PRODUCTIVITY: PHILPOTT VERSUS STATS

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(Reprinted from NZ Economic Papers, 40(2), 2007, pp.215-223)

Introduction

Statistics New Zealand has only recently completed new estimates of national productivity for the economy. The new figures refer to what Statistics calls the "measured sector" of the economy. This definition excludes some industry sectors and local and central government and is said to be more representative of the commercial sector. The new estimates run from 1987/88 to 2004/05 and it has been stated that they will be extended backwards as time and resources permit. Statistics employs the Australian and New Zealand Standard Industrial Classification (ANZSIC). This system contains 117 separate categories and is known as ANZIND. The published statistics on GDP are aggregated to 30 industry categories. In Philpott's time, the published system included 22 industry categories.

Bryan Philpott last contributed to this subject in 1999 with the publication of data sets for real gdp, labour employed and real gross capital stock for the period 1960-1990 (Philpott 1994, 1999). His data is all converted to 1982/83 prices and is based on the then official data collections. In 2005 I updated the Philpott data base to the year 2002 with the help of official sources and arranged for the data set to be placed on the Motu website. This data set is consistent with the earlier New Zealand Standard Industrial Classification (NZSIC).

This note is to compare the basic productivity estimates using the two sets of data and to identify where data changes and improvements in data recording have influenced the results.

Philpott Sources and Definitions

Real Gross Domestic Product by SNA Industry Group: Professor Philpott utilised the existing Statistics data sets for GDP. Statistics moved the price base sucessively from 1982/83 to 1991/92 and then 1995/96 over the period under review. It is not clear how Philpott converted the later price based data to the earlier one. Between 1991/92 and 1995/96, Statistics changed from the New Zealand Standard Industrial Classification (NZSIC) to the Australia and New Zealand Standard Industrial Classification (ANZSIC). This change of industry definitions meant changes in the grouping of the 117 base categories in the published 30 industry tables. In some published documents Statistics utilises a 52 industry breakdown. For updating of NZSIC tables prepared before 1995/96, a system is needed to re-group the ANZSIC industries into the 22 industry categories employed by Philpott.

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There are 3 steps to generate NZSIC consistent records from present-day ANZSIC–based statistical series:

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(i) Identify changes in the major industry groups;
(ii) Identify numerical changes as a result of re-classification; and
(iii) Adapt ANZSIC data sets to Philpott's NZSIC data sets.

Industry Groups: In most published tables there are 30 industry categories which Statistics labels `ANZSIC published aggregates' (Statistics 2004). In working papers Statistics recognises a 52 industry table called `ANZIND published industry' and a 117 industry classification called `ANZIND working industry'. A comparison of the 30 industry list for ANZSIC and the 22 industry list used by Philpott is shown in Box 1. In some cases, the components within an ANZSIC 30 industry grouping have been changed (e.g. *Wood* and *Paper* are brought together) and in some cases an ANZSIC industry is published separately from its previous grouping (e.g. *Wholesale Trade*).

Box 1 Industry Nomenclature for ANZSIC 30 and NZSIC 22

ANZSIC	NZSIC
Agriculture	Unchanged
Fishing	Unchanged
Forestry &Logging	Unchanged
Mining	Unchanged
Food,Beveridges, and Tobacco Manufacturing	Unchanged
Textiles&Apparel Manufacturing	Textiles,Apparel&Leather
Wood&Paper Product Manufacturing	Wood&Wood Products
Printing,Publishing&Recorded Media	PaperProducts,Printing& Publishing
Manufacturing	)Rubber&Plastics
Non-Metallic Mineral Product Manufacturing	Unchanged
Metal Product Manufacturing	)Machinery,Metal
Machinery&Equipment Manufacturing	)Products&Other
Furniture&Other Manufacturing	)
Electricity,Gas&Water Supply	Unchanged
Construction	Unchanged
Wholesale Trade	)Trade,Restaurants&
Retail Trade	) Hotels
Accommodation,Restaurants&Bars	)
Transport&Storage	Unchanged
Communications Services	Unchanged
Finance&Insurance	)Finance&Insurance&
Property&Business Services	)Real Estate&Business)Services
Ownership of Owner-Occupied Dwellings	Unchanged
Central Government	)Government,Central& Local
Local Government	)Local&Health/Education
Personal and Community Services (+Health&Education)	)Community,Social&)Personal

Numerical and other changes: David Haugh (2001) first worked on this problem in The Treasury. He utilised the 1987-88 52-industry nominal GDP tables to work out the implications for each industry sector of the ANZSIC re-classification for comparisons with earlier classifications. ANZSIC re-grouped each of the *Wood*, *Paper*, and *Machinery* components of NZSIC with the weights shown in Box 2. Our procedure requires us to transfer the components back to their NZSIC equivalents. For *Government* and *Personal Services* there were significant differences. *Local Government* remained unchanged, but the education and health components of *Central Government* were moved into *Personal Services.*.

Box 2: Concordance Factors for Real GDP in 1987-88
(after Haugh)

I Transfer 30% of combined total of ANZSIC *Wood and Paper Products* and *Furniture&Other* to *Machinery, Metal Products&Other (representing Furniture)* (balance combines with balance of *Wood&Paper Products* to form *Wood&Wood Product Manufacturing*).

II Transfer 52% of ANZSIC W*ood&Paper Products (representing Wood Products)* to *Wood&WoodProducts* (balance to *Paper Products&Printing*).

III Transfer 30% of ANZSIC *Metal Products Manufacture(representing Basic Metal Manufacturing)* to *BasicMetal Products* (balance is *Machinery and Equipment*).

IV Maintain *Finance, Insurance, Property and Business Services* as an aggregate

V Transfer 34% of ANZSIC combined total of *Government (Central and Local)* and *Personal&Community* to NZSIC *Central Government (*balance to NZSIC *Community&Personal Services*).

VI All other industries assumed to be defined approximately the same in both classifications.

This procedure assumes that the concordance ratios hold constant back through time. The Philpott series go back to 1960. By taking 1987-88 52-industry estimates the adjustment preserves any trend shown in the Philpott data between the classification change, but the absolute amounts would be increasingly distorted for the industries concerned the further the series is extended back. An alternative would be to weld the Philpott data to the ANZSIC data base by matching the old data to the new data at a common year. This would preserve the trend in the old data but the absolutes would still have less meaning compared with the ANZSIC-Haugh framework.

NZSIC consistent Estimates: The third step is to extend the Philpott tables from 1990 to 2002 by converting all GDP series published since 1990 from an ANZSIC basis to an NZSIC basis using the concordances in Box 2.

Measured Sector: The Statistics productivity aggregates are confined to the productive sectors of the economy and are called the `measured sector'.The measured sector of the economy excludes from the 30 industry table the following sectors: *Property&Business Services, Ownership of Owner-occupied Dwellings, Central Government&Defence, Local Government Administration, and Personal and*

Community Services. `*Property and business services*' is not identified in the Philpott tables and in what follows it is still included in the measured sector under *Finance, Insurance and Real Estate.*.

Employment in Full Time Equivalents by Industry Group: This data was first obtained from the Quarterly Employment Survey and from 1990 the Household Labour Force survey (HLFS). Part-time workers were converted to full-time equivalent at a ratio of 0.35. This ratio was chosen by Professor Philpott from data in the Quarterly Employment Survey and relates to the then assumption part-time work was less than 20 hours per week (Philpott 1992). Statistics New Zealand curently employs a weighting of 0.5 and the requirement is less than 30 hours per week. For the present updating, Statistics provided a special run from the HLFS with a weight of 0.35. The measured sector FTEs are derived from the same categories as for GDP.

Gross Capital Stock: Philpott derived this series from original sources. He established base stocks from the old Factory Production Statistics from the 1950s. He then used Statistics' capital expenditure series to update the stocks using the perpetual inventory model (PIM). He assumed a lifetime for each class of capital goods and depreciated each annual stock by a straight line factor. (In a net capital stock series he used Inland Revenue depreciation rates instead). From 1990 there was a delay in the publication of industry capital expenditure and Philpott derived his data from estimates given at the time by NZIER. In updating this series, I took the latest Statistics capital formation series, deflated it by the capital goods price index back to 1990 in 1982/83 prices, and re-estimated the gross stocks from the existing stock in the Philpott series from 1990 onwards. Since then Statistics have published their own estimates of productive capital stocks. While these are based on the perpetual inventory method, they use different assumptions for depreciation and capital gains. The measured sector gross capital stock is derived by the same rules as for GDP.

Compensation of Employees by Industry Group: This is needed for weighting the relative shares of capital and labour in the multi-factor productivity index. Nominal GDP is divided between the reward to capital and labour by identifying `compensation of employees' and the remainder (representing the reward to capital) from national income statistics. This data is available in Philpott (1994) up to 1991, and thereafter can be found in the national income website (www.statistics.govt.nz). The weighted index for total factor inputs is obtained by weighting the physical indexes of the two variables by a moving geometric average of the annual factor shares (the Tornqvist formula). For the measured sector, the labour share is slightly lower than that for the economy as a whole. There is no reason to believe that the factor shares for each year would differ between Philpott's data set and those employed by Statistics New Zealand.

Statistics New Zealand Definitions: (a) Labour: `Estimates of labour volume are based upon hours paid for all employed persons engaged in the production of goods and services in the measured sector. The key data sources are the annual Business Demography employee count, the Quarterly Employment Survey, the five-yearly Population Census and the Household Labour Force Survey. These sources are used to derive industry March-year annual total hours paid series. These are then aggregated by a chained Tornqvist index in which the weights are based on industry shares of the measured sector nominal labour income (including self-employed). Assuming a positive correlation between relative industry labour incomes and skill

levels, this industry weighting regime implicitly goes some way towards quality-adjusting the labour input series'(Statistics New Zealand 2006).

(b) Capital Stocks: `The capital series takes as its starting point the annual constant-price productive capital stocks series, which have been developed using a perpetual inventory model that generates productive stock estimates for 26 asset types by industry. In addition to the PIM-derived fixed asset stocks, the range of capital included in the productivity measures is supplemented by separate estimates for three other assets, namely livestock, exotic timber grown for felling and land in use in agriculture and forestry. The productive capital stock represents the gross capital stock (value of assets in existance) adjusted for efficiency loss... … Capital service flows are assumed to be proportional to these productive stock estimates, and are aggregated to the industry level using a Tornqvist index with weights based upon implicit rental prices (or user costs) which are a function of an endogenous rate of return, depreciation and asset price changes.. The measured sector capital index is calculated, in turn, as a Tornqvist index of the industry indexes, with the industry shares of total user costs (equal to industry gross operating surplus less the estimated labour income of the self-employed) providing the weights' (ibid).

(c)Composite input index: `A composite input index is constructed by combining the labour and capital factor indexes at the measured sector level. The total inputs index is a Tornqvist index, with the factor shares of value-added providing the weights' (ibid).

Comparisions of Productivity Parameters

Statistics (2006) presents productivity estimates for three periods: 1988-93, 1993-05 and 1988-05. As the Philpott tables have only been updated to 2002, the comparable periods have been estimated from the Statistics data file in Table 1 (Jason Ede, Statistics, pers. com.).

Table 1:Average Annual Growth Rates for Productivity Parameters for Measured Sector by Periods in Philpott Data Set
(Stats estimates in parenthesis)

Period	L	K	GDP	GDP/L	MFP
1988-93	-2.6 (-3.2)	1.4 (2.0)	-0.3 (-0.2)	2.3 (3.2)	0.15 (1.2)
1993-02	2.1 (1.4)*	1.7 (2.4)	4.2 (4.1)	2.1 (2.6)	3.18 (2.2)
1988-02	0.4 (-0.3)*	1.6 (2.3)	2.6 (2.5)	2.3 (2.8)	2.00 (1.8)

* Stats estimates adjusted to 1993-02 and 1988-02

Discussion

The GDP series are most comparable as they are drawn from essentially the same source. The Philpott capital stock series appears to systematically underestimate the growth of capital stocks compared with the Statistics series. Though the Statistics productive capital stock series has a wider coverage the capital formation component is drawn from the same source. In these circumstances, the differences in growth of stocks appear to lie in the different depreciation assumptions employed. Philpott assumed a lifetime decline in usefulness while Statistics employs a sophisticated measure of loss in efficiency.

The Philpott labour series appear to fall more slowly and rise faster than the Statistics series. Statistics have greatly improved their estimates of actual labour expended in terms of hours worked. This series is to be preferred in future work once it is extended back to 1972.

In the period covered by the statistics the measured sector contributed on average 65 per cent of industry GDP and accounted for 69 per cent of total paid hours (ibid p.9). Comparisions of annual average growth rates in FTEs in the total economy and the measured sector in the Philpott data set were:

Period	Total Economy	Measured Economy
1988-93	-1.45%	-2.6% (-3.2)
1993-02	+2.30	+2.1 (1.4)
1988-02	+0.94	+0.4 (-0.3)

The measured economy dropped employment faster after the 1989 slump and has recovered more slowly after 1993. In comparision with hours worked, the measured sector FTEs fell more slowly in the first period and rose more quickly in the second period.

The overall result is that measured sector labour productivity is higher in the Statistics estimates (principally due to the definition of the employment series), and multi-factor productivity in the Statistics estimates is higher in the first period but lower in the second period.

Long-term rates of growth

Since Professor Philpott's data set is the only comparable data set to the recent Statistics estimates, his data is an excellent source for estimates of long-term growth rates of the productivity parameters for the measured sector (Table 2).

Table 2: Long-term Annual Average Growth Rates for Productivity Parameters for Measured Sector by 10 Year Periods in Philpott Data Set

Decade	L	K	GDP	GDP/L	MFP*
1960-70	1.75	3.80	4.15	2.36	2.67
1970-80	0.94	3.63	2.13	1.17	0.89
1980-90	-1.19	2.38	1.87	3.10	1.44
1990-00	1.09	1.53	2.92	1.81	2.28
1960-00	0.64	2.83	2.76	2.11	1.82

* Tornqvist weighting for composite input index as in text.

In growth theory terms, 1960-70 was a period of economic expansion with GDP growth driven by high productivity growth and factor inputs. Lower growth in 1970-80 was accompanied by lower productivity growth and in labour employed in the measured sector. In 1980-90 productivity continued to improve but employment fell. This combination contributed to higher labour productivity. In 1990-2000 we have a

recovery in GDP growth (though not as good as the 1960s), through good growth in MFP and both factor inputs.

Over the forty year period, GDP growth has been modest by international standards at 2.76% per year, and growth of capital employed has well exceeded labour employed. Capital per labour unit has expanded considerably over the forty years as a result by a factor of 2.36. We have sustained labour productivity increases of over 2 per cent per year. Factor productivity throughout is in excess of one per cent per year and helps maintain growth in national GDP of 2.76 per cent. Philpott's consistent assumption of 1 per cent per year in a number of planning exercises has turned out to be an underestimate. There is some suggestion that the growth of capital stock has fallen in each sucessive 10 year period. This is not borne out in the comparison of the 1988-93 and the 1993-02 periods in Table 1. It remains a possibility for further investigation whether MFP can increase without gains in capital productivity.

Conclusion

I believe that the new Statistics New Zealand estimates of national productivity are an improvement on previous estimates of the essential parameters. Their usefulness will be enhanced when the series are extended back to 1972 as has been announced. In the meantime, the data set assembled by Professor Bryan Philpott of Victoria University back to 1960 is one of a few sources that is sufficiently comprehensive and consistent to estimate long-term trends in the national productivity parameters. On this evidence, labour employed in productive activities is shown to fluctuate with changes in the economic cycle while capital employed increased at a faster rate in earlier decades than it did in later decades. The drive for productivity growth appears to have slowed in the first two decades but slowly recovered in the second two decades. More research would be useful to determine the source of these changes.

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