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Why Total Factor Productivity is an Incomplete Measure of Performance for Government Enterprises

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Abstract:

A key element of the Australian Government's microeconomic reform program has been to improve the performance of government trading enterprises (GTEs). Total Factor Productivity (TFP) was advocated as an appropriate measure of this performance. More recently, the emphasis has shifted to financial performance measures, yet measures such as rates of return can be misleading for enterprises with market power, e.g. exploitation of demand could generate high profits even if a firm were inefficient. TFP by itself is also misleading. Although one might expect a strong correlation between productivity gains and financial performance, there is a strong possibility of divergence between the two measures. While many studies have recognised the importance of monitoring both productivity and financial performance, they have ignored the dangers of systematic deviations between the two criteria. A case study of Australian National during the 1980's is given as an illustration. We then review alternative measures of financial performance and demonstrate how to link them with TFP measures. While TFP is of major importance in assessing performance of GTE's, it should be combined with overall financial performance and information on performance levels gained by benchmarking studies. Both financial performance and productivity are goals for a GTE. Neither, by itself, constitutes a satisfactory overall performance measure.

Disclaimer: The analysis and opinions in this paper are those of the authors and do not necessarily reflect the views of the BTCE nor the University of British Columbia.

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Introduction

For some years, one of the key elements of the Australian Government's microeconomic reform program has been to improve the performance of government trading enterprises (GTEs). Total Factor Productivity (TFP) was advocated as an appropriate measure of this performance. The major contributors to the TFP studies were the Industry Commission (1991) and the Steering Committee on National Performance Monitoring (1992, 1993), but studies have also been conducted by Australian National (1992), the Bureau of Transport and Communications Economics (1991), Pacific Power (1992), the Prices Surveillance Authority (1993), Telecom (Telstra) (Smith and Fedderson, 1989), Swan Consultants (1991), and Zeitsch and Lawrence (1993). The Steering Committee on National Performance Monitoring for instance, has argued that:

> "Monitoring the TFP performance of government trading enterprises provides a ready means of gauging how successful GTE reforms have been. TFP changes show whether key government supplied services are being produced with relatively fewer inputs. By improving levels of technical efficiency in service provision, the cost of providing these services can be reduced and the resources tied up in those industries freed for use in other parts of the economy. This leads to improved competitiveness and improved domestic living standards." (Steering Committee 1992)

More recently, the Steering Committee has relied more heavily on financial performance measures. The latest report on performance indicators (Steering Committee 1997) does not include TFP nor is it even mentioned in the section on "Future directions in monitoring" (pp.9-12). This reliance on financial performance is problematic because the shortcomings of profitability analysis for GTEs are well known. (We will summarise these shortcomings in this paper.) Given the shortcomings of profitability, most economists probably would advocate a rising TFP as the more useful measure of successful performance. However, we shall demonstrate that an increase in TFP can actually be consistent with a decline in allocative efficiency and a worsening of overall economic performance.

In general, there appears to be considerable confusion about what is a suitable measure of performance. While some studies have made strong claims for TFP, other studies have been more cautious and hedged their conclusions with numerous caveats. There is therefore scope for clarification of exactly what TFP and other measures tell us.

This paper shows how TFP can be misleading but also how it can be combined with financial measures to provide a fuller picture of performance. We begin with a brief review of performance measures, focusing on the shortcomings of profitability analysis and why TFP is thought to be more useful. We then show that there is a link between productivity and financial performance and that both must be monitored to obtain an accurate picture of an enterprise's performance. Next we give an illustration (for

Australian National during the 1980s) where TFP performance is misleading Then, alternate measures of financial performance are reviewed to see how they can be linked with TFP measures. A couple other issues about TFP are addressed including the need to use benchmarks to establish base performance levels, and TFP and quality changes. A brief conclusion follows.

Alternate Performance Measures

The range of performance measures generally suggested includes: traditional profitability or various financial rates of return; economic rate of return (ERR); data envelopment analysis (DEA) (a linear programming method of assessing relative importance of inputs and outputs); and what might be called 'Terms of Trade' (prices of output compared to prices paid for inputs). (DEA is not discussed in this paper; see Hensher and Waters 1993). Lawrence (1993) describes these as "useful measures". The Steering Committee (1996b) endorsed the use of ERR as a surrogate for capital market disciplines, to be complemented with other performance indicators such as TFP and with a range of initiatives such as the promotion of competition. Other studies have produced a whole grab-bag of partial performance measures rather than a comprehensive measure (for example, the Bureau of Industry Economics Studies on International Performance Indicators and the more recent Steering Committee reports on performance monitoring). But there has been a lack of discussion about how each of these measures fit together and add up to form a whole.

Profitability as a performance measure

The most common and familiar measure of firm performance is profitability. In private enterprise it is virtually the only criterion The economic performance of a private commercial enterprise operating in a competitive environment is focused squarely on the need to generate an economic rate of return at least equal to risk adjusted opportunity cost benchmarks (also called a 'normal' rate of return or zero pure profit)

Note however, that in comparing profit rates among competitive firms or industries, economic profits are expected to be zero so this may not be a useful performance measure. While profits are the goal of private enterprises, competition may render profit rates not very useful as a long term measure of performance This is why TFP has become a preferred measure; more shortly.

Profitability and government enterprise performance

Pure profit seeking, or any financial rate of return target, should not be the only goal of government trading enterprises. We outline four problems with profit and rate of return measures below.

One problem with profit as an objective is that government trading enterprises (GTEs) are not typically subject to competition — they can exploit consumers and often have wide latitude in their use of resources and delivery of goods and services, free of the scrutiny of shareholders and creditors, and secure from competition for their customers. That is, GTEs often have market power, and financial performance measures such as rates of return can be misleading. For example, desired rates of return can be achieved by exploitation of demand through overpricing, and a GTE can thereby avoid making hard decisions about the allocation of resources necessary to achieve efficiency.

Second, GTEs are often natural monopolies able to generate substantial scale and other size-related economies. The presence of economies of scale clouds the issue of whether a firm should recover all its 'costs.' The first best rule is that pricing should be at marginal cost. Therefore making a 'loss' (at least in the sense of recovery of historical costs) is not necessarily socially undesirable.

Third, GTEs may provide important social services (community service obligations CSOs). To the extent that these are not separately quantified and funded out of the Government budget, there is an argument for GTEs to make a loss as a form of implicit subsidy. Even the separate quantification of CSO costs can be a problem if it is based upon the inflated costs of a GTE not subject to normal commercial pressures.

Finally, there is an argument for GTEs to make a profit in order to supplement the government's revenues.

The forgoing reviews the various reasons why profitability is not necessarily an appropriate objective for GTEs. But this also raises the spectre that if profits are not a goal, what incentive is there for GTEs to control costs and pursue revenues? Life is easier if inputs are used and paid generously and customers are not squeezed. Even if we force a GTE to achieve a 'normal' return, it may be able to do so by under- or over-pricing sufficiently to offset any allocative inefficiencies. Therefore the economic rate of return by itself cannot be relied on as a measure of performance, and this consideration has led many to recommend the use of TFP as a substitute.

Another aspect of performance is that it can be useful to assess how efficient or productive an enterprise is relative to others. Also important is the direction of change. Even if a firm's efficiency is wanting, is it improving? Conversely, even if a firm appears to have been performing well compared to others, is it continuing to do so? In assessing performance we are interested in both the level of, and change in, efficiency.

In brief, both financial performance *and* productivity are goals for a GTE. Neither by itself constitutes a satisfactory overall performance measure.

Total factor productivity

Measures of productivity compare outputs with inputs. All manner of partial measures of productivity are possible: one can compare the quantity of any one or more outputs with any one or more input categories. But partial productivity measures, while popular for measuring routine operating performance (e.g., freight wagons switched per switch-engine hour, tonne-kilometres of freight per litre of fuel), are notoriously unreliable because they do not take into account simultaneous changes in other output or input categories. For example, the popular measure of labour productivity (output per employee) ignores the contribution of capital which usually drives labour productivity improvements.

TFP compares *total* outputs with *total* inputs; more specifically, it compares the growth of total outputs compared to the growth of total inputs. TFP provides a comprehensive measure of productivity performance, a 'bottom line' measure analogous to that of overall profitability. Note that even if profitability remains constant near zero as in competitive industries, TFP measures the increase in outputs relative to inputs which is taking place, and thus provides a measure of the rate of improvement in economic performance. However, what is not always recognised, is that it is possible for productivity performance to conflict with financial/economic measures of performance. That is the focus for this paper.

Total factor productivity (TFP) is measured by the growth of output relative to the growth in inputs (taking the logs of equation 1 converts these to growth rates, and TFP growth is the growth rate of output minus the growth rate in inputs):

$$TFP = \frac{Y_1/Y_0}{X_1/X_0} \quad \text{or} \quad \frac{Y_1/X_1}{Y_0/X_0} \qquad (1)$$

where Y_0 and Y_1 are output quantities (indexes); and
X_0 and X_1 are input quantity indexes.

The second expression in (1) is the ratio of a TFP index for each period. The output index is weighted by revenue shares of various outputs (which indicate the relative importance of different outputs to the firm), and the input quantity index weights inputs by their respective cost shares.

There are two comments regarding output weights. Revenues generally are accepted as an indication of the importance of a commodity to an enterprise's management. This is true for commercial companies. However, if a public enterprise is charged with delivering a deliberately low-priced output (a CSO), a shadow price indicating its relative social valuation would be more appropriate than revenues. However, for commercial GTEs, revenues are accepted as appropriate weights unless some alternate argument is forthcoming.

The second point about weights involves the interpretation of TFP. Some economists advocate the use of cost elasticity weights rather than revenue shares, i.e., that cost elasticities are a better measure of the impact of particular outputs on the total costs of the firm. Cost elasticity weights and revenue shares are identical only if the firm is subject to constant returns to scale, and there are no other endogenous sources of productivity gains. Expressed another way, the index number approach to TFP produces a 'gross index' measure of TFP, it measures improved output relative to inputs regardless of the explanation or sources of the productivity gains. The cost elasticity approach generally uses econometric cost functions to estimate the change in productivity over time. The estimate of productivity is net of any influence of returns to scale, density or other endogenous influences on productivity. For comparisons of productivity with prices, which we do shortly, it is the index number approach which is more relevant (see Oum, Tretheway and Waters 1992 or Diewert 1992).

The link between productivity and financial performance

To illustrate the links, use some simple algebra for two time periods, 0 and 1. One can think of a single product firm (or industry or GTE) employing only one input, or index numbers to represent multiple output and input prices and quantities. Note that for index numbers, the respective price and quantity indices must be dual to one another so that there is computational consistency.

Y_0 and Y_1 are output quantities (indices); and
X_0 and X_1 are input quantities (indices); as shown above, and
P_0 and P_1 are output prices (indices);
W_0 and W_1 are input prices (indices).

hence

R revenue = P x Y and C costs = W x X

Costs include capital costs, i.e., these are total economic costs The price and quantity indices must satisfy the 'product test', i.e., the ratio of price indices over two periods times the ratio of quantity indices should equal the ratio of corresponding expenditure indices.

Π_0 and Π_1 are measure of economic profit; for analytical convenience defined as the ratio of revenues to costs rather than the difference

$\Pi_0 = R_0 / C_0$

Note that there is no requirement that economic profits be zero, although that would be the expectation for perfectly competitive industries.

It is desirable to link productivity measurement with financial performance This is straight-forward, but note that because TFP data includes capital inputs and their service price in calculating productivity, it is economic and not accounting profits which should be compared with TFP. As noted, for analytical convenience, we work with economic profit Π as a ratio of revenues to costs rather than the difference.

Any change in profitability between the periods is indicated by the change in revenue/cost ratios:

$$\Pi_1/\Pi_0 = \frac{R_1/C_1}{R_0/C_0} \text{ or } \frac{P_1Y_1 / W_1X_1}{P_0Y_0 / W_0X_0} \qquad (2)$$

which is rewritten:

$$\Pi_1/\Pi_0 = \underbrace{\frac{Y_1}{Y_0} \times \frac{1}{X_1/X_0}}_{\text{TFP}} \times \underbrace{\frac{P_1}{P_0} \times \frac{1}{W_1/W_0}}_{1/\text{TPP}} \qquad (3)$$

Any change in the financial condition of the enterprise (economic profit) reflects the change in productivity *and* any change in relative prices of inputs and outputs The second expression in (3) is the ratio of the change in output prices to changes in input prices. The latter may be called a 'terms of trade' (TOT) concept, i.e., the price (index) the firm gets relative to what it must pay for inputs, or it is the reciprocal of what has been labelled 'total price productivity' or 'total price performance' (TPP) (Waters and Tretheway 1994). (The concept of using input and output prices to measure productivity rather than input and output quantities has been recognised for some time in the productivity literature in economics but it is rarely calculated or examined, e.g., Jorgenson and Griliches 1967 and Diewert 1992; in contrast, the link between TFP and profitability has been recognised in the management literature, e g , Landel 1983, Miller 1984 and Aboganda 1994). By tracking changes in output and input prices along with TFP, we can directly monitor any change in the firm's financial status along with its productivity changes.

It is important to note that the data required for the TPP or TOT calculation are already present in a TFP study. The input and output price indices are dual to the output and input quantity indices. The input price index is found by dividing total costs by the input quantity index; similarly, the output price index is total revenues divided by the output index. No new data collection is needed for this analysis.

Also note that financial performance is monitored relative to the base period. If R_0/C_0 is not equal to unity, then the firm is not in long run competitive equilibrium. If $R<C$ and the firm is making a loss, it is necessary/desirable that the firm's financial condition improve. It would be quite different if the firm started in a substantial monopoly position Here public policy would be looking for a decline in the financial performance In brief, one must pay attention to the conditions in the base period R_0/C_0 in assessing the desired link between productivity and financial changes in the firm.

Further, note that there is no guarantee or necessity that C_0 be the minimum possible cost of production. That is the expectation of firms in competitive industries, but this cannot be taken for granted for GTEs.

If competitive conditions do prevail, the firm is a price taker for both outputs and inputs and economic profits are zero hence R/C = 1 and TFP = TPP, i.e., all productivity gains (Y/X) are passed on in the form of lower prices for outputs relative to prices paid for inputs. There is a duality between TFP and TPP. By plotting TFP and TPP together, they are expected to overlap; but they do not exactly, and the ratio of TFP to TPP indicates the extent to which productivity gains are shared with customers.

The same comparison can be applied to public enterprises. They might exploit monopoly power and extract supranormal profits out of any productivity gains. Of equal interest however, is the opposite possibility: a GTE might show productivity gains but deteriorate financially. In fact this appears to be a common occurrence. That is, the GTE may succeed in increasing outputs relative to inputs, but it might not do so well in raising output prices while holding down input prices paid. Indeed, by making generous wage settlements in exchange for reducing inputs, the GTE can show improved productivity performance but at a high price, i.e., a deteriorating financial performance. Unless GTEs are monitored both for productivity *and* financial performance, focusing on productivity could be misleading.

TFP and Financial Performance of Australian National during the 1980s

An illustration of the inadequacy of TFP as a performance measure without regard for financial performance appears to be the case of Australian National Railways (AN) in the 1980's decade. The Steering Committee reported that "AN's measured level of TFP grew strongly over most of the period from 1979-80 to 1988-89" BTCE (1991) and the Industry Commission (1991) reported similar results. However, financial performance was not measured. (In what follows, the reader should note that approximately 60 per cent of AN's activities were subsumed into the National Rail Corporation on 19 September 1991 and thus performance indicators calculated for periods prior to this date provide no indication of the current performance of either AN or the National Rail Corporation.)

Our calculations use the Steering Committee's data. The Steering Committee used a 'fixed base' index formula. We recalculate the TFP index as a Fisher index and use a 'sliding base' formulation. The sliding base Fisher index method is superior to other index formulae in that it satisfies an extensive list of tests as to what constitutes an ideal index. In particular, the Fisher satisfies the *Product Test* which we used above in relating the revenue/cost ratio to TFP and TPP.

We then construct the Fisher input and output price indices dual to the input and output quantity indices used for our Fisher TFP calculation and produce cumulative indices (e.g. cumulative value for year 2 is year 1 times year 2). These indices are shown in Figure 1. The 'terms of trade' (TOT) is the weighted index of the ratio of unit revenues (or output prices) to weighted input prices, where the weights are the

respective shares of revenues and costs just as in the TFP index. It provides an indication of how the output prices of an organisation are performing relative to prices paid for inputs, an indicator of overall price performance which is parallel to the indication of 'total' productivity provided by TFP. Figure 1 shows that the rate of rise of output prices is substantially below that of input prices.

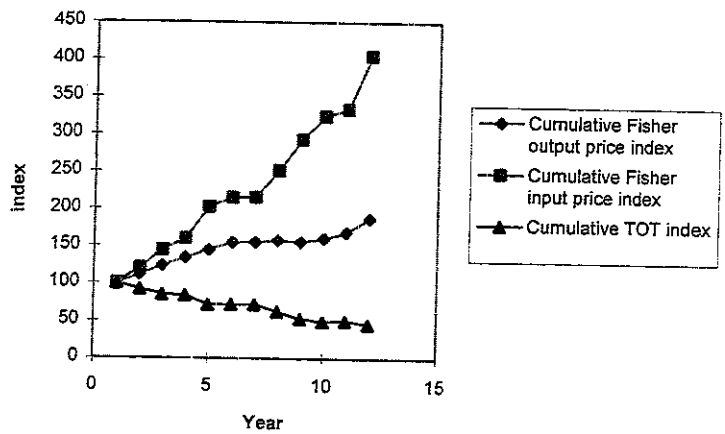

Figure 1: Cumulative indexes of output prices, input prices and terms of trade

Figure 2 inverts the TOT to what we call TPP, the measure of 'total price performance' and includes the indices for TFP and the Revenue/Cost ratio. As noted earlier, if the revenue/cost ratio was unchanged, TFP and TPP would coincide, meaning all productivity gains were passed on to consumers as a lower output prices relative to input prices paid. (The year to year changes in the indices and our calculations are available upon request).

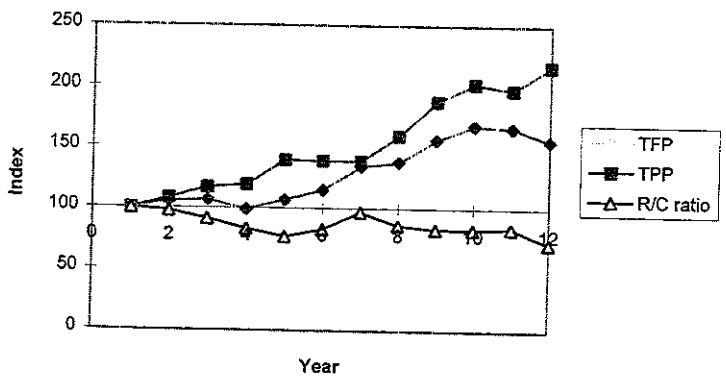

Figure 2: Cumulative TFP, TPP and R/C ratio indexes

The plot of TFP against TPP shows that the extent to which input prices rose relative to output prices charged exceeded productivity growth TFP. That is, price performance TPP exceeded (or terms of trade declined) the rate of increase of TFP, hence the financial performance of AN worsened significantly over the same period as TFP improved. There was a net decline in overall economic performance.

Looking at Figure 2 more closely, the pattern between productivity change, input/output price change, and change in financial performance is evident. In most years, TPP exceeds TFP, hence R/C declines. For example, the first three years show a steady decline in R/C. In year 4, both TFP and TPP increase, the latter more than the former, therefore R/C still declines. Over the next two years the TFP change is positive but TPP is flat, therefore there is notable improvement in R/C. Then the TPP change exceeds the TFP change once again and R/C is negative, except for year 11 when a decline in TFP exceeds the decline in TPP hence R/C improves. The final year shows a decline in TFP despite a rise in TPP and hence a significant decline in R/C.

Some studies have recognised this possibility of productivity and financial performance being in conflict, if in a rather cryptic fashion. For example, Australia Post noted: "an organisation can take little comfort in high productivity growth if at the same time it is earning low returns on the capital it employs". (Steering Committee, 1992, p112, but it did not explain how this could happen.)

In brief, the AN TFP experience illustrates the danger of relying on TFP as a sole performance measure. At a minimum, it is necessary to monitor TFP as well as economic profitability. Alternatively, one can monitor TFP and TPP. Any two of TFP, TPP and the ratio of revenues to total costs (including capital) will reveal the change in overall performance of the enterprise.

Linking Productivity with Rates of Return

The framework used earlier shows the direct connection between productivity and financial performance, the latter defined in terms of the revenue/economic-cost ratio. However, a revenue/economic-cost ratio is not a common financial performance measure. It would be desirable to show a link between profitability or standard rate of return measures with productivity. Unfortunately, this is not straight-forward.

There are a number of alternate economic financial measures, a few of which are listed below. For this discussion, we distinguish between two cost categories: 'capital' and 'all other', labelled VC for variable costs. Capital could be expressed in accounting or historical book values K_B or current market values K_M. The opportunity costs of capital are of two components: real economic depreciation expressed as a proportional rate d, and the costs of capital r (which includes a risk component not written explicitly).

Table 1: Alternate economic financial measures

economic profits	R - C
accounting profits	R - VC - book depreciation
operating ratio	VC/R
operating margin	(R - VC)/VC
accounting rate of return	(R - VC - book depreciation)/K_B
economic rate of return:	(R - VC - dK_M)/K_M
economic rate of profit:	(R-C)/K_M this can be rewritten (R-VC-dK_M-rK_M)/K_M or ([R-VC-dK_M]/K_M)-r, or ERP = ERR-r

Given that R-VC equals net cash receipts and dK_M equals change in market value, our definition of ERR is equivalent to other definitions in for example, Treasury 1990 and Fallon 1993

Proportional and absolute measures can differ considerably due to scale That is, R/C can be the same proportion for large or small firms, but the absolute profit level can differ immensely. The absolute level of profits may be a useful performance target for an enterprise in isolation, but it is not a useful performance measure for comparisons across different size firms. Providing that R/C is near unity, the direction of change between proportional and absolute measures can be consistent. That is, a rise in R/C implies a rise in profitability. However, if R/C is considerably different from unity, then the direction of change in R/C will not always correspond to the direction of change of absolute profits. For example, suppose R is much smaller than C; a larger proportionate increase in R compared to C will increase the R/C ratio, but it is still possible for absolute profits to decline. (In fact, this happens for year 11 (1989-90) of the Australian National data.)

The operating ratio (operating expenses as percentage of revenues) is a common financial measure in the transportation industries. It shows the percentage of revenues absorbed by operating costs, i.e., the proportionate residual to cover depreciation and return on capital. The more capital-intensive modes and firms will need a higher operating ratio, e.g., trucking generally well-above 90, railways try to be near 80 While the operating ratio can be a very useful management target, it is important to know what the appropriate operating ratio should be. There is a well-known distortion in simply using the operating ratio as a performance target. The operating ratio ignores capital costs. Hence this can lead to a distortion as government enterprises can substitute capital for operating costs to lower their operating ratio, but possibly with a decline in overall financial performance.

The operating margin is a variation on the operating ratio, specifically it is the same as the reciprocal of the operating ratio minus one.

The traditional accounting rate of return is not explored here for the well known reason that book values of capital are an unreliable guide to the current market valuation of capital assets.

The *rate* of profit is a more widely-used indicator of performance. Because the R/C used above in demonstrating the link between TFP and financial performance uses the economic definition of costs (including a market return of current dollar valuation of capital), the economic rate of profit (ERP) is the relevant measure to try to link with R/C. (Use of an accounting rate of return is not appealing if the ratio of market to book valuations of capital vary across firms and over time). But the numerator of ERP is the difference R-C so it is still necessary to examine any link between the absolute difference and ratio of R and C.

There is a direct link between these in particular circumstances. Suppose the efficient mix of capital and non-capital inputs would remain fixed, and the productivity of capital grows in the same proportion as that for other inputs. Then there would be a constant proportional relationship between total costs and the size of the capital stock K_M measured in current dollars (the same as other inputs). In this case there is a direct relationship between movements in R/C and ERP. First, the ERP is:

$$ERP = \frac{R - C}{K_M}$$

By initial assumption, if there is a constant relationship between the size of the capital stock and total economic costs, then $K_M = k\,C$ where k is some proportion which depends on the size of the capital stock relative to the annual flow of capital services from that stock, and the share of total costs corresponding to that capital service flow (more specifically, $k = K/Kflow * (s_k/r)$ where s_k is capital's cost share, and r is the cost of capital). Then:

$$ERP = \frac{R - C}{K} = \frac{R-C}{k\,C} = \frac{R}{kC} - \frac{1}{k}$$

$$= \frac{1}{k}\left(\frac{R}{C} - 1\right)$$

and any change in R/C is also a guide to the change in ERP. Since ERR equals ERP-r, this means any change in R/C is also a guide to ERR.

Of further interest, in this special case of assuming ($K_M = kC$), the economic rate of return formula (ERR) also leads to the expression:

$$ERR = \left[\frac{1}{k}\left(\frac{R}{C} - 1\right)\right. - d$$

which implies that r=d for this special case to be true that the capital stock bears a constant proportionate relationship to total economic costs.

However, if the share of capital in total economic costs changes, and/or capital becomes more or less productive (different service flow relative to the value of the capital stock), then the relationship between ERP and R/C is more complex. Capital inputs usually do not adjust as rapidly as other inputs, therefore over a business cycle it is plausible to see some variation in the share of capital inputs because they are not shed as quickly as other inputs during downturns, nor is capital added as rapidly as other inputs during upturns. Note however, if the service flow of capital is associated with the actual utilisation of capital rather than simply proportional to the stock of capital, then the service flow of capital would adjust up and down with output fluctuations just like other variable inputs. This would retain (at least approximately) the proportionality between capital and total costs, and thus the proportionality between R/C and ERP or ERR.

In sum, providing that the share of capital in total costs is relatively stable, then changes in R/C will be closely related to changes in ERP or ERR.

The current dollar or market valuation of a capital stock is very difficult to estimate. However, this is done in many TFP studies. The series of capital investments are accumulated over the years, corrected by a price index to keep the accumulating stock in constant dollars, less a rate of economic depreciation. This is the Christensen-Jorgenson (1969) perpetual inventory method of estimating capital stocks. Typically, the growth of the capital stock is used as the proxy for the growth of capital inputs to the enterprise. The constant dollar capital stock can be converted to any year's valuation to calculate an economic rate of return.

Some studies use proxies for capital inputs, e.g., miles of track for a railway, or the cumulative horse-power of a locomotive fleet. Once a weight is assigned to represent capital's share in total costs, given that labour or other expenses are expressed in current dollars, there is an implied current dollar valuation of the capital inputs for that year. Making an assumption about the magnitude of capital service flows relative to a stock yields an implied capital stock valued in current dollars.

Further Issues in Measuring Productivity Performance

The foregoing shows the link between productivity measurement (TFP) and overall financial performance. Monitoring these measures will accurately reveal the performance change over time. But there are additional issues in performance measurement to consider.

The need for measuring base period performance

TFP or any performance comparison is relative to some base. In the above discussion, TFP (and TPP or the change in economic profitability) are relative to a base year. This is accurate as far as it goes, but it does not guarantee that the level of costs in the base year was at a minimum (it may not have been allocatively efficient). It is desirable to have a benchmark or absolute measure of performance as to monitor the improvement in performance over time. Ideally, the allocatively-efficient total cost would be calculated for the base year, and this would provide a solid guide to both productivity and financial performance assessment.

In lieu of an absolute efficiency benchmark, presumably greater confidence in assessing productivity performance comes about with larger sample sizes or data periods. A firm might not be operating near the efficient frontier initially, but a period of productivity increases would still show efficiency improvement. If a number of firms are shared in a productivity data base (multilateral productivity measures), then one can make absolute performance comparisons among firms (the Canadian rail studies by Freeman, et al., 1987 and Tretheway, Waters and Fok, 1994 employ multilateral indices).

Quality changes and productivity measurement

A shortcoming of virtually all productivity measures is that they ignore quality changes. Output is assumed to consist of identical units from year to year. In particular, there is the danger that increasing inputs to improve quality will not change the number of tonne-kilometres, hence it is possible that quality improvements will show up as declines in productivity. This shortcoming is well-known, and there is little that can be done about it unless quality measures are explicitly introduced into the output dimensions, but there have been few examples of this being done in practice. The danger is that firms judged primarily by productivity performance measures could be discouraged from pursuing quality improvements because of this bias in productivity measures.

The linkage between productivity measures and financial returns may provide some insight into quality and productivity measurement. Even if quality dimensions go unmeasured, for inputs into quality to be successful, they must either manifest themselves as increased output (in which case they will show up in productivity measures) or, more likely, a higher quality output will command a higher price. By monitoring both TFP and TPP, a successful quality improvement might entail a lower TFP but it would show up as a reduced TPP. The improved financial return would show the success of the quality initiative notwithstanding a reduced quantitative productivity performance. Conversely, if inputs into quality do not generate improved financial returns, then quality improvements are not a satisfactory excuse for reduced productivity performance.

Conclusions

We conclude that TFP, or indeed any other single performance measure currently available, are insufficient in themselves to measure overall performance.

It is important not to 'throw out the baby with the bathwater' however. This paper should not be taken as an endorsement of less performance monitoring for GTEs, but the reverse. We particularly warn against any tendency to revert to the collection of a host of meaningless partial measures of performance, without any attempt to analyse what they mean as a whole. TFP measures are still theoretically superior to partial measures of productivity.

We have shown that the data from a TFP study is capable of revealing more information about performance. Monitoring output and input price indices along with TFP will link productivity performance with financial performance. More specifically, TFP, TPP (or TOT) and R/C (revenue/total-economic-cost) are directly linked. Any two of the three will reveal the combined result of productivity and financial performance and provide a basis for identifying and ultimately eliminating the kind of problem we have identified in this paper. If for example, a GTE was 'buying' productivity improvements at an excessive price paid to inputs, this would show up as excessive price performance TPP (or worsening terms of trade) and deterioration of revenues/costs (economic rate of return). If a GTE was exercising its market power to achieve a financial target by raising output prices, this would not conceal poor productivity performance.

The forgoing indicates the change in performance, i.e., the change in TFP, TPP and R/C indices. All are measured relative to some base year (and some benchmark company if multilateral indices are used). It is also desirable to measure the absolute level of performance, i.e., benchmarking. This is of two types: (1) comparisons with top-performing enterprises in or out of the country; and (2) reviewing the organisation's proper mission: the importance of commercial versus social objectives and the appropriate allocation of gains brought about by genuine improvements in productivity. For instance, gains may be shared between reduced charges to consumers, increased wages and other returns to factors, improved cost recovery or improved service quality.

In conclusion, TFP is of major importance in assessing performance of GTEs, but it is essential that TFP be combined with overall financial performance as well as evidence on absolute performance levels gained by benchmarking studies. And fortunately, we have shown that the data compiled for TFP studies is capable of providing additional insight into these two primary dimensions of performance. In the absence of TFP, economic rents may be obtained via market power rather than more efficient operations. TFP and financial measures combined provide a more robust measure of performance.

Glossary

AN = Australian National Railways
BTCE = Bureau of Transport and Communications Economics
CSO = community service obligation (also called universal service obligation)
DEA = data envelopment analysis
ERP = economic rate of profit
ERR = economic rate of return
GTE = government trading enterprise
R/C = revenue/cost ratio index
Steering Committee = Steering Committee on National Performance Monitoring of Government Trading Enterprises
TFP = total factor productivity
TOT = terms of trade

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