House of Representatives Standing Committee on Economics: Inquiry into Raising the Level of Productivity Growth in the Australian Economy

Submission from the Australian Bureau of Statistics

Please find enclosed a submission by the Australian Bureau of Statistics (ABS) regarding the House of Representatives Standing Committee on Economics: Inquiry into Raising the Level of Productivity Growth in the Australian Economy.

The ABS contact for this submission is Jason Russo, Assistant Statistician, Economic Analysis and Reporting Branch, telephone 02 6252 7690.

Ian Ewing
Deputy Australian Statistician
Macro-economic Statistics and Integration

The ABS Productivity Measurement Program: Issues and Prospects

1. Introduction

1. This submission focuses on the adequacy of ABS productivity statistics as measures of productivity growth for the Australian economy. The ABS is in a position to provide advice on the use of productivity statistics and associated measurement issues. This submission does not give suggestions or comments regarding policy settings or regulatory matters. The ABS supports the Committee making this submission public.

2. There are three key messages from this ABS submission. First, the ABS productivity statistics are compiled employing the best international practices and as a key international contributor in this field, the ABS is among the top statistical agencies in terms of the quality of its productivity statistics. Second, despite decades of painstaking effort by great minds in economic measurement and leading statistical agencies (including the ABS), many measurement issues and challenges still remain. Third, the ABS has been making significant progress in improving its productivity statistics.

3. This submission outlines the methodology underlying the ABS productivity statistics and highlights the key measurement issues and challenges in regard to the measurement of productivity in the Australian economy, particularly in relation to the measurement of multifactor productivity (MFP). The rest of this submission is structured as follows: Section 2 describes basic concepts and outlines current ABS productivity statistics; Section 3 discusses the major measurement issues and challenges that affect the accuracy and interpretation of MFP measures; Section 4 reviews the progress ABS has achieved in improving its productivity statistics; Section 5 describes the current work the ABS is doing to develop its productivity statistics; Section 6 outlines possible future research directions; and Section 7 concludes.

2. Current ABS productivity measures

4. Measuring productivity is an important work program for statistical agencies across OECD countries. The OECD has produced a number of handbooks and manuals to set out a guide for 'best practice' in productivity measurement by statistical agencies. The ABS was a major contributor to the development of the OECD Capital Manual, which is an important document for guiding practitioners on how to measure the capital services component of productivity measures.

5. The methods used by the ABS in compiling productivity statistics align with international best practice as implemented by most OECD countries. The ABS MFP statistics are compiled on the basis of the standard growth accounting framework, which is widely adopted by leading statistical agencies and recommended by the OECD. For a detailed description of the growth accounting framework, see Chapter 27, Productivity Measures in the *Australian System of National Accounts: Concepts, Sources and Methods* (ABS cat. no. 5216.0).

6. The ABS produces annual indexes of labour productivity, capital productivity and MFP for a set of industries (referred to as the *market sector*) in the Australian economy, which are published in the *Australian System of National Accounts* (ABS cat. no. 5204.0). Quarterly estimates of labour productivity for both selected industries in the market sector

and the whole economy are published in the *Australian National Accounts: National Income, Expenditure and Product* (ABS cat. no. 5206.0). In addition the ABS produces MFP estimates at the industry level for a selection of industries, which are still experimental in nature and are released in *Experimental Estimates of Industry Multifactor Productivity* (ABS cat. no. 5260.0.55.002).

7. Productivity is the efficiency with which an economy transforms inputs into outputs. Productivity statistics provide measures of changes in the efficiency of production. Productivity is typically measured in the form of Gross Domestic Product (GDP) divided by some inputs. Economists refer to inputs to the production process as factors of production. Of the various factors of production, the most important are labour and capital. Partial measures of productivity take into consideration a single input like labour or capital. For instance, labour productivity is frequently used as an indicator of productivity growth, which is simply measured as a ratio of GDP per hour worked. Similarly, capital productivity is measured as GDP per unit of capital. When multiple inputs such as labour and capital are taken into consideration, this is termed multifactor productivity (MFP), which is measured as GDP per unit of a combined bundle of labour and capital.

8. Labour productivity is perhaps the easiest concept to understand and its simplicity allows it to be widely used for making historical comparisons of productivity growth, or comparisons across different countries over time. As growth in labour productivity has a close long term relationship with growth in labour earnings, labour productivity is often regarded as a basic indicator of improvements in economic living standards over time. Of specific interest to economists, however, are the underlying causes of productivity growth. Partial measures of productivity, such as labour productivity, do not specifically identify the sources of productivity growth. Put differently, labour productivity indexes reflect not only the contribution of labour to changes in production per labour unit, but are also influenced by the contribution of capital and other factors affecting production such as technological change as well as labour efficiency. In comparison, measures of MFP do enable the attribution of growth of GDP per hour worked (or per capita) to three drivers: labour, capital and improvements in ways of doing things (technical progress). It is MFP that is therefore most commonly used in rigorous productivity analysis, and for this reason, the discussion of this submission focuses attention on MFP measurement.

9. MFP statistics are designed to inform how much economic growth originates from productivity growth (increased outputs from the same quantity of inputs) and how much from increased inputs (increased outputs from more capital goods or additional working hours). Key to long term improvements in Australia's living standards is productivity growth and therefore enhancing national productivity is one of the basic goals of economic policy. In this context, ABS productivity measures are important indicators for gauging Australian economic progress and provide a basis for governments and the broader community to examine aggregate trends in productivity growth over the longer term.

10. Table 22 and Table 23 (attached as appendices in this submission) of the *Australian System of National Accounts* (ABS cat. no. 5204.0) provide estimates of the relative contributions of labour and capital inputs, and MFP to the output growth for the *market sector*. Table 23 of the 2007-08 publication provides contributions to output growth for eight distinct productivity growth cycles between 1964-65 and 2003-04, as well as the long-term average contribution for all eight productivity growth cycles combined. Between 1964-65 and 2003-04 for instance, real output growth averaged 3.3 percentage points per annum. Of this, capital input contributed 1.6 percentage points (nearly 50 percent of the

total output growth) per annum and labour input contributed 0.5 percentage points. Productivity growth contributed 1.3 percentage points (almost 40 percent of total output growth).

11. Economic statistics may be fit for one purpose but may not be fit for others. MFP measures are developed for conducting analysis of long term productivity growth. It is not ideal for users to employ them for assessing short term productivity fluctuations. Caution needs to be exercised in interpreting productivity measures, which are derived as a 'residual' and are therefore subject to any errors in the output and input measures. Such errors carry a relatively greater importance with respect to productivity estimates, which are calculated as a ratio of outputs to inputs. In the short to medium term, MFP estimates are subject to variations in capacity utilisation or other factors such as the weather. Taking into account these factors, MFP estimates are probably most useful when viewed as average growth rates between growth-cycle peaks, which tends to also remove much of the random error.

3. Measurement issues and challenges

12. Turning to measurement issues, while the definition of productivity and related concepts sounds simple and clear, in practice it is very difficult for statistical agencies to derive perfect measures of productivity performance for their national economies.

13. A key limitation in the current measures of productivity relates to coverage of MFP measurement, which is limited to selected industries across OECD countries. The published ABS MFP statistics for the Australian economy are currently confined to a subset of industries under the Australian and New Zealand Standard Industry Classification (ANZSIC) 1993. This is largely due to the fact that the outputs of some service-producing sectors are hard to measure, in particular for the services provided by governments. Nevertheless, recent decades have witnessed the gradual shift in the composition of aggregate output towards service-producing industries and there is strong support to expand productivity measurement to these sectors, despite the significant measurement challenges that may be involved.

14. For the industries covered by the ABS MFP statistics, important measurement issues remain. To measure real output, statisticians need information on the quantity of all goods and services produced, along with the average prices received for each of these goods and services. In practice, what is usually available are estimates of revenue totals in current dollars, from which real output measures are derived by dividing current value totals by price indexes. As a result, the quality of real output measures critically depends on the quality of the available price data. Adjusting for quality changes and the appropriate inclusion of new goods and services in constructing good price indexes requires an ongoing research effort from statistical agencies.

15. It is also a challenge to aggregate heterogeneous labour inputs. The standard method of accounting for quality changes in labour inputs is to disaggregate hours worked by education, potential work experience and sex. This accounting method is confined only to generic human capital skills (such as educational attainment and working experience). Firm specific and task specific human capital skills are still left unaccounted. Whilst occupation and industry information could be useful, it is extremely difficult to define homogeneous occupational and industrial classes over even moderate periods of time.

16. Perhaps the most problematic job in productivity measurement is to measure capital input. The construction of capital stock series, based on some cumulated function of past investment expenditures (the so called perpetual inventory model (PIM)), critically depends on the availability of constant quality price indexes and assumptions regarding the capital decay process. There has been on-going research in each of these areas to examine the reasonableness of related assumptions and associated impact on the accuracy of capital stock estimates. No universal consensus has been reached so far and alternative assumptions have a significant impact on resultant capital estimates.

17. Accounting for capital utilisation is also problematic for correctly calculating capital services from corresponding capital stock. Using the standard practice, the ABS assumes that capital services are proportional to capital stock. This simplifying assumption does not capture the fact that business cycle fluctuations result in fluctuations in the rate of utilisation of existing machines, equipment and other capital assets. It has proven difficult to design improved measures of capital utilisation.

18. The rate of return on capital assets is a key variable for estimating rental prices with which to aggregate all types of capital services to form a measure of capital inputs. Researchers and practitioners are still divided on the relative merits of alternative approaches (endogenous versus exogenous) in deriving rates of return to capital assets. The treatment of business income taxes is another complex issue in the construction of user costs of capital.

19. Given the various measurement issues discussed above and the lack of perfect methods for addressing them, it is inevitable that the ABS measures of productivity growth reflect a mix of factors, such as efficiency improvements, reallocation of resources, returns to scale and other factors. In particular, year-to-year changes contain 'noise' that is distinct from the notion of productivity. As noted above, the ABS advises users to examine productivity changes over an extended period to look through some of the short-term volatility.

4. ABS progress towards improving productivity statistics

20. To improve its productivity statistics, the ABS has devoted considerable effort to extending and enhancing its measures of productivity for the Australian economy. Two major achievements have been made in recent years: One is the development of measures of labour input that take account of changes in the quality of labour. The other is the release of experimental estimates of MFP for individual industries. This initiative is significant because it facilitates a more detailed analysis, and as such, data quality issues can be more readily identified and addressed.

21. The ABS has made significant progress in improving its measures of capital in its economic statistics. This enables improved measurement of the capital inputs that feed into measures of productivity over time. Key initiatives include:
- recognition of computer software, mineral exploration, artistic originals and livestock as fixed depreciable assets. Work is also under way to include research and development (R&D) assets;
- a more detailed asset breakdown for machinery and equipment into more homogeneous characteristics (in particular, computers) so that rapid compositional changes in capital expenditure and prices can be better captured;

- methodology changes to estimation of capital services flows, being derived directly from capital efficiency parameters rather than the averaging of gross and net capital stock;
- improvements to the user cost of capital, for example accounting for immediate and delayed tax deductibility which varies considerably between different asset classes and industries and over time.

22. The ABS also has improved measures of aggregate output, which have made significant contributions to enhancing productivity measures. Key initiatives include:
- introduction of chain volume measures in measuring aggregate output. The annual re-weighted volume indexes provide superior measures of economic growth to the previously periodically re-weighted indexes;
- various improvements to deflation methods in national accounts, particularly capital and value added, through the implementation of price indexes for services industries and labour price indices;
- improved measures of output for service-producing sectors, such as health and education, which has laid a solid foundation for introducing more service sectors into official productivity measurement in the future.

5. Current ABS productivity work program

23. The ABS is committed to continuous improvement of its productivity statistics. A number of productivity research projects are under way. The ABS is reviewing its methodology for calculating capital services, incorporating recent developments both in the literature and at other statistical agencies. The ABS is also reviewing the existing methodology for calculating quality adjusted labour inputs. The main purpose of this review is to examine the impact and desirability of labour inputs based on an alternative measure of educational attainment developed by the ABS human capital measurement program and an alternative data source for labour earnings. It is hoped that this will reduce volatility in related productivity measures.

24. The ABS is developing measures of capital services from R&D and assessing its impact on the ABS productivity statistics, as part of implementing the 2008 System of National Accounts (SNA08). SNA08 recommends that R&D expenditure be capitalised. This project examines the ways capital services can be calculated from stock measures for R&D capital.

25. From a coverage perspective, as part of implementing ANZSIC 2006, the ABS is undertaking studies into the viability of including additional industries, particularly with a services focus, into the market sector, subject to data quality considerations. The immediate industry divisions being targeted are Rental, Hiring and Real Estate Services, Professional, Scientific and Technical Services, Administration and Support Services, and "Other" Services (ANZSIC, 2006). This initiative will also take into consideration the viewpoints of key users of productivity statistics.

26. To contribute to studies of the factors underlying aggregate productivity growth, ABS has been conducting studies of firm innovation activities and the resulting performance impact using the ABS Business Longitudinal Database (BLD). These projects are examining some of the key factors determining business performance, including their propensity to innovate. As is widely accepted that business innovation activities and resulting performance are key drivers of technical progress, it is anticipated that these

studies will shed light on the causes of productivity growth at the firm level and provide micro-level evidence to improve the accuracy (and understanding) of aggregate productivity measures.

6. Future research directions

27. Health and Education are among the most important services industries of interest to governments and understanding the performance of these industries is important to informing policy formulation. However, meaningful measures of productivity growth for these two industries are available for very few countries. The ABS plans to conduct further research on how to include them in official productivity statistics in future. This will involve investigating the best international practices in these fields and assessing the relevance and quality of available data.

28. At present, the ABS industry level MFP measures are experimental in nature, and there have been issues surrounding the reliability of MFP measures for certain industries, such as Mining, Water, Electricity and Gas sectors. The ABS will review the measures of these industries. In addition, the ABS may produce MFP measures at the subdivision level for certain industries, depending on users' need and availability of reliable data.

29. Recent years have seen a dramatic increase in international studies on productivity that use longitudinal micro level data, for example, as a means to understand the underlying drivers of productivity growth at the firm level. Such studies enhance the understanding of productivity, beyond simple aggregate measures. The ABS plans to conduct research and analysis that explores the drivers of productivity growth by utilising firm level productivity analysis. These studies may be pursued in collaboration with interested stake holders.

30. In the longer term, the ABS may explore research themes on alternatives or supplements to the conventional MFP framework. These include econometric specifications (in addition to the index number approach underlying the MFP framework), the use of vintage capital models (rather than the classical residual approach), departure from the equilibrium assumptions, and introduction of environmental variables.

7. Conclusion

31. The ABS is committed to advancing work in economic statistics generally and specifically in the area of productivity measurement. While the ABS, as one of the premier international statistical agencies, has made significant progress towards refining its productivity statistics in recent years, many challenges still remain. A range of enhancements to ABS productivity statistics are either planned or are already underway. Improving the accuracy of the suite of ABS productivity statistics and expanding the set of official productivity measures will require a sustained effort over a number of years.

32. The ABS looks forward to the findings of the committee in relation to the adequacy of productivity growth measures.

Australian Bureau of Statistics
August 2009

	1999–00	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08
INDEXES OF PRODUCTIVITY AND RELATED MEASURES(b)									
Productivity indexes									
Labour productivity(c)									
Hours worked	86.8	89.0	92.3	93.9	96.7	96.8	99.3	100.0	101.1
Quality adjusted hours worked(d)	89.5	89.6	92.7	94.1	97.0	97.1	99.6	100.0	100.8
Capital productivity(e)	107.6	105.3	106.2	106.0	105.9	104.4	101.6	100.0	97.7
Multifactor productivity(f)									
Hours worked	95.2	95.7	98.1	99.0	100.6	100.1	100.3	100.0	99.6
Quality adjusted hours worked(d)	96.8	96.1	98.4	99.2	100.8	100.2	100.5	100.0	99.4
Output measures									
GDP—market sector(g)	81.3	81.6	84.5	87.2	91.2	93.9	96.6	100.0	103.8
Input measures									
Labour services									
Hours worked	93.6	91.7	91.5	92.9	94.3	97.0	97.3	100.0	102.7
Quality adjusted hours worked(d)	90.8	91.2	91.1	92.7	94.0	96.7	97.0	100.0	103.0
Capital services(g)	75.5	77.5	79.6	82.3	86.1	90.0	95.0	100.0	106.3
Total inputs									
Hours worked	85.4	85.3	86.1	88.1	90.6	93.9	96.3	100.0	104.3
Quality adjusted hours worked(d)	83.9	85.0	85.9	88.0	90.4	93.7	96.1	100.0	104.5
Capital—labour ratio									
Hours Worked	80.7	84.5	87.0	88.5	91.3	92.7	97.7	100.0	103.5
Quality adjusted hours worked(d)	83.2	85.0	87.3	88.8	91.6	93.1	98.0	100.0	103.2
PERCENTAGE CHANGES TO PRODUCTIVITY INDEXES (%)(b)									
Productivity indexes									
Labour productivity(c)									
Hours worked	—	2.5	3.7	1.7	3.0	0.1	2.5	0.7	1.1
Quality adjusted hours worked(d)	0.2	0.1	3.5	1.5	3.0	0.1	2.5	0.4	0.8
Capital productivity(e)	—	–2.1	0.8	–0.1	–0.1	–1.5	–2.6	–1.6	–2.3
Multifactor productivity(f)									
Hours worked	—	0.6	2.5	0.9	1.6	–0.6	0.3	–0.3	–0.4
Quality adjusted hours worked(d)	0.1	–0.8	2.4	0.8	1.7	–0.6	0.2	–0.5	–0.6
GROWTH ACCOUNTING ANALYSIS — CONTRIBUTIONS TO GROWTH (% pts)									
Output growth(h)	3.9	0.5	3.5	3.3	4.5	3.0	2.8	3.6	3.8
Contribution of output growth (MFP - Hours worked basis)(c)									
Capital services	1.6	1.1	1.1	1.5	2.0	2.0	2.4	2.3	2.8
Hours worked	2.4	–1.2	–0.2	0.9	0.8	1.6	0.1	1.6	1.5
Multifactor productivity - hours worked basis	—	0.6	2.5	0.9	1.6	–0.6	0.3	–0.3	–0.4
Contribution of output growth (MFP - Quality adjusted hours worked basis)(c)									
Capital services	1.6	1.1	1.1	1.5	2.0	2.0	2.4	2.3	2.8
Hours worked	2.4	–1.2	–0.2	0.9	0.8	1.6	0.1	1.6	1.5
Labour composition(d)	–0.2	1.4	0.1	0.1	—	—	—	0.2	0.2
Multifactor productivity - hours worked basis(d)	0.1	–0.8	2.4	0.8	1.7	–0.6	0.2	–0.5	–0.6

— nil or rounded to zero (including null cells)	(e) Gross domestic product per unit of capital services
(a) ANZSIC divisions A to K and P. See Glossary–Market sector.	(f) Gross domestic product per combined unit of labour and capital.
(b) Reference year for indexes is 2006–07 = 100.0.	(g) Chain volume measures. Reference year is 2006–07.
(c) Gross domestic product per unit of labour input.	(h) Growth in chain volume GDP for the market sector.
(d) Experimental estimates.	

	1964-65 to 1968-69	1968-69 to 1973-74	1973-74 to 1981-82	1981-82 to 1984-85	1984-85 to 1988-89	1988-89 to 1993-94	1993-94 to 1998-99	1998-99 to 2003-04	1964-65 to 2003-04
COMPOUND ANNUAL PERCENTAGE CHANGE BETWEEN MFP GROWTH CYCLES PEAKS (%)									
Hours worked basis									
Productivity indexes									
Labour productivity(c)	2.5	2.9	2.1	2.3	1.0	2.2	3.3	2.2	2.3
Capital productivity(d)(e)	−0.7	−0.5	−1.1	−1.1	0.4	−0.9	0.8	−0.3	−0.5
Multifactor productivity(f)	1.2	1.6	1.0	1.1	0.8	1.0	2.3	1.1	1.3
Output measures									
GDP—market sector(e)	5.1	4.6	2.1	1.8	4.1	1.7	4.6	3.1	3.3
Input measures									
Labour services	2.5	1.6	—	−0.5	3.1	−0.4	1.2	0.9	1.0
Capital services	5.9	5.1	3.3	3.0	3.7	2.6	3.7	3.4	3.8
Total inputs	3.9	2.9	1.1	0.7	3.3	0.7	2.2	2.0	2.0
Capital—labour ratio	3.3	3.5	3.3	3.5	0.6	3.1	2.4	2.5	2.8
Quality adjusted hours worked basis(g)									
Productivity indexes									
Labour productivity(c)	..	..	..	..	0.3	1.7	3.1	1.7	..
Multifactor productivity(f)	..	..	..	..	0.4	0.7	2.2	0.8	..
Input measures									
Labour services	..	..	..	..	3.8	0.1	1.4	1.4	..
Total inputs	..	..	..	..	3.7	1.0	2.3	2.3	..
Capital—labour ratio	..	..	..	..	−0.1	2.6	2.3	2.0	..
GROWTH ACCOUNTING ANALYSIS—CONTRIBUTIONS TO GROWTH (% pts)									
Output growth(h)	5.1	4.6	2.1	1.8	4.1	1.7	4.6	3.1	3.3
Contributions to output growth (MFP—hours worked basis)(i)									
Capital services	2.3	1.9	1.1	1.1	1.5	1.0	1.5	1.5	1.6
Hours worked	1.6	1.0	—	−0.3	1.9	−0.3	0.7	0.5	0.5
Multifactor productivity—hours worked basis	1.2	1.6	1.0	1.1	0.8	1.0	2.3	1.1	1.3
Contributions to output growth (MFP—quality adjusted hours worked basis)									
Capital services	..	..	..	..	1.5	1.0	1.5	1.5	..
Hours worked	..	..	..	..	1.9	−0.3	0.7	0.5	..
Labour composition	..	..	..	..	0.4	0.3	0.1	0.3	..
Multifactor productivity—quality adjusted hours worked basis	..	..	..	..	0.4	0.7	2.2	0.8	..

.. not applicable

— nil or rounded to zero (including null cells)

(a) ANZSIC divisions A to K and P. See Glossary–Market sector.

(b) Growth cycle peaks are identified by considering the distance between the MFP estimate and its long term trend as well as general economic conditions.

(c) Gross domestic product per unit of labour input.

(d) Gross domestic product per unit of capital services.

(e) Chain volume measures. Reference year is 2006–07.

(f) Gross domestic product per combined unit of labour and capital.

(g) Experimental estimates.

(h) Growth in chain volume GDP for the market sector.

(i) Percentage points contribution to output growth.