume of output in period *t*

K_t = volume of capital input in period *t*

L_t = volume of labour input in period *t*

A_t = the shift in the production function for given levels of labour and capital

Using a non-parametric index number approach (OECD 2001) and applying a total (logarithmic) differential of the production function, equation (1) can be re-expressed as:

$$\frac{\dot{Q}_t}{Q_t} = \frac{\partial Q}{\partial K}\frac{K_t}{Q_t}\frac{\dot{K}_t}{K_t} + \frac{\partial Q}{\partial L}\frac{L_t}{Q_t}\frac{\dot{L}_t}{L_t} + \frac{\dot{A}_t}{A_t} \qquad (2)$$

This expression indicates that the growth of real output is a result of the growth in labour and capital inputs (weighted by their respective output elasticities) and the shift in the production function. Assuming that there is perfect competition in labour and capital markets, the price of each input will be equal to its marginal product, i.e.:

$$\frac{\partial Q}{\partial K} = \frac{r_t}{p_t} \text{ and } \frac{\partial Q}{\partial L} = \frac{w_t}{p_t} \qquad (3)$$

Where r_t= the price of capital in period t

w_t= the price of labour in period t

Substituting these relative prices into equation (2) results in an expression of the growth in the 'Solow Residual" (i.e. the growth in multi-factor productivity) as:

$$\frac{\dot{A}_t}{A_t} = \frac{\dot{Q}_t}{Q_t} - s_t^K\frac{\dot{K}_t}{K_t} - s_t^L\frac{\dot{L}_t}{L_t} \quad (4)$$

Where s_t^K = capital's share of income in period t

s_t^L = labour's share of income in period t

This provides the theoretic basis for the "growth accounting" decomposition of multi-factor productivity.

There are two important assumptions underlying this formulation of growth in multi-factor productivity. The first assumption is that of constant returns to scale technology: this imposes the restriction that, in any one period, the output elasticities sum to unity. The second assumption is that of perfectly competitive labour and capital markets, such that labour and capital prices equal their respective marginal products.

Statistics NZ work to date

In 2003 Statistics NZ received funding under the Government's Growth and innovation Framework (GIF) to develop official productivity measures for the New Zealand economy.

In March 2006, Statistics NZ published the first official estimates of multi-factor productivity for New Zealand. These estimates were for a subset of the industries in New Zealand, referred to as the ‘Measured Sector’. The original ‘Measured Sector’ comprised of ANZSIC96 divisions A to K plus P, and covered the period 1988 to 2005. In March 2008, additional industries (ANZSIC96 divisions L (part) and Q) were included in the scope of the ‘Measured Sector’, bringing approximately 73 percent of economic activity in New Zealand in scope of official productivity estimates.

Work to date has focussed on producing productivity estimates at the aggregate ‘Measured Sector’ level. This work has involved developing general methodologies for the compilation of the labour and capital input indexes, together with an expansion of the range of industries covered within the ‘Measured Sector’, and extending the aggregate series back to 1978.

The following table provides a summary of the releases which have been published to date, and which are available on the Statistics NZ website.

Table 1. Statistics NZ Productivity Publications

Release Date	Title and Description
March 2006	Productivity Statistics Information Paper
March 2006	Productivity Statistics (1988 – 2005)
March 2007	Productivity Statistics (1988 – 2006)
October 2007	Extracting Growth Cycles from Productivity Indexes
October 2007	Productivity Statistics (1978 – 2006)
March 2008	Productivity Statistics (1978 – 2007)
December 2008	Quality Adjusted Labour Volume Series
March 2009	Productivity Statistics (1978 – 2008)
March 2010	Productivity Statistics (1978 – 2009)
March 2010	Productivity Statistics Sources and Methods (updated March 2010)
March 2010	Measuring government sector productivity in New Zealand: a feasibility study

Capital Services Measures

Underlying concepts and methods

Capital, (together with labour) is one of the primary inputs in productivity analysis. In practice, it is not the actual physical stock of capital that is considered to be the input into the productive process, rather the ongoing flow of capital services which that capital stock generates. In the absence of directly observable flows of capital services, these are approximated as a proportion of the productive capital stock (OECD 2009, p. 60).

Statistics NZ uses a perpetual inventory method (PIM) to derive the productive stock of capital by asset type and industry. These productive capital stock estimates, together with estimates of the stock of land (in agricultural and forestry industries), livestock (in agriculture), and standing timber (in forestry) are used to derive the capital services volume measure used in MFP calculations. At the time of writing this paper (early 2009), land was only included within the agriculture and forestry industries. This has since been improved to include estimates for land in all other industries. In addition, inventories are now also included in all industries. For more detailed information on the capital services measures in New Zealand’s MFP estimates, see “Productivity Statistics: Sources and Methods” (2009).

Industry capital services indexes are constructed as Törnqvist indexes, where the geometric mean of assets’ two-period productive capital stock ratios are weighted exponentially by each asset’s mean two-period share of the industry’s value of capital costs. An asset’s cost of capital is its user cost (rental price) multiplied by its flow of capital services. An index of capital services K for industry i in period t can be expressed as follows:

$$K_{it} = \frac{C_{it}}{C_{i(t-1)}} = \prod_j \left(\frac{PKS_{ijt}}{PKS_{ij(t-1)}}\right)^{Wl_{it}} \quad (13)$$

Where: K_{it} = the index of capital services of industry *i* in period *t*

C_{it} = the volume of capital services produced by industry *i* in period *t*

PKS_{ijt} = the productive capital stock of asset *j* in industry *i* in period *t*

Wijt = the weight of asset *j* in industry *i* in period *t*

The weights can be expressed as follows:

$$w_{ijt} = \frac{1}{2}\left(\frac{u_{ijt}PKS_{ijt}}{\sum_j u_{ijt}PKS_{ijt}} + \frac{u_{ij(t-1)}PKS_{ij(t-1\_}}{\sum_j u_{ij(t-1)}PKS_{ij(t-1\_}}\right) \quad (14)$$

Where

u_{ijt} = the user cost (rental price) of asset *j* in industry *i* in period *t*

The user cost of capital could theoretically be observed as a market rental price for the asset concerned. Given however that capital rental markets are often very sparse (if not non-existent), the user cost is approximated by an implicit rental that owners of capital are inferred to be charging themselves. The formula for this user cost equation currently employed by Statistics NZ is as follows:

$$u_{ijt} = p_{ijt}\left(i_{it} + d_{ijt} - g_{ijt}\right) + p_{ijt}x_{it} \quad (15)$$

Where:

p_{ijt} = the change in the price index of new capital asset *j* in industry *i* in period *t*

i_{it} = the nominal rate of return in industry *i* in period *t*

d_{ijt} = the rate of economic depreciation of asset *j* in industry *i* in period *t*

g_{ijt} = the capital gain effect due to the revaluation of asset *j* in industry *i* in period *t*

x_{it} = the average non-income tax rate on production for industry i in period t

In the absence of price change (i.e. $p = 1$ and $g = 0$) this user cost equation effectively means that the owner of the capital is imputed to charge themselves a "rental price" which is sufficient to cover an expected rate of return, the depreciation of the asset, and any taxes on production which are attributable to capital. Where prices are increasing, these factors are scaled up accordingly, and the user cost is reduced to reflect that fact that the owner of the capital asset is effectively discounting the rental price by the amount of the capital gain which is experienced. In Statistics NZ's original productivity estimates, capital gains were only included in the user cost equation in New Zealand for land and buildings.

The nominal rate of return term in equation 15 represents the rate of return which is expected within an industry. Originally, Statistics NZ calculated an "endogenous" rate of return, where it was assumed that the remuneration of capital services exactly exhausted gross operating surplus i.e.

$$i_{it} = \frac{Yk_{it} - \sum_j PKS_{ijt}(p_{ijt}(d_{ijt} - g_{ijt}) + p_{ijt}x_{ijt})}{\sum_j p_{ijt}PKS_{ijt}} \qquad (16)$$

Where

Yk_{it} = current price capital income in industry i in period t

In a model where all capital assets are observed and there is perfect competition, such that the marginal product of capital is equal to its factor price, then this approach has a degree of intuitive appeal.

Interpreting the user cost of capital

The user cost of capital is used to weight together the movements in the volume of the services provided by each asset within an industry's capital services index. Remembering that under the growth accounting decomposition of the Solow residual, the marginal product of capital services is assumed to be equal to the marginal cost of capital services, this implies that the user cost can be interpreted as either:

- the marginal revenue attributable to each "unit" of capital services; or
- the marginal cost associated with each "unit" of capital services,
- with the assumption being that these are equal (assuming perfectly competitive markets).

Calculating the nominal rate of return endogenously (ex-post) such that the value of capital services completely exhausts capital income is consistent with treating the user cost of capital as the marginal revenue. Applying an exogenously (ex-ante) determined rate of return that is predicated on the basis of an average long-run rate of return is also aligned with the view of user costs as being aligned with the marginal revenue interpretation, while applying an exogenously (ex-ante) determined rate of return that is predicated on the basis of a firm's costs of financing is aligned with treating the user cost as being equivalent to the marginal cost interpretation.

In reality, markets are not perfectly competitive, and consequently there will inevitably be differences in the user costs derived using the different approaches. These differences will manifest themselves in differing asset-weights within any particular industry capital services index.

In all countries, the nominal rate of return is derived either endogenously, or via an exogenous rate that relates to an expected long-run rate of return, thus aligning the user cost to the marginal revenue. In the main this is likely due to the difficulty in selecting an appropriate interest rate to use as the cost of finance.

This paper considers the formulation of the user cost of capital viewed from the perspective of the marginal revenue generated by that capital.

The rate of return and capital gains

There are a number of potential criticisms which can be made of the endogenous approach to determining the nominal rate of return. Firstly, this approach assumes that all of gross operating surplus (after deducting labour income) is attributable to the observed capital in scope of the productivity analysis. Schreyer (2004) observes that the national accounts provide no indication as to exactly which factor of production is remunerated though gross operating surplus, and goes on to say:

> Fixed assets are certainly among them but they are not necessarily the only ones. The business literature offers a wealth of discussions about the importance of intangible assets, and there are many good reasons to argue that such assets account for at least part of GOS [Gross Operating Surplus]. While this may appear a minor point, it puts in question an assumption routinely made by analysts of productivity and growth, namely that GOS exactly represents the remuneration of the fixed assets recognised in the System of National Accounts (SNA), or the value of these services of these assets. Schreyer (2004)

Within the MFP productivity estimates produced by Statistics NZ, only a subset of intangible assets (mineral exploration and software) is recognised as providing a flow of capital services. Additionally, land is only currently included within agriculture and forestry industries. Assets which might additionally be included include natural resources and other intangible assets such as patents, copyrights, goodwill etc. This point is also raised in the OECD Manual on Measuring Capital, which states:

> If an endogenous rate is computed on the basis of those fixed assets that are measured in the accounts, but if there are other, unmeasured assets that provide capital services, the resulting rate may be liable to bias. OECD 2009 (p68)

Other "missing" assets include such things as:

- inventories - which were not originally in scope of the assets providing a flow of capital services to production in the Statistics NZ productivity estimates (since included)

- financial assets
- other non-produced assets not in scope of the assets recognised within the System of National Accounts (eg sub-soil assets)

Secondly, there is the fact that when firms make investment decisions and decisions regarding the price they are willing to pay for the use of a capital asset, they are doing so in an ex-ante manner. That is, they are making their decisions based on expectations as to the rate of return they are expecting. The endogenous approach effectively assumes that firms are possessed of perfect foresight, and as such the endogenously determined rate of return is an ex-post one. In the derivation of the endogenous nominal rate of return in Statistics NZ's original estimates, a 5-year moving average of industry-level capital income was used, together with a 10-year moving average of the capital gain term (for land and buildings only). The logic behind this decision was that investment decisions are based on an expected rate of return on assets covering a number of years, and should not be too influenced by one-off events in a particular year. As Diewert (2001) observes:

> ...assuming that anticipated price changes are equal to actual ex post price changes is very unsatisfactory since it is unlikely that producers could anticipate all of the random noise that seems to be inherent in series of actual ex post asset price changes. Moreover, this approach generates tremendous volatility in user costs and statistical agencies would face credibility questions if this approach were used. Diewert (2001) at p72

Thirdly, the endogenous approach assumes that there is perfect competition, and that capital and rental markets are perfectly clearing such that the marginal cost of the assets are equal to their marginal product and revenue, Schreyer (2004) outlines a number of examples of where "mark-ups" (i.e. the extent to which an endogenously determined rate of return would exceed an exogenously determined rate) could exist. It is assumed that in the long run, mark-ups would be positive, since a negative term over an extended period of time would imply sustained losses, which is economically implausible. These include:

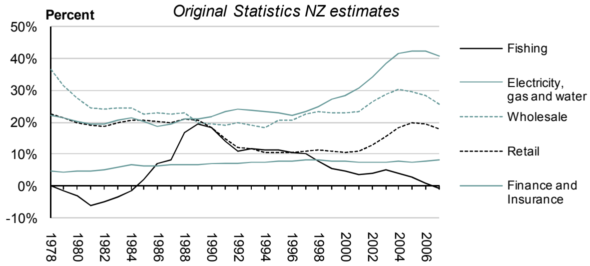
- Where output markets are not fully competitive so that monopoly rents exist;
- Under Schumpeterian growth patterns where mark-ups constitute the incentives for entrepreneurial activity;
- Within industries where long gestation periods of investment are prevalent;
- Where there is time-varying capacity utilisation.

A consequence of using an endogenously-determined rate of return can be that specific industry rates of return can appear economically implausible. Figure 2 below shows the time pattern of the endogenously-determined rate of return for selected industries underlying Statistics New Zealand's originally published aggregate productivity measures.

Rates of return for the fishing industry move from being consistently negative prior to the mid-eighties, to being significantly positive through the mid-eighties to late-nineties, and have since tapered off to essentially zero in 2006/7. The "improvement " in the rate of return in the mid-eighties coincides with the introduction in October 1986 of the Quota Management System for New Zealand fisheries, whereby firms were allocated quotas which are effectively an intangible asset, and are not included in scope of the assets within the current productivity system in New Zealand. Contrast this with the nominal rate of return observed within the Finance and Insurance industry, which has steadily increased from a relatively stable rate of around 23 percent during the period prior to 1997, to almost double that in recent years (approximately 40 percent). The relatively high rates of return for the Finance industry are a consequence of the significance of ("missing") financial assets within this industry.

Distribution industries (FA and GA) also have relatively high rates of return as a result of the non-inclusion of inventories. These can be compared with the rate of return calculated for an industry such as Electricity Gas & Water (DA) which does not have significant holdings of inventories or other non-produced assets.

Figure 2 - Endogenous rates of return for selected industries



Source: Statistics New Zealand

The OECD manual on productivity measurement recognises that there can be issues with measuring the industry rates of return endogenously, stating:

> While this approach is quite common and easy to implement, it requires that the underlying production function exhibit constant returns to scale, that markets are competitive and that the expected rate of return equal the ex post, realised rate of return. A practical problem can also arise when capital income in the national accounts (gross operating surplus) [sic] is small and rates of return turn negative. OECD 2001 (p.70)

The OECD manual on capital measurement suggests a "simplified" version of the ex-post approach that builds on the concept of 'balanced real rates', where the main simplifying assumption is that the real revaluation of assets is set to zero. In this approach, the real rate in the simplified method again exactly exhausts capital income (OECD 2009). Under this approach, the nominal rate of return would then be calculated as a variant of equation (16) as follows:

$$i_{it} = \frac{Yk_{it} - \sum_j PKS_{ijt} p_{ijt}(d_{ijt} + x_{ijt})}{\sum_j p_{ijt} PKS_{ijt}} \qquad (17)$$

It should be noted that the manual goes on further to say that where land is included in the asset mix; this is one asset class where real holding gains should always be set to zero:

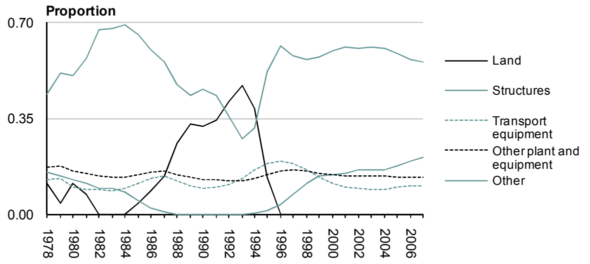
Note that there is one particular asset, land, for which it is always recommended to set holding gains to zero or to some long-run value rather than using the ex-post movements in real land prices. The reason.... is that land markets are often subject to bubbles and bursts which, by definition, incorporate an element of irrational behaviour but also risk-taking on the side of economic actors. The standard equilibrium condition, which predicates that the price of an asset reflects the discounted value of future benefits from using the asset, is unlikely to hold on such markets and expectations in a context of speculative behaviour are nearly impossible to gauge on the basis of ex-post observations. Thus, there are both practical and conceptual reasons to stay way from estimating asset-specific expected holding gains in the case of land. OECD 2009 (p 145)

There is an argument for excluding the capital gains terms for buildings as well, on the basis that markets for buildings are similarly subject to bubbles and bursts.

The original methodology for the Statistics NZ productivity estimates included the capital gains term (in fact a 10-yearly moving average of the capital gains term was used) in the formulation of the user cost of capital for land and buildings only. This can have the effect of making the calculated user cost of capital negative (i.e. the capital gain exceeds the nominal rate of return for the industry and any taxes on production). In these instances, a user cost of 0.00001 was used in order to ensure a non-zero and non-negative user cost of capital (Statistics NZ 2008).

The effect of setting the user cost to close to zero is that the weight assigned to the asset within the calculation of the industry capital services index is effectively set to zero. The impact of this on the weights within the agriculture capital services index which was implicitly published in March 2008 is illustrated in Figure 3 below. From the early- to mid-nineties the weight of land within the capital services index rose from zero to 20 percent, before falling away to zero again.

Figure 3 - Broad asset weights within agriculture
Original Statistics NZ estimates



Source: Statistics New Zealand

The rental price (as previously specified in equation 15) is:

$$u_{ijt} = p_{ijt}(i_{it} + d_{ijt} - g_{ijt}) + p_{ijt}x_{it} \qquad (15)$$

Where:

p_{ijt} = the price index of new capital asset j in industry i in period t

i_{it} = the nominal rate of return in industry i in period t

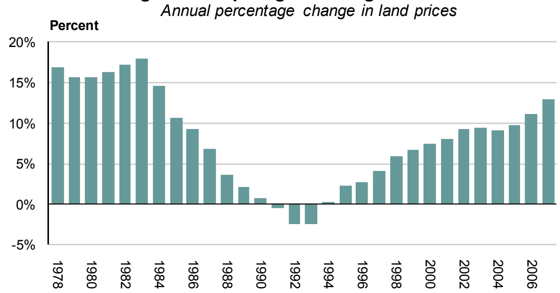
d_{ijt} = the rate of economic depreciation of asset j in industry i in period t

g_{ijt} = the capital gain effect due to the revaluation of asset j in industry i in period t (for land and buildings only)

x_{it} = the average non-income tax rate on production for industry i in period t

The zero rental price weights for land observed for all years apart from the period between 1989 and 1994 is primarily a function of the capital gains term for land being positive for all years except from 1991 – 1993 (see Figure 4). For almost all periods except between 1989 and 1994 the capital gain outweighs the endogenously determined rate of return, resulting in negative user costs for land for these periods.

Figure 4 - Capital gains on agricultural land
Annual percentage change in land prices



Source: Statistics New Zealand

The OECD Productivity Manual goes on to state that an external measure (e.g. interest rates for government bonds) can be a plausible alternative to the endogenous approach. The authors do however express a "certain preference" for the endogenous rate of return. When adopting an exogenous rate of return, most countries use a rate of 4 percent plus the prevailing inflation rate (typically the CPI). The figure of 4 percent is used by convention, as this is the average long-run real rate of return that has been observed in many empirical studies, and this is the discount rate that has been used in the Statistics NZ perpetual inventory model (based on observed average real 90-day bank bill rates of 3.9 percent over the period 1980–2000).

As with the endogenous measure, there are a number of practical issues associated with using an ex-ante or exogenous rate of return. Firstly, a decision has to be made as to what the exogenous rate of return should be. When rates are allowed to vary between industries, the problem is compounded because in principle, a rate has to be chosen that reflects industry-specific risk. Second, there may also be instances of economically meaningless negative user costs if the expected nominal return plus depreciation is lower than the expected nominal asset inflation rate. Third, if there are systematic differences between the ex-ante and ex-post rates for particular industries or for the economy as a whole, this requires explanation. While this may be an interesting terrain for analysis, it complicates life for the statistician who needs to communicate on these differences which is not always straightforward (OECD 2001).

The exogenous approach has a number of intuitive appeals, in that it is more consistent with ex -ante decision-making processes of firms, and it allows for the existence of economic rents. Another approach has been suggested (Oulton 2005) whereby first an ex-post, endogenous rate is computed and then the ex-ante rate is chosen as the trend of the ex-post rate of return. This proposal has the advantage that it avoids the problem of selecting an extraneous rate of return while preserving the ex-ante nature of the calculation (OECD 2009). A further advantage of this hybrid approach is that it allows for an empirically derived industry-specific rate of return which could reflect (amongst other things):

- Missing assets from the capital services model (such as land, R&D and other intellectual property assets) which may vary in significance from industry to industry;
- Industry-specific risk premiums

The Australian Bureau of Statistics (ABS) adopts a combination of both endogenous (ex-post) and exogenous (ex-ante) rates of return in their official productivity estimates. The ABS approach is to use the endogenous rate, but to set an exogenous "floor" to this rate, with this floor being 4 percent plus the CPI (ABS 2007). This approach has the benefit of stopping the nominal rate of return from going negative when capital income is low in certain years (and hence avoiding the occurrence of many negative user costs) while preserving the industry-specific rates of return which come from solving the nominal rate of return endogenously. There is a potential criticism of this approach in that it is not symmetric (ie it imposes a floor to the rate of return, without a corresponding ceiling), however a counter to this is that the exogenous floor preserves the long-run ex-ante nature of investment decision-making while allowing for higher rates of return to manifest where there are missing assets.

It should be noted that the choice of method for determining the nominal rate of return effectively only impacts on the asset weights within a particular industry's capital service index. This effect then flows through to the aggregate measured sector capital services index, although since the aggregate capital services index is weighted together using ex-post capital income (see equations 18 and 19 below), any possible misalignment of the weights with current period income not be compounded.

$$K_t = \prod_i (k_{it})^{Wk_{it}} \qquad (18)$$

Where K_t = the measured sector capital services index in period t

$$Wk_{it} = \frac{1}{2}\left(\frac{Yk_{it}}{\sum_i Yk_{it}} + \frac{Yk_{i(t-1\_}}{\sum_i Yk_{i(t-1\_}}\right) \qquad (19)$$

In this paper, I have considered the effect of deriving the user cost of capital under a number of scenarios. Firstly with respect to the rate of return, I consider:

- the exogenous method,
- the endogenous method, and
- the endogenous method with an exogenous floor (ie the 'ABS' method)

Secondly, with respect to the capital gains on assets, I consider the following scenarios:

- including capital gains for all assets,
- including capital gains for all assets excluding land and buildings, and
- including capital gains for no assets,

The results of the nine combinations of these methods are then compared.

Assessment criteria for the user cost of capital

In assessing the user costs of capital that result from the nine scenarios outlined above, the question arises: how do we decide which series of user costs provides the 'best' series of asset capital services weights?

This is not an easy question, as the user cost of capital is an implicitly derived approximation to something that is (at least in general) not observable. Any assessment of the fitness for purpose of the user cost series will then come down to a combination of assessments against a range of criteria such as: conceptual coherency; international comparability; combined with an assessment of a range of observable (derived) metrics which eventuate. Metrics which can be used to assess (but not necessarily determine) the quality of the user costs include: the user costs themselves; the industry nominal rates of return; together with the asset capital services weights which result.

The broad assessment criteria which have been considered are briefly outlined as follows.

Conceptual fit and international recommendations

This criterion will consider each of the options in light of international recommendations, primarily in terms of the practice recommended by the OECD.

Plausibility of user costs

The user cost of capital is used to weight together the respective volumes of capital services provided by the stocks of capital extant within each industry. Following from equation (3) above, the user cost can be interpreted as the marginal product of the capital services being provided, and when viewed as such, negative user costs are economically implausible.

Volatility of user cost weights

As the user cost weights effectively represent the structure of the underlying production function, it would not be expected that these weights would display significant volatility in the short- to medium-term. In the absence of fundamental changes to the production function (for example as the result of quantum leaps in technology); asset capital services weight relativities would be expected to remain relatively stable over the short- to medium-term.

Relationship to underlying capital stock

While there will be differences in the flows of capital services from different classes of assets, based on differing age-efficiency and price profiles, one would expect to see a broad alignment between the relative weights of the volumes of the productive capital stocks of assets within an industry and the associated volumes of capital services provided. In particular, where a stock of productive capital of an asset exists within an industry, one would at least expect there to be a corresponding flow of capital services (however small).

Comparison with directly observed rental prices

In an ideal world (from a measurement perspective), there would be observable market asset rental prices that could be used in the weighting together of the movements in the volume of capital services provided by different classes of assets. In reality however, these markets are either non-existent or so thin as to make practical measurement infeasible, thus the need to approximate the asset rental price via the derived user cost. Where it is possible to observe rental prices however, these can serve as a valuable comparator or quality check on the derived user cost. It should be noted that observed rental prices may well differ from derived user costs for perfectly legitimate reasons. For example, the rental market may be serving smaller/newer firms who do not have the resources to purchase assets so therefore rent them instead - it is possible that these "renters" will attract a higher risk premium than "owners" and that this may vary over the business cycle.

Alignment with international practice

As productivity statistics are often compared across and between countries, it is important that the methods used do not preclude meaningful cross-country comparisons.

Practical impact on resulting productivity estimates (fitness for purpose)

The question of the formulation of the user cost of capital is a conceptually interesting one, with many possible interpretations and approaches. At the end of the day however, it must be remembered that the user cost of capital is used to provide the underlying asset capital services weights within a series of capital services indexes. While different approaches to the derivation of the user cost of capital can result in differing asset capital services weights, the impact on the resulting capital services indexes should be part of the "fitness for purpose" assessment criteria.

Assessment of Scenarios

Conceptual fit

As outlined in section 3 above, each of the nine scenarios can be justified from a theoretical basis, and there appears to be no clear consensus on what is the preferred approach.

With regard to capital gains, there appears to be a view (OECD 2009) that capital gains on land should not be included in the user cost equation, due to the potential confounding effects of "bubbles and bursts" in asset prices. This effect is not restricted to land however, and an argument can be made to extending this exclusion to buildings as well. A summary of the conceptual fits under the different scenarios is presented in Table 2.

Plausibility of user costs

As mentioned previously, another way of assessing the validity/quality of the derived user costs is to observe the incidence of economically implausible results. Given that we are endeavouring to approximate the marginal product of the assets, we would not expect to observe instances of negative user costs, as this would imply that the marginal product of the asset in question was negative. While this may be economically plausible in the very short term, in the medium to longer term such results are unsustainable.

Table 3 provides a summary of the incidence of negative user costs within the detailed industry level capital services indexes compiled under each of the nine scenarios. With 24 industries and 27 asset-types, there are a maximum possible 848 asset-industry combinations in each displayed year (although in reality the number will be less as not all industries contain all assets). As can be seen, when capital gains are included, there are increased occurrences of negative user costs, particularly when an endogenous rate of return is used. When capital gains are excluded on all assets, and either an exogenous or the ABS hybrid rate of return are used, there are no occurrences of negative user costs. When capital gains are included for all assets excluding land and buildings, the ABS and exogenous approaches yielded a small number of instances of user costs, however these were for industry-asset occurrences which were relatively insignificant, and which had no material impact on the respective industry capital services indexes.

Volatility of user cost weights

While an assessment of the user costs themselves is an interesting exercise, the real purpose of the user costs within the measurement of capital services is to provide the basis for deriving the asset weights within an industry's capital services index. In cases where the user cost is negative, Statistics NZ overrides this negative with a very small number close to zero (0.00001) so that there are no negative weights feeding into the Törnqvist capital services index. The effect of this on the asset weights within an industry can be profound, and is clearly illustrated in the following selected examples.

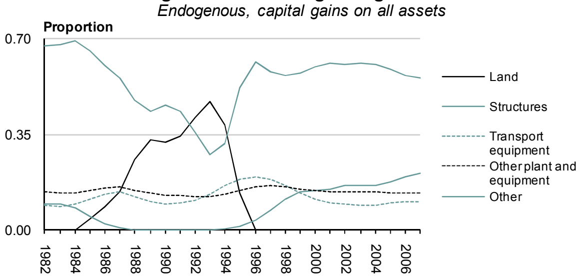
This volatility can be seen very clearly in the selected examples presented below, for the Agriculture and Hotel and restaurant industries. These industries were chosen as they are good examples of the impact that either rates of return or capital gains can have on relative asset weights within industry capital services indexes.

Figures 5 – 13 below show the high-level asset weights within the agriculture industry under a selected range of scenarios. The effect of the capital gains on land can be seen in the weight assigned to land (arguably one of the most important factors of production in the agriculture industry). While decisions as to which methodology to adopt should ideally be made with on the basis of a clear and accepted conceptual basis, where there are a number of (equally valid) approaches which could be taken, then the empirical results deriving from the alternative scenarios should be assessed for economic coherence.

In the case of the agriculture asset weights time series presented below, it make absolutely no economic sense whatsoever to have what is the single largest asset of an agricultural enterprise (i.e. the land that it uses to operate) providing no flow of capital services to the production function at various times over the period 1982-2007.

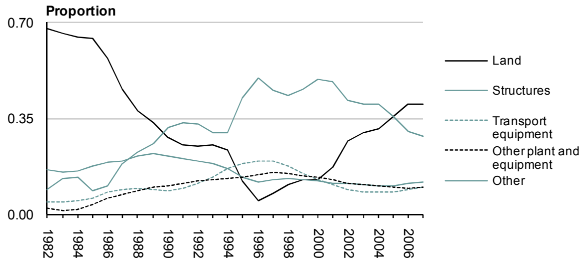
When the rate of return is measured <u>endogenously</u> (Figures 5 – 7), the weight assigned to land in the capital services index is highly variable, as a result of both the variable capital gains on land, and the variable Gross Operating Surplus (GOS) numbers for Agriculture over the period covered. None of these series of weights looks at all sensible.

Figure 5 - Asset weights: agriculture
Endogenous, capital gains on all assets



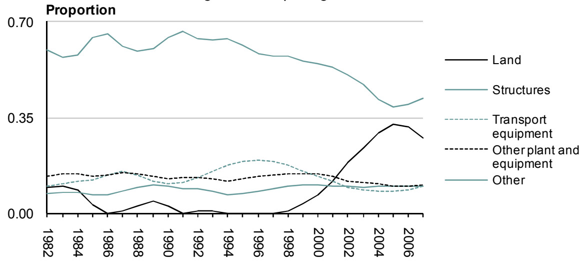
Source: Statistics New Zealand

Figure 6 - Asset weights: agriculture
Endogenous, capital gains on all assets (excl land and buildings)



Source: Statistics New Zealand

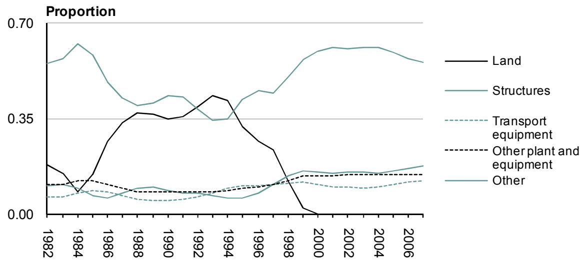
Figure 7 - Asset weights: agriculture
Endogenous, capital gains on no assets



Source: Statistics New Zealand

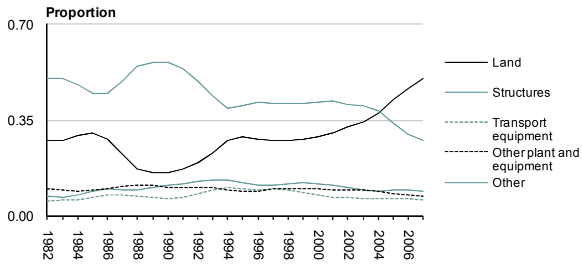
When the rate of return is measured <u>exogenously</u> (Figures 8 – 10), the impact of capital gains on land can be seen clearly where capital gains are included on all assets, with land having no weight from 2000 onwards. As the weights have to sum to unity, the "loss" of the weight on land is distributed across other asset types, and those assets with higher depreciation rates (in this case livestock) picking up most of the excess. The distribution of weights assuming either no capital gains or capital gains on all assets excluding land and buildings are virtually identical.

Figure 8 - Asset weights: agriculture
Exogenous, capital gains on all assets



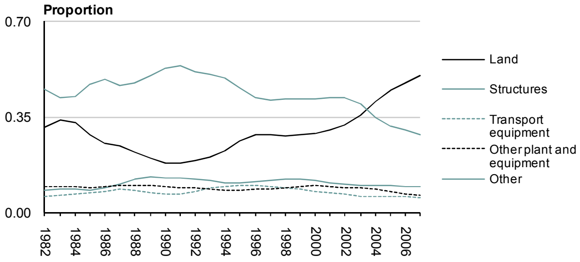
Source: Statistics New Zealand

Figure 9 - Asset weights: agriculture
Exogenous, capital gains on all assets (excl land and buildings)



Source: Statistics New Zealand

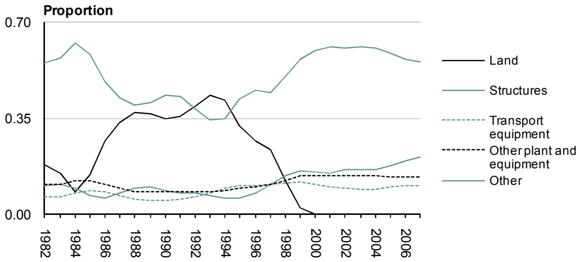
Figure 10 - Asset weights: agriculture
Exogenous, capital gains on no assets



Source: Statistics New Zealand

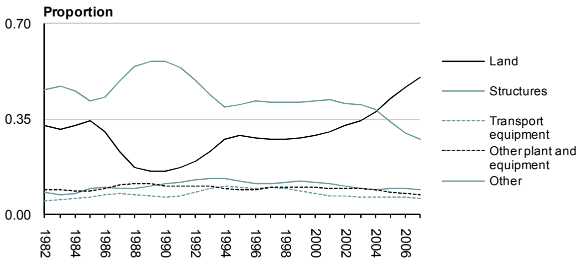
When the rate of return is measured using the "ABS" approach (Figures 11 – 13), the results are virtually identical to the results from using the exogenous rate of return. This is because the endogenous rate of return for Ag is relatively low, and the "floor" in the ABS approach is triggered, with very few instances of the endogenous rate exceeding the exogenous rate.

Figure 11 - Asset weights: agriculture
"ABS", capital gains on all assets



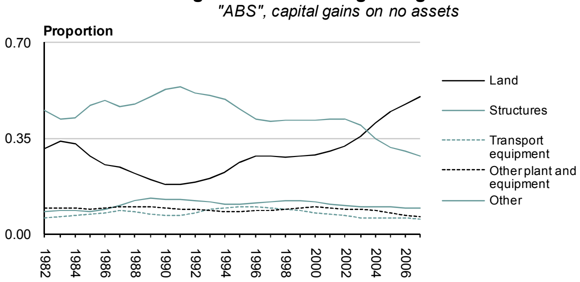
Source: Statistics New Zealand

Figure 12 - Asset weights: agriculture
"ABS", capital gains on all assets (excl land and buildings)



Source: Statistics New Zealand

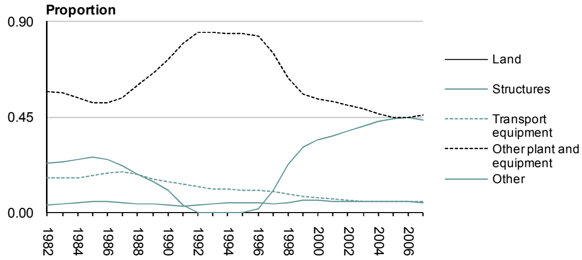
Figure 13 - Asset weights: agriculture
"ABS", capital gains on no assets



Source: Statistics New Zealand

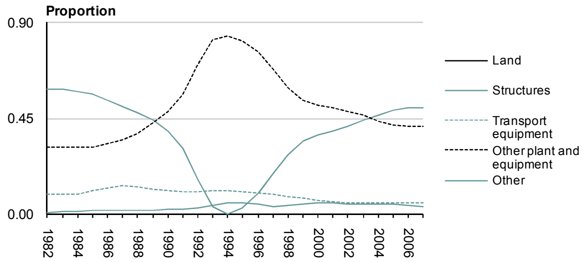
Another industry which provides a good comparison of asset weights under the various scenarios is the Hotels and restaurants industry. This industry is a good illustration, since it highlights quite clearly the impact of the endogenously determined rate of return on the asset weights, independently of the impact of capital gains. When the rate of return is determined endogenously (Figures 14 – 16), the weight allocated to non-residential buildings (eg hotels, motels etc) drops to zero during the period from 1991 to 1996. This is pretty much irrespective of the treatment of capital gains, and is the result of the endogenous rate of return either approaching zero or going negative over this period. When this happens (i.e. the nominal rate approaches zero) the weights will be heavily influenced by depreciation rates. Since buildings have relatively low depreciation rates, they become the first asset to "lose" their weight, and assets with high depreciation rates pick up the slack (in this case furniture).

Figure 14 - Asset weights: hotels and restaurants
Endogenous, capital gains on all assets



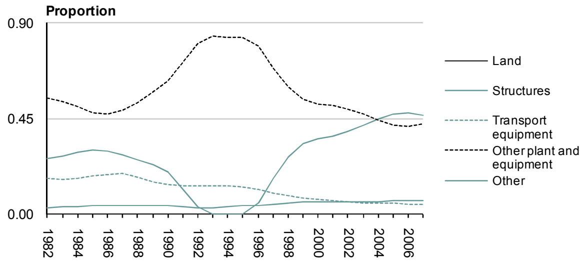
Source: Statistics New Zealand

Figure 15 - Asset weights: hotels and restaurants
Endogenous, capital gains on all assets (excl land and buildings)



Source: Statistics New Zealand

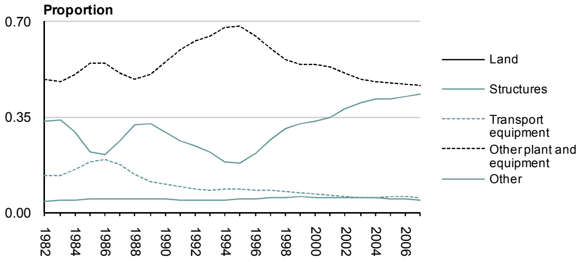
Figure 16 - Asset weights: hotels and restaurants
Endogenous, capital gains on no assets



Source: Statistics New Zealand

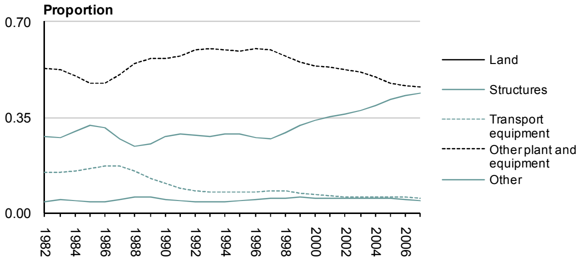
Where the rate of return is determined exogenously (Figures 17 – 19), the weights series begin to look much more sensible. Where capital gains are included on buildings, the weight of buildings is relatively low over the mid-late 1980's as a result of the capital gains effectively discounting the user cost of capital for buildings over this time, thereby reducing the weight of buildings in the capital services index. What this is therefore implying is that the capital services provided by buildings were of relatively less value to the hotel and restaurant industry over this period (whereas furniture was relatively more valuable). This is a clear example of where the user cost equation does not provide an economically meaningful proxy for the marginal product of the capital asset.

Figure 17 - Asset weights: hotels and restaurants
Exogenous, capital gains on all assets



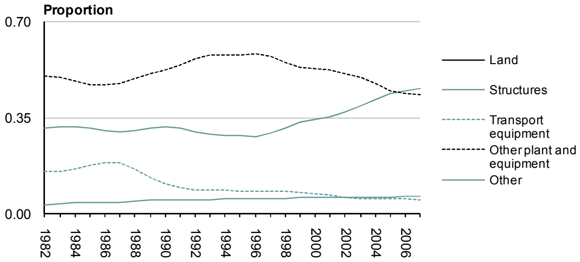
Source: Statistics New Zealand

Figure 18 - Asset weights: hotels and restaurants
Exogenous, capital gains on all assets (excl land and buildings)



Source: Statistics New Zealand

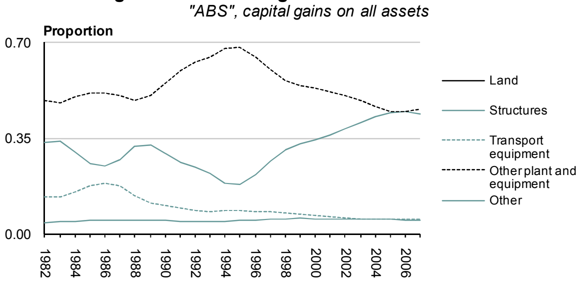
Figure 19 - Asset weights: hotels and restaurants
Exogenous, capital gains on no assets



Source: Statistics New Zealand

For the sake of completeness, I have included below (Figures 20 – 22) the asset weight graphs for Hotels and restaurants using the "ABS" approach. Since the issue with Hotels and restaurants was the result of relatively low endogenously determined rates of return, the "ABS" approach is virtually identical to the exogenous approach.

Figure 20 - Asset weights: hotels and restaurants
"ABS", capital gains on all assets

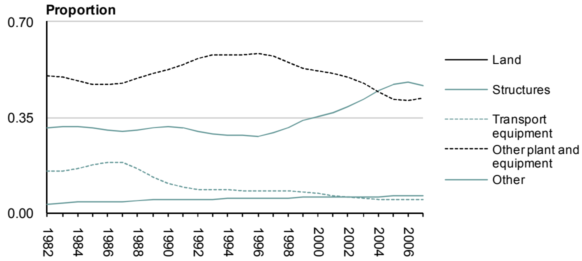


Source: Statistics New Zealand

Figure 21 - Asset weights: hotels and restaurants
"ABS", capital gains on all assets (excl land and buildings)

Source: Statistics New Zealand

Figure 22 - Asset weights: hotels and restaurants
"ABS", capital gains on no assets



Source: Statistics New Zealand

Another way of illustrating the volatility of the asset weights resulting from the implementation of the various scenarios is to consider the distribution of the large year-on-year capital services asset weights. These are presented in Table 4. As can be seen, either the 'ABS' or exogenous approach with capital gains excluded from all assets eliminate instances of very large swings in asset weights over the short to medium term. Many of these large swings are illustrated in the preceding graphs (for example in the agriculture and hotel and restaurant industries).

Relationship to underlying capital stock

Table 5 shows how the underlying asset capital services weights compare to the underlying productive capital stock volume weights (based on the volumes of productive capital stock expressed in 1995/6 prices). The table shows the number of times that an the asset weight within an industry capital services index differs (in terms of percentage points) from the underlying PKS volume weights over the period 1997 - 2007. To provide context to these numbers, there are just over 11,000 observations of industry-asset-year weights over this period.

As this table shows differences in weights expressed in percentage points, the instances of absolute differences greater than 50% represent quite fundamental differences in the capital services weights compared with PKS volume weights.

The effect on including the capital gains term can be clearly seen here, with all of the observations of weight differences of greater than 70 percent being accounted for by timber within the forestry industry as a result of the capital gains term.

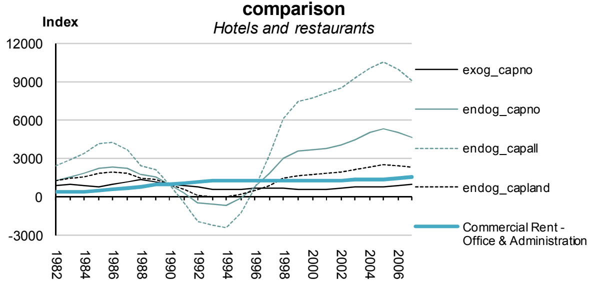
Comparison with observed rental prices

In an ideal world (from a measurement perspective), there would be observable market asset rental prices that could be used in the weighting together of the movements in the volume of capital services provided by different classes of assets. In reality however, these markets are either non-existent or so thin as to make practical measurement infeasible, thus the need to approximate the asset rental price via the derived user cost. Where it is possible to observe rental prices however, these can serve as a valuable comparator or quality check on the derived user cost. It should be noted that observed rental prices may well differ from derived user costs for perfectly legitimate reasons. For example, the rental market may be serving smaller/newer firms who do not have the resources to purchase assets so therefore rent them instead - it is possible that these "renters" will attract a higher risk premium than "owners" and that this may vary over the business cycle.

Figure 23 illustrates the differences between the derived user costs for non-residential buildings within the hotel and restaurant industry under a selection of the scenarios, contrasted with a price index of commercial rentals obtained from the Producers Price Index (PPI). Using an endogenous rate of return in the derivation of the user cost for non-residential buildings in this industry results in negative user costs over the period from 1991 to 1995, with the level of the user cost varying quite dramatically over time, particularly when capital gains from land and buildings are included. The negative user costs result from negative endogenous nominal rates of return over this period as a consequence of relatively low GOS over this period coinciding with a recession in the New Zealand economy just prior to this period (the lagged effect due to taking a back-ward looking rolling average of capital income in calculating the endogenous rate or return). As can be seen, the user costs derived using the exogenous rate, together with capital gains on no assets (exog_capno) tracks the PPI series much more closely.

Figure 23 - Non-residential buildings user cost comparison

Hotels and restaurants

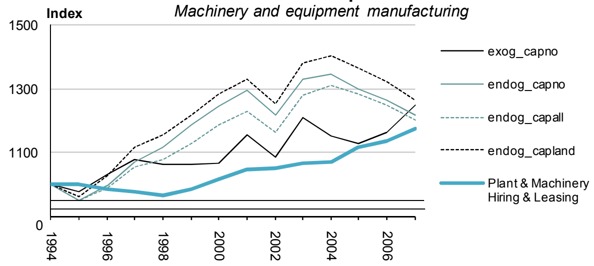


Source: Statistics New Zealand

It should be noted that in most instances, the user costs do not vary a great deal between scenarios. It is only is particular instances (such as when capital income is relatively low, or when capital gains are particularly strong for a particular asset) that these variations occur. This is illustrated in Figure 24, where the comparison is presented for the user costs for general purpose contrasted with the PPI for Machinery and Equipment Manufacturing. In this case, each of the scenarios provides very similar user costs (and movements).

Figure 24 - General purpose plant and equipment user cost comparison

Machinery and equipment manufacturing

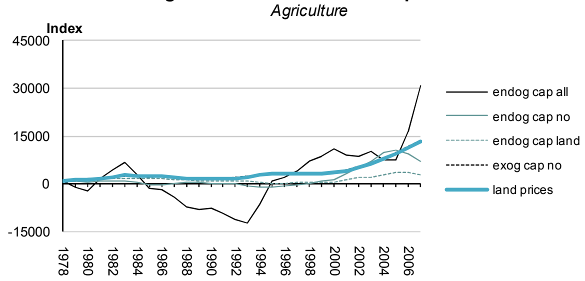


Source: Statistics New Zealand

This can be contrasted with an example of where strong capital gains are experienced, as illustrated in Figure 25, where the user costs for land are contrasted for a range of scenarios.

Figure 25 Land user cost comparison

Agriculture



Source: Statistics New Zealand

User costs appear to be particularly influenced in the presence of either high capital gains for assets or of relatively low capital income, in the following scenarios:

- Endogenous rate of return with capital gains on all assets
- Endogenous rate of return with capital gains on no assets
- Exogenous rate of return with capital gains on all assets

User costs which appear to have the most stable and realistic time series of movements include:

- Exogenous rate of return with capital gains on no assets
- Exogenous rate of return with capital gains on all assets excluding land and buildings
- 'ABS' rate of return with capital gains on all assets excluding land and buildings
- 'ABS' rate or return with capital gains on no assets

Alignment with international practice

The following table provides a summary of international practice in calculating the user cost of capital. As can be seen, the consensus practice is to use an endogenous rate of return (with the exception of the ABS, where an exogenous floor is imposed and the Netherlands which use an exogenous nominal rate), with capital gains included for all assets.

Table 6. Summary of International Practice

Country	Capital Gains	Rate of Return
Australia	All Assets	Endogenous, with exogenous floor (4% + CPI)
UK	All Assets	Endogenous
Canada	All Assets (?)	Endogenous
US	All Assets	Endogenous
NZ (originally)	Land and Buildings only	Endogenous
NZ (currently)	No Assets	Exogenous (4%)
Netherlands	All Assets	Exogenous (Inter-bank rate + 1.5%) (Bergen 2007)

It should be noted that the published methodology papers for various countries outline their methodologies in quite simple terms, there are indications that interventions are made when user costs (and weights) eventuate which are economically implausible.

Practical impact on resulting productivity estimates (fitness for purpose)

The question of the formulation of the user cost of capital is a conceptually interesting one, with many possible interpretations and approaches. At the end of the day however, it must be remembered that the user cost of capital is used to provide the underlying asset capital services weights within a series of capital services indexes. While different approaches to the derivation of the user cost of capital can result in differing asset capital services weights, the impact on the resulting capital services indexes should be part of the "fitness for purpose" assessment criteria.

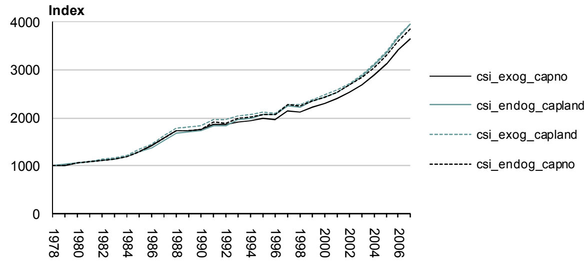
While the impact of the differing methodologies can be quite marked on the resulting weighting patterns underlying the industry-level capital services indexes, the impact on the actual capital services indexes which result at the industry level are less pronounced. Using the Agriculture industry example highlighted above, where the relative weights are impacted significantly by the different scenarios, the major differences appear between 1985 and 1995 (Figure 26).

Figure 26 - Capital services indexes
Agriculture

Source: Statistics New Zealand

This can be compared with the capital services indexes for hotel and restaurants (Figure 27), where there is very little difference in the resulting capital services indexes.

Figure 27 - Capital services indexes
Hotels and restaurants



Source: Statistics New Zealand

Summary and Conclusion

The choice of methodology used to derive the user cost of capital services can have a significant impact on the relative weights assigned to the various asset capital services providing an input into the production function of an industry.

In particular, choices around whether an endogenous or exogenous rate of return is used (or some hybrid thereof), and how capital gains are treated, can have a marked impact on the resulting asset capital services weights.

International recommendation (and theory) allows for the many alternative methodologies in formulating the user cost of capital, with recognition that often the choice will come down to what suits the unique circumstances of each country.

International practice appears to (with the exception of the ABS who use a hybrid approach to determining the rate of return) favour the use of an endogenous rate of return with capital gains included (as a discount factor) in the formulation of the user cost of capital.

While the preferred method in much of the literature appears to be to use an endogenous nominal rate of return with capital gains on assets (excluding land and buildings), a number of factors render the resulting time series of weights in the New Zealand situation economically implausible. The underlying assumption that the marginal cost of capital is equal to its marginal product (assumed as part of the growth accounting framework) requires markets to be perfectly competitive and clearing. Additionally, where there is incomplete asset coverage, the nominal rate of return will be biased upwards, leading to relative under-weighting of assets with high depreciation rates.

An analysis of the various options indicates that the use of an exogenous real rate of return (set at 4 percent) and excluding capital gains from the formulation of the user cost of capital provides superior results in the New Zealand context. The industry asset-weights which are derived from this method provide a superior representation of the underlying production function of many of the industries, and display markedly less volatility, and hence are considered to be a more realistic representation of the change in the aggregate industry production functions over time. Consequently, this method has been adopted by Statistics NZ to construct the capital services indexes in the current published estimates of multi-factor productivity.

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Table 2. Conceptual fit of different scenarios

Scenario		Comments
Capital Gains	**Rate of Return**	
All assets	Endogenous	Generally consistent with OECD recommendations, however the inclusion of capital gains on land (and buildings) can be questioned.
	Endogenous (with exogenous floor)	Generally consistent with OECD recommendations, however the inclusion of capital gains on land (and buildings) can be questioned. The application of the floor allows the ex-ante nature of decision-making to be somewhat preserved, however in the presence of missing assets, the nominal rate of return can come to dominate the user cost, meaning that asset relativities which would otherwise come through from varying depreciation rates are muted.
	Exogenous	Generally consistent with OECD recommendations, however the inclusion of capital gains on land (and buildings) can be questioned. The exogenous rate here is interpreted as a "nominal" rate of return.
All assets (excluding land and buildings)	Endogenous	Fits with OECD recommendations, and is theoretically "pure", however assumes: perfect competition strictly rational expectations (ie perfect foresight)
	Endogenous (with exogenous floor)	Generally consistent with OECD recommendations, and the application of the floor allows the ex-ante nature of decision-making to be preserved, however in the presence of missing assets, the nominal rate of return can come to dominate the user cost, meaning that asset relativities which would otherwise come through from varying depreciation rates are muted.
	Exogenous	Fits with OECD recommendations, and can be justified on the basis of ex-ante expectations.
No assets	Endogenous	Fits with OECD recommendations, and is theoretically "pure", however assumes: rate of return is interpreted as a "balanced real rate" rather than a nominal rate perfect competition strictly rational expectations (ie perfect foresight)
	Endogenous (with exogenous floor)	Generally consistent with OECD recommendations, and the application of the floor allows the ex-ante nature of decision-making to be preserved, however in the presence of missing assets, the nominal rate of return can come to dominate the user cost, meaning that asset relativities which would otherwise come through from varying depreciation rates are muted. Again, the rate of return should be interpreted as a "balanced real rate"
	Exogenous	Fits with OECD recommendations, and can be justified on the basis of ex-ante expectations. Again, the rate of return should be interpreted as a "balanced real rate"

Table 3. Occurrence of Negative User Costs Under Different Scenarios

Occurrence of Negative User Costs										
YEAR	**Total (negative and non-negative)**	**Capital Gains on All Assets**			**Capital Gains on All Assets (excl. land and buildings)**			**Capital Gains on No Assets**		
		endog	**abs**	**exog**	**endog**	**abs**	**exog**	**endog**	**abs**	**exog**
1979	354	13	1	1	26			8		
1980	354	9	1	1	23			8		
1981	354	10	1	1	28			8		
1982	354	11	1	1	30			8		
1983	377	10	1	1	29			9		
1984	379	10	1	1	25			9		
1985	379	7		3	20		1	8		
1986	379	4			24			8		
1987	381	6			29			4		
1988	381	10			28					
1989	381	11		1	22		1			
1990	381	12		1	23		1			
1991	381	15		1	20		1	1		
1992	381	17		1	18		1	8		
1993	381	11		1	16		1	7		
1994	381	10	1	9	15		1	7		
1995	381	11		2	13		1	5		
1996	382	9		2	11		1	1		
1997	411	4	1	1	5			1		
1998	415	2	1	2	3		1			
1999	415	2	2	2	3					
2000	416	6	6	10	6	4	8			
2001	416	5	5	9	5	3	7			
2002	416	2	2	2						
2003	415	2	2	2	3					
2004	416	6	2	2	7					
2005	416	8	1	1	9					
2006	416	10	1	1	11					
2007	416	11	1	1	14					
Total		**244**	**31**	**60**	**466**	**7**	**25**	**100**		

Table 4. Distribution of large asset capital services weight movements (percentage points) 1979-2007

	Capital Gains on All Assets			Capital Gains on All Assets (excl. land and buildings)			Capital Gains on No Assets		
	endog	abs	exog	endog	abs	exog	endog	abs	exog
Five-Year Movements									
+/- > 30%	8	3	17	12	2	14	2	0	0
+/- > 21 – 30%	31	14	17	34	16	11	29	12	12
+/- > 11 – 20%	165	108	150	167	118	122	134	80	86
One-Year Movements									
+/- > 10%	11	5	15	8	5	10	2	0	0
+/- 6 – 10%	47	24	47	45	28	28	30	8	13

Table 5. Percentage point differences in weights (compared with PKS volume weights) 1979 – 2007

	Capital Gains on All Assets			Capital Gains on All Assets (excl. land and buildings)			Capital Gains on No Assets		
	endog	abs	exog	endog	abs	exog	endog	abs	exog
+/- >70%	0	0	7	0	0	7	0	0	0
+/- 51 - 70%	19	3	7	5	2	5	11	0	0
+/- 31 - 50%	84	29	32	33	19	25	74	13	16
+/- 21 - 30%	120	123	250	64	85	267	121	127	203
+/- 11 - 20%	642	561	688	377	354	692	531	471	622
+/- 1 - 10%	10,444	10,593	10,325	10,830	10,849	10,313	10,572	10,698	10,468

Table 6. Endogenous Rates of Return by Industry 1996 – 2007 (percentage)

Capital gains on land and buildings only

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Agriculture	1	2	3	4	4	5	7	8	8	9	9	10
Forestry	5	5	5	4	4	4	3	4	4	4	3	2
Fishing	11	10	8	5	5	4	4	5	4	3	1	-1
Mining	7	7	8	8	8	8	9	9	9	7	5	4
Food, beverage and tobacco	9	9	9	10	9	9	10	10	10	10	8	6
Textiles, apparel and footwear	11	12	12	13	15	14	13	14	14	13	13	13
Wood and paper products	9	9	8	7	7	7	6	11	12	12	10	9
Printing and publishing	13	13	14	14	13	13	13	14	15	15	14	13
Petroleum, chemicals and plastics	9	10	11	10	8	9	11	13	15	17	16	15
Non-metallic mineral products	18	20	21	20	19	17	16	18	20	19	18	17
Metal products	6	7	7	7	7	8	9	10	12	13	13	13
Machinery and equipment	12	13	13	14	14	14	14	15	16	16	15	13
Other manufacturing	8	9	8	9	9	10	11	14	16	16	15	15
Electricity, gas and water supply	8	8	8	8	8	8	7	8	8	7	8	8
Construction	6	7	7	8	9	8	9	11	13	12	12	11
Wholesale trade	21	22	23	23	23	23	26	29	30	30	28	26
Retail trade	10	11	11	11	11	11	13	16	18	20	19	18
Hotels and restaurants	1	3	4	5	5	5	6	6	7	7	7	6
Transport and storage	6	7	7	6	5	4	4	5	4	4	4	3
Communication	15	14	14	14	14	12	11	13	15	17	17	16
Finance and insurance services	22	23	25	27	28	31	34	38	42	42	42	41
Business services	14	17	20	20	20	19	19	22	24	24	24	22
Cultural and recreational services	6	7	7	7	7	7	7	8	9	10	10	10
Personal and other community services	3	3	4	5	6	6	7	7	8	8	7	6

Table 7. Endogenous Rates of Return by Industry 1996 – 2007 (percentage)

No capital gains

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Agriculture	0	0	0	0	0	1	1	2	2	2	1	1
Forestry	6	6	5	5	4	4	4	4	4	4	4	3
Fishing	10	10	8	5	4	4	4	5	4	3	1	-1
Mining	7	7	8	8	8	8	9	9	9	7	5	4
Food, beverage and tobacco	8	8	9	9	9	9	9	9	10	9	7	5
Textiles, apparel and footwear	10	11	12	13	14	13	12	13	13	12	12	11
Wood and paper products	9	9	8	7	7	7	6	10	12	12	9	8
Printing and publishing	12	13	14	13	13	12	13	13	14	14	13	12
Petroleum, chemicals and plastics	8	10	11	10	8	9	10	12	15	17	16	15
Non-metallic mineral products	17	19	21	20	19	17	16	17	19	18	17	16
Metal products	5	6	6	6	7	7	8	9	11	12	12	12
Machinery and equipment	11	12	13	13	13	13	13	14	15	15	14	12
Other manufacturing	7	8	8	9	8	9	10	13	15	15	14	13
Electricity, gas and water supply	8	8	8	8	8	7	7	7	8	7	8	8
Construction	5	6	7	7	8	8	9	10	12	11	11	10
Wholesale trade	19	21	22	22	22	23	25	28	29	28	27	24
Retail trade	9	10	10	10	10	10	12	15	18	19	18	17
Hotels and restaurants	-1	1	3	4	5	5	5	5	6	6	5	4
Transport and storage	6	6	6	6	5	4	3	4	4	4	3	2
Communication	15	14	14	14	14	12	11	13	15	16	16	16
Finance and insurance services	20	22	24	26	28	30	33	37	40	41	41	39
Business services	13	17	19	19	20	19	19	21	24	24	23	21
Cultural and recreational services	4	6	6	7	7	7	7	7	8	9	8	8
Personal and other community services	1	2	3	4	5	6	6	6	7	6	6	5

Table 8. Endogenous Rates of Return by Industry 1996 – 2007 (percentage)

Capital gains on all assets (excluding land and buildings)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Agriculture	0	0	1	1	1	2	2	2	2	2	2	1
Forestry	13	10	10	8	8	7	6	4	1	1	1	-
Fishing	10	10	9	7	6	6	5	4	3	2	1	1
Mining	10	9	10	9	9	10	10	11	11	9	8	7
Food, beverage and tobacco	8	8	9	10	9	9	10	10	10	9	8	6
Textiles, apparel and footwear	10	11	12	13	14	14	13	13	13	12	12	12
Wood and paper products	9	9	9	8	8	8	7	11	12	12	10	9
Printing and publishing	12	12	14	13	13	13	13	13	14	14	13	12
Petroleum, chemicals and plastics	9	10	11	11	9	10	11	13	16	17	17	16
Non-metallic mineral products	18	20	21	20	19	17	17	18	19	18	18	17
Metal products	6	7	7	7	8	8	9	10	11	12	13	13
Machinery and equipment	11	12	13	13	14	14	14	15	15	15	14	13
Other manufacturing	7	8	8	9	8	10	11	13	15	15	14	14
Electricity, gas and water supply	11	10	10	9	9	9	9	9	10	10	10	10
Construction	6	7	7	8	9	9	9	11	12	11	11	10
Wholesale trade	19	21	22	22	22	22	25	28	29	28	27	24
Retail trade	9	10	11	10	10	11	12	15	18	19	19	18
Hotels and restaurants	- 1	2	4	5	5	5	5	6	6	6	5	5
Transport and storage	7	7	7	7	6	5	5	5	5	5	5	5
Communication	15	14	13	13	13	12	11	12	14	16	16	16
Finance and insurance services	20	21	23	25	26	29	32	36	39	40	40	38
Business services	12	15	17	17	18	17	17	20	22	22	21	20
Cultural and recreational services	4	6	6	6	6	7	7	7	8	8	8	8
Personal and other community services	1	2	3	4	5	6	6	6	7	6	6	5

Table 9. Exogenous Nominal Rates of Return 1996 – 2007 (percentage) - (4% + CPI)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
All industries	6	7	6	5	5	5	6	7	6	6	6	7