Centre for the
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Improving Australia's Productivity Statistics

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IMPROVING AUSTRALIA'S PRODUCTIVITY STATISTICS

AUSTRALIAN BUREAU OF STATISTICS

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Introduction

In 1995, the ABS received funding to improve the measurement of price change, productivity and economic growth. The general goals to which the research into productivity is designed to contribute are:

    (a)   facilitating macro-economic analysis of growth and assisting efforts to maximise sustainable non-inflationary economic growth by improving measures of price change, real growth and productivity;

    (b)   facilitating industry productivity analysis, particularly in relation to micro-economic reform by developing (or at least analysing the issues related to) productivity measures for service industries and general government; and

    (c)   facilitating Commonwealth budget indexation arrangements by disentangling productivity effects from price measures.

2.   The research on prices is aimed specifically at:

    (a)   preparing a framework within which new measures of general price change can be developed;

    (b)   developing Producer Price Index (PPI) stage of processing indexes;

    (c)   expanding the range of available producer prices, especially for services industries;

    (d)   developing a coherent set of prices publications or alternatively a thematic publication on inflation measures;

    (e)   investigating sources of possible bias in the CPI and the PPIs; and

    (f)   investigating possible measures of "underlying inflation".

3.   There are two parts to this paper. The first focuses on the overall ABS strategy for upgrading productivity statistics and the second focuses on particular developments in respect of public acute care hospitals.

PART 1

A.   The Overall Approach

4.   This part of the paper begins by outlining the advantages of basing productivity measures on the national accounts. The main requirements of this system are then identified and these needs are compared to the data sources that the ABS is developing. The first part of the paper concludes by suggesting a tentative timeframe for preparing new measures and describes some further issues related to productivity measurement.

5.   In terms of a strategy for meeting the need for improved productivity statistics, the initial emphasis of the ABS work program will be on developing the data infrastructure needed to trace the extent to which growth in different industries can be attributed to either increased use of inputs or to productivity improvements.

6.   This approach, sometimes called contribution analysis, is directed at meeting the first two general goals for productivity measures described above.

National Accounts as a Basis for Measuring Productivity

7.   Productivity change is measured as the difference between the rate of change of outputs and the rate of change of the inputs used to create the outputs. Both outputs and inputs are measured in real terms, so they are free of the direct effects of price change. The inputs comprise capital, labour, and the intermediate goods and services used up in the production of the outputs.

8.   For this need to be met it is essential that the coverage of the source data is as comprehensive and consistent as possible. Consequently, it is the ABS view that the national accounts are the obvious base from which to construct a comprehensive system of productivity measurement.

Improvements in the Australian National Accounts

9.   In 1994, the ABS commenced a work program aimed at enhancing the relevance, coherence, comprehensiveness and accuracy of the Australian national accounts. Two major factors influenced this new work:

(a)   a new international standard for national accounting was released, namely, The System of National Accounts, 1993 (SNA93); and

(b)   two recent major reviews by the ABS of the methods used to compile the annual and quarterly accounts identified ways in which the quality of the accounts could be improved by using new compilation methods.

New International Standards

10.   Since the previous national accounting standards were promulgated by the United Nations in 1968, there have been major changes in the structure of economic activity in most countries, and the demands of those using national accounts statistics have also changed. Financial markets have been de-regulated, exchange rates have been floated, new ways of doing business have been developed, and there has been a marked shift in the mix of economic activities (e.g., in Australia, as in most industrialised countries, the services industries have significantly increased their share of economic activity, largely at the expense of manufacturing and agriculture). Producing the national accounts on the basis of SNA93 will provide a set of data which will be more informative and through the introduction of chain volume indexes more accurately reflect economic growth.

The 'Input-Output Approach'

11.   As a result of the reviews referred to above, the ABS is currently working on a major development which will ultimately see the national income, expenditure and product (NIEP) accounts integrated with the input-output tables.

12.   Integrating the input-output tables and the NIEP accounts has three main advantages:

  (a)   the accounts will be more consistent, both for any particular year and over time;

  (b)   the data confrontation and balancing process at detailed levels, as occurs during the compilation of the input-output tables, can lead to better estimates by identifying data deficiencies, thus prompting remedial action before the annual accounts are released; and

  (c)   input-output tables can provide a focus for data collection activities and also a 'quality filter' on the economic statistics collected.

Improvements in Source Data

13.   A major requirement of the so-called 'input-output approach' is more detailed source data, particularly those collected in the annual economy-wide Economic Activity Survey and the annual manufacturing collection.

Chaining to Improve Measurements of Change

14.   Many ABS statistics, including the national accounts, are expressed at prices in a base period so that underlying changes in quantities, or 'real' growth rates, can be assessed. Over many years, the established practice in the ABS and most other national statistical agencies has been to rebase (i.e., change the base year for weighting and reference purposes) every five years. The base year at present used by the ABS is 1989-90 and the next base year for constant price estimates produced by the ABS is scheduled to be 1994-95. However, significant changes in measured growth rates have occurred in

some components of the accounts following the last two rebases and it has become apparent that rebasing every five years may not be sufficiently frequent. A problem arises with infrequent rebasing when both price and volume relativities between major commodities change rapidly.

15.   SNA93 recommends more frequent rebasing than the traditional five-yearly cycle. It proposes a procedure referred to as 'chaining' or 'chain linking'; the output from the chaining is referred to as 'chain volume indexes'. In effect, these indexes are derived by chaining together constant price estimates which are rebased frequently (generally annually) with price weights that more closely reflect current relativities. Chain volume indexes provide better indicators of growth than the more conventional 'fixed base' constant price estimates in situations where price and volume relativities are changing significantly. As an example, this situation is presently occurring to varying degrees for aggregates where computer and other high technology equipment is a substantial component. Computer equipment prices, relative to capability, have been falling rapidly and usage has been growing at a faster rate than that for most other goods. In these circumstances constant price estimates rebased infrequently will overstate growth for the latest periods because the (price) weights assigned to the products whose volumes are growing faster than the average are higher than they would be if a more recent base period were chosen.

16.   There are several alternative formulae which can be used to calculate chain volume indexes. At the present time, the ABS is calculating some experimental quarterly chain volume indexes using weights which change annually. The results are expected to be released in a Discussion Paper in mid 1997. The aim will be to inform users about the issues associated with chain volume indexes and to provide an indication of the likely impact of their introduction. The growth rate recorded by chain volume indexes is generally considered to be a more realistic indicator of actual growth. However, 'constant price' value series calculated using chain volume indexes lose additivity, i.e., the components of an aggregate such as GDP do not sum to the total. The discussion paper will set out the various issues in detail prior to a round of meetings which the ABS intends conducting with interested users.

International Best Practice

17.   Earlier, it was suggested that productivity statistics should be developed as measures derived from national accounts aggregates. The Statistics Canada multifactor productivity accounts program is integrated with the national accounts and represents the most comprehensive framework available internationally.

18.   The Canadian model is based on input-output tables at both current and constant prices, supplemented by information about capital and labour inputs from other sources. Broadly this model uses the constant price estimates as output measures. The inputs of intermediate goods are also taken from the constant price tables. Capital and labour volume measures are compiled in a form consistent with the constant price tables.

19.   The ABS intends to utilise the principles of the Canadian model:

- It adopts a bottom-up approach in the sense that the productivity measures are estimated at the lowest aggregation level (allowed by data availability); high level productivity indices are based on these components. The Canadian model covers 122 industries at the most disaggregated level. This permits outputs and inputs to be better weighted together to form aggregate measures.

- For the industry productivity estimates, intra industry sales can be treated in different ways to produce different measures. For example, in combining different industries together the output of the individual industries can be either aggregated together, or sales between industries within the group can be netted out. Productivity measures using both types of aggregates can be defined within this system.

- Productivity measures are produced for both industries and commodity group. The commodity group estimates are an important extension which exploit the wealth of data available in the constant price input-output tables. (Looking at the relevant Canadian publication it appears that productivity indices for at least 35 commodity groups are produced.)

- The disaggregated productivity indices enable the analysis of specific factors contributing to the change in aggregate productivity. The ability to move between commodity bundle estimates and industry measures enables policy makers to track down and analyse the contribution of either each industry or each commodity bundle production process to aggregate productivity growth. Furthermore, the model provides an analytical tool for describing the sources of growth in terms of the industrial distribution of production activity and changes in the composition of output (and thus of the consumption pattern) and inputs.

20. Further points to bear in mind about the Canadian approach are:

(a) The Canadian approach was adopted at least in part because Statistics Canada had a history of compiling constant price input-output tables. The need for a time series of these tables for Australia is discussed in paragraphs 84-86, below.

(b) The problems with output measurement in service industries limit the coverage of the Canadian published measures on an industry basis. In short, the method assumes that adequate input and output measures are available to be incorporated in the model.

Current ABS Practice

21. The ABS currently publishes aggregate multifactor productivity (MFP) estimates in *Australian National Accounts: Multifactor Productivity* (Cat. No. 5234.0), and indexes of labour productivity at the 1 digit level in *Australian National Accounts: National Income, Expenditure and Product* (Cat. No. 5204.0). The former publication presents annual indexes (base year 1989-90 =100) and average annual growth rates of MFP for the market and (by deducting the Agriculture division) non-farm market sectors of the

Australian economy. Also included are comparable indexes of gross product per hour worked and per unit of capital.

22.   In the absence of acceptable measures of output, measures of labour input are used as indicators for compiling constant price estimates for all, or a major portion, of the output of the following industries: Government administration and defence; Education; Health and community services; Personal services; Finance and insurance; and Property and business services. As a result, these industries and "ownership of dwellings" are excluded from the estimates of MFP and labour productivity.

23.   A more in depth review of existing ABS methodology is provided in the following ABS publications:

- Occasional Paper: *Estimates of Multifactor Productivity,* Australia (Cat. 5233.0) which presents estimates of multifactor productivity for the market and non-farm market sectors of the Australian economy for the period 1964-65 to 1988-89 and describes the methodology used and major limitations of the estimates.

- Occasional Paper *Productivity, Prices, Profits and Pay* (Cat. No. 5239.0) released in February 1992 which presents, in the form of index numbers from 1964-65 to 1989-90, annual estimates of the productivity of labour and capital in the non-farm market sector and in communication and electricity, gas and water industries. In addition, the paper discusses the measurement of productivity in the non-market sector, with particular reference to the Australian Public Service.

24.   The main difference between the Canadian approach and current ABS practice is the industry and commodity group detail that can be calculated when constant price input/output tables are available. Current ABS estimates also do not discriminate between the labour and capital used in different industries.

25.   For ABS to move towards being able to produce the type of measures produced by the Canadian system the main conditions that have to be fulfilled are:

(a) The compilation of output measures and input measures within a consistent framework.   A potential problem occurs when measures of input and of output are taken from different sources and consequently may be incompatible. The work being done in preparing constant price input-output tables and labour accounts will require that these types of inconsistencies are confronted as well as possible

(b) In addition, if we are to derive productivity statistics for the whole economy rather than just the 'market' sector, then we need to measure output for the non-market industries without using proxies based on input measures. In general, being able to make accurate constant price estimates of output depends on either having an appropriate output price index to deflate a current price measure or being able to observe changes in the volume of output directly. Relevant ABS activities are outlined in the following section.

(c) Consistently accounting for labour and capital inputs. The requirement is for the total level of inputs to be estimated and then allocated to industries in an exhaustive and mutually exclusive way. The relevant parts of the ABS forward work program are described in Section C below.

B.   Improved Output Measures

26.   The main feature of output measurement that distinguishes it from input measurement is that, while to a significant degree inputs (eg. labour, capital) are similar across industries, it is the differences in outputs which are essentially the reason that firms are in different industries. Consequently, each industry has the potential to require individual approaches to output and price measurement.

<u>Market Sector</u>

27.   Goods producing industries are reasonably well covered in present ABS surveys. The area where the data infrastructure is weakest is the services sector. Improving real output measures for the market services sector involves two major workstreams:

(a)   improving the annual and quarterly current price output measures; and

(b)   enhancing the range of price indexes for deflation purposes.

28.   The appendix details how the ABS prepares constant price estimates for service industries, together with plans to improve the available data. The broad plans are as follows:

a.   Introduction of comprehensive sub-annual measures of services industry output, to provide a broad indicator of performance in the service industries sector.

29.   The quarterly Survey of Stocks and Sales will be extended during 1996-97 to collect sales for those service industries in scope of that collection (other than retail, which has its own survey). For other services industries (the majority), a separate survey will be instituted collecting data on turnover or sales as the most readily available common proxy measure for industry output.

b.   An enhanced annual overview of the structure and operation of the service industries sector, in the context of the overall 'market' economy.

30.   The principal source of data for the revamped annual input-output tables is the Economic Analysis Survey (EAS). Investigations to supplement the sample of units directly

surveyed with a substantial sample of tax records, and thereby greatly reduce sample error, is at an advanced stage.

c.   A revamped program of periodic statistics on the nature, structure and operation of service industries at a detailed level, and of significant across-industries services activities.

d.   Accelerated development of producer price indexes for service industries.

31.   The coverage of the Producer Price Index (PPI) collections is being extended further into the services industries to allow output measures (whether quarterly, annual or less frequent), as proposed under streams a, b and c above, to be expressed in volume terms. Such indexes will also be of interest in their own right as signals of upstream price pressures. Work is proceeding on the development of PPIs for <u>Road freight</u>, <u>Property services</u> and <u>Business services</u>.

<u>Measurement of Market Service Sector Outputs</u>

32.   Comments on the measurement of market service sector outputs in particular industries follows.

33.   <u>Retail Trade</u>. At present, the ABS uses components of the CPI to deflate the current price estimates of turnover for 18 retail industries. These constant price estimates are then added together using value added weights from the 1991-92 retail census. The aggregate is then used to extrapolate the base year (1989-90) current price estimate of gross product on the assumption that the quantum of services in distributing a commodity is a fixed proportion of the quantum of turnover of industry groups. Conceptually the "product" of this service is represented by the intermediation between producer and consumers.

34.   Concern is expressed in the literature about the validity of assumptions such as the one just mentioned and about whether the improvements in service quality and quantum brought about by, for example, longer opening hours have been adequately captured in the output measure. This is a very difficult problem to solve, and ABS has no immediate plans to address it.

35.   <u>Wholesale trade.</u> Deflators relating to Australian-produced and imported goods are used to derive the constant price estimates of sales. In all other respects, the methodology is the same as that for retail trade.

36.   <u>Transport.</u> Mainly volume output indicators are used to derive constant price estimates of gross product for this industry division. The major weakness is in respect of road freight, the largest sub-industry. At present, there are no suitable output indicators available, and wholesale sales statistics, weighted using transport margins, are used as proxies. However, quarterly turnover statistics are to be collected starting this year and the development of price indexes is well advanced.

37.   As for retail trade, there are problems in taking account of quality changes in this industry. Indicators such as passenger-kilometres or tonne-kilometres take no account of changes in the quality of services provided.

38.   Quality changes also present problems in compiling price indexes, but they are more tractable because it is generally sufficient to obtain price data from a relatively small number of businesses. Hence, the ABS is looking towards replacing volume indicators with constant price estimates of turnover derived by deflation where practicable in the transport industry.

39.   Communication services.   A mixture of volume indicators and deflated revenue data in respect of the major businesses in this industry is used to derive constant price estimates of gross product. This is a rapidly changing industry and the ABS accepts that it will have to invest a considerable on-going effort to maintain statistics of acceptable quality.

40.   Finance and Insurance.   While this industry (and Property and business services) is lumped into the 'non-market' sector as far as the current productivity estimates are concerned, it rightfully belongs in the market sector. Current ABS practice is to use labour input (hours worked: derived by multiplying employment estimates from the Survey of Employment and Earnings (SEE) and average hours worked from the labour force survey (LFS)) to estimate output for both the finance and insurance industries. Improved output measures using a combination of quantity revaluation and price deflation are being developed, and it is hoped to introduce them in the near future.

41.   Property and Business Services.   As for Finance and insurance, hours worked data are used to derive constant price estimates of output.

42.   The introduction of regular current price output indicators together with the development of producer price indexes will lead to the development of real output measures for these industries, probably in the next two or three years.

43.   Construction.   Constant price estimates of gross product are derived by weighting together constant price estimates of the value of work done of the sub industries using value added weights. The major weakness in the estimates is the use of input price indexes for deflating the value of work done on engineering construction. A model pricing approach is being used to develop output price indexes.

Non-Market Sector

44.   Annual constant price estimates of gross product for the non-market, public sector dominated industries are currently derived by deflating wages from SEE using wage rate indexes and adding the result to constant price estimates of their consumption of capital inputs. Quarterly estimates are derived by interpolating and extrapolating the annual estimates using quarterly estimates of hours worked. These estimates reflect the changing staffing profiles of the industries. If there are shifts, which there have been, particularly in government administration, to more highly paid classifications, then the estimates grow at a faster rate than hours worked. But clearly, productivity change cannot be adequately reflected by such measures. The challenge therefore is to determine the

best way to measure output in each of the non-market industry divisions. The main issues to be considered were outlined in the ABS paper by Johnson and O'Dea (1996) presented to the Joint UN ECE / Eurostat / OECD meeting on national accounts in Geneva, a copy of which is available on request.

45.   The national accounting requirement is for the measurement of outputs as distinct from outcomes. As stated in SNA93 (para 16.135):

"The objective is to measure the quantities of services actually delivered to households. This should not be confused with the benefits or utility derived from those services"

46.   The main challenge is to identify the best treatment for each industry. In a paper by the CBS Netherlands (Kazemier, 1996), three options were evaluated:

(a)   an input based method, similar to current ABS practice;

(b)   a modified input approach (called "structural determinants") where input estimates are used with production functions estimated from market industries to calculate labour productivity estimates. These in turn are used to produce output measures; and

(c)   the direct measurement of output.

47.   The second method produces approximate output movements from input data. It is always limited by the assumption that organisations corresponding to government agencies can be found in the private sector.   ABS research work is focusing on the direct measurement of output. This will provide a basis for evaluating whether the introduction of direct measurement will produce improved output measures for the non-market sector.

48.   The main challenges of this work can be divided into two categories: conceptual challenges and the acquisition of data. The conceptual challenges consist of overcoming difficulties in the definition of output and developing the details of methods for constructing output indexes and incorporating estimates based on them into the national accounts.

49.   In very broad terms, the difficulties of defining appropriate output measures for service industries in the market sector are added to for the non-market sector by the absence of a current price value of output. This means that the only practical way of directly measuring the growth in the volume of output is by using cost data to weight together volume indicators of homogeneous services.

50.   The lack of volume data that meet the criteria for output measurement is one of the factors that is likely to limit the scope of output measures being included in the national accounts. The other general issue that arises is that individual sources of data on outputs can cover different activity from the available data about inputs; therefore it is necessary to adjust them so that they can be used together in a productivity calculation.

51.   There are several initiatives taking place within Australia which have the potential to expand the range of indicator data for the non-market sector. The Council of Australian Governments (COAG) process has established a steering committee to oversee a series of working groups in establishing measures of the effectiveness of different forms of

federal and state government service provision. The focus of this work is on <u>outcomes</u> (or effectiveness) of public services and on making comparisons between jurisdictions. This is in contrast to the need for output indicators that is required for productivity measurement. However, examination of the measures that are emerging from the COAG process reveals that there is likely to be considerable overlap with the data needed for our productivity work.

52.   The Department of Finance (DOF) has two broad programs that are emerging from the COAG process that are relevant to this work.

    (a) The response to a National Audit Commission report. DoF is preparing a scoping document on the move to accrual accounting within the federal government and is due to report early in 1997. One of the issues that will be considered will be whether the move to accrual accounting will be accompanied by a move to report output measures within an agreed framework of output classes. If this is considered feasible, then it would be important that this framework is consistent with the Government Purpose Classification (GPC).

    (b) The development of an ongoing reporting framework, which requires negotiation with agencies about how performance will be measured as part of the process of dispensing funding.

53.   To varying degrees, State treasuries are developing measures of output for the range of services delivered by State agencies. The NSW Treasury seems to be in the forefront of this work. The next NSW budget will have output indicators for all of the 61 agencies delivering services. This work is mainly improving the performance of the service delivery agencies. Consequently, there is less emphasis on aggregating measures into an overall summary of total performance. Nevertheless these measures may be able to be adapted for incorporation into the ABS output measures.

54.   ABS work should in principle cover all of the industries in the non-market sector, that is, health, education, community services, justice (police, courts and corrective services etc.), defence and general government administration at federal, state and local levels. The individual industries can be allocated a priority according to their contribution to the economy and an *a priori* assessment of the feasibility of being able to introduce direct measurements of outputs.

55.   As a result of considering these factors the ABS has chosen to focus its initial efforts on the health, education and welfare industries. In addition, an initial examination of data sources covering a range of other industries will be carried out so that the feasibility of producing measures for these industries can be assessed in greater detail.

56.   The practical challenges in this work are significant but there are international models provided by the type of work done by the US Bureau of Labor Statistics in collecting a range of output indicator measures for general government services.

57.   In terms of the health industry, the Australian Institute of Health and Welfare (AIHW) has undertaken considerable work constructing a health information model for the industry and developing an extensive database of the outputs of hospital care. The Methodology Division of the ABS has combined these data with other more detailed data

to produce preliminary estimates of the outputs of hospital care. The approach to this work is summarised in Part 2.

58.   AIHW has begun corresponding work on the production of an information model for the delivery of community services, and the ABS is currently conducting a sample survey that incorporates measures of output for the industry. The ABS has also started investigating the possibilities for constructing output indexes for education.

59.   Present plans are to incorporate as much as possible of this enhanced output information into the national accounts in late 1998.

C.   Input Measure Development

60.   In broad terms, the different types of inputs that need to be covered are labour, capital and intermediate goods.

61.   The production of constant price input-output tables will facilitate constant price estimates of intermediate inputs. Planned work on labour and capital inputs is now described.

Development of New Capital Input Measures

62.   The current ABS estimates of multifactor productivity use capital stock data from the national accounts capital stock estimates. They are derived using a perpetual inventory method (PIM). A range of reservations have been expressed about the quality of current capital stock statistics. These can be summarised as:

(a)   the asset life assumptions are out of date;

(b)   the changing composition of equipment is not adequately accounted for;

(c)   the age-efficiency profiles underlying the depreciation assumptions in the PIM model need to be re-examined; and

(d)   the productive capital stock measures could be improved by weighting components at a more detailed level (using rental prices) then at present; and

(e)   the extended asset boundary of SNA93 requires the extension of the asset types measured to include computer software, expenditure on mineral exploration and certain types of defence expenditure.

63.   A project has begun to address these issues and to redevelop capital stock estimates accordingly.

64. The broad program for improved capital stock statistics involves:

   (a) improvements being made to existing measures (by addressing issues to (a) to (d), above);

   (b) estimates being compiled in accordance with the SNA 93 asset boundary ((e) above); and

   (c) implementation of chain volume measures (see paragraphs 14-16 above).

65. Evaluating ways to measure the variation in capital utilisation within the business cycle is also a potential area of research. Further fruitful areas for research may emerge from the International Conference on Capital Stock Measurement to be hosted by the ABS in early March.

66. A tentative date for completing work on capital stock improved measures is June 1998.

<u>Labour Input Measure Development</u>

67.   Various source data are currently used for labour-related components of the national account. The survey of employment and earnings (SEE) and the labour force survey (LFS) are used together in compiling the quarterly earnings data used in wages, salaries and supplements, an element of GDP(I). As noted earlier, SEE employment data are used in conjunction with average hours from the LFS as indicators for estimation of outputs in a range of services industries in the compilation of GDP(P).

68.   ABS has embarked on a labour accounts project aimed at reconciling the employment, earnings and hours worked series derived from the various labour surveys. Our approach follows closely the work done in the CBS Netherlands and is conceptually quite complex. A prerequisite has been to address known deficiencies in the SEE survey, work which has been proceeding in the ABS over the last 18 months or so.

69.   We are hopeful that the labour accounts work, and further improvements to surveys that may be indicated as being necessary from the data confrontation involved, will in due course lead to substantial improvements in the labour-related components of the national accounts and hence in the labour component of the productivity work.

D.   Related Productivity Issues

70.   The main focus of part 1 of this paper has been on the process of developing improved productivity statistics in the context of more general plans to improve the quality and comprehensiveness of the Australian national accounts. This section outlines other related work that might impact on productivity measurement.

<u>Innovation Statistics</u>

71.   There is interest in understanding the relationship between different sorts of investments and innovations, and eventual improvements in productivity and profit.

72.   The proceedings of the June 1989 OECD conference on Technology and Productivity identified the need for statistics that do more to explain how inputs are used to improve productivity. The idea is that while traditional measures account for the total level of resources used, they do not explain how this is translated into productive capacity.

73.   The ABS has a program to address this need, the main elements of which are innovation surveys run every three years that collect information about types of innovative business behaviour and a longitudinal business survey which allows the comparison of innovative behaviour with price and productivity changes in subsequent years. This is an emerging area of statistical data collection and the use and interpretation of these statistics is at a developmental stage.

<u>International Comparisons as a Guide to Competitiveness</u>

74.   The relevance of international comparisons in productivity work was explained by Van Ark 1996 as follows:

The rise in interdependencies between countries through trade and capital mobility, has increased the importance of international productivity studies. The principal notion behind comparative advantage is that countries specialise in industries for which cost per unit of output is relatively low compared to other countries.

75.   Unlike the temporal productivity measures referred to elsewhere in this paper, the productivity measures required for this type of analysis are completed using current price data. For a comprehensive analysis, the outputs and inputs should be adjusted using their respective purchasing power parities. In the absence of such adjustments, only the ratios of output to input can be compared. It is critical that the data used in such international comparisons be comparable. This means the data needs to be compiled to international standards, such as SNA93, and be classified according to standard industry classifications.

E.   Timescale for Improved Statistics

76.   As described above, the ABS has an ambitious program to improve productivity statistics within an enhanced national accounting framework. The timetable for the production of constant price input-output tables is as follows:

Table 1 Constant Price Input-Output Table Production Timetable

table reference year	table status	completion date	base period
92-93	final	Dec 96	(89-90 prices) experimental
93-94	final	June 97	(92-93 prices)
94-95	final	March 98	(93-94 prices)
95-96	prelim	May 98	(94-95 prices)
96-97	1st prelim	June 98	(95-96 prices)

77.   The preliminary tables will be less detailed than the final tables.

78.   While detailed MFP indexes could begin to be compiled in the late 1990s, their usefulness would be limited if the capital and labour inputs were not adjusted for variations in their utilisation. As demand varies according to the business cycle, the extent to which labour and particularly capital inputs are utilised varies. Thus, productivity measures derived using capital stock and hours worked as inputs will vary according to the business cycle.

79.   In some respects, the situation is analogous to seasonal variation in monthly and quarterly data. Analysts are generally interested in knowing what the underlying growth rates are, and so they use seasonally adjusted or trended data. Similarly, analysts of productivity data are generally interested in the underlying growth rates.

80.   A partial solution to the problem is to calculate average annual growth rates between cyclical peaks, and assume that the utilisation rates are similar at those peaks.   A more complete solution would be to do the equivalent of seasonal adjustment, and adjust each year's productivity estimates for variations in labour and capital utilisation. This requires having good indicators of capital and labour utilisation rates - something the ABS does not have.   (The traditional methods of seasonal adjustment are inappropriate because business cycles do not have a fixed frequency and the profile of business cycles vary quite a lot.)

81.   The upshot is that, with a business cycle of 4 to 5 years, it will not be until the early years of the next century, at least, before it will be possible to gauge (average) underlying annual productivity growth rates with a reasonable degree of confidence.

82.   The following table summarises a suggested timeframe for improved productivity statistics.

Table 2 Timetable for Improved Productivity Measures

Date	Features
July 1998	Trial measures incorporating; i) Constant price I/O tables 93/94-96/97 ii) New capital utilisation measures iii) Available integrated labour measures.
July 1999	Incorporation of improved output measures for non-market sector into national accounts.
July 2000	First regular productivity publication under the new framework.

Part 2   Measuring Outputs, Inputs and Productivity for Australian Public Acute Care Hospitals

Introduction

81.   The Methodology Division of the ABS is currently undertaking a component of the research program which is concerned with trying to improve the measurement of outputs, inputs and productivity for the Health Services Industry. This paper presents attempts to measure the outputs and inputs of a segment of the Health Services Industry: Public Acute Care Hospitals. Other segments of the Health Services Industry to be analysed include: Private Hospitals, General Practitioners, Dentists, Paramedical Services and Community Health Services.

82.   This part of the paper is organised as follows: section F explores conceptual issues in defining the output of the health services industry; section G examines two frameworks for measuring health outputs; section H discusses how output estimates of public acute hospitals might be derived; section I examines alternatives for weighting together output estimates; section J presents experimental estimates of output; sections K through to M detail labour, capital and intermediate input estimates, respectively; and section N sets out the current dilemmas and the future directions of the ABS productivity work programme.

F.   Measuring Health Service Outputs

83.   The output of health service providers is more difficult to define and measure than is the output of, say, the producers of medical goods - services are less tangible and tend to be more heterogeneous. For example, if we were to attempt measuring health service output in a given year by counting the number of different services delivered, we would face two problems -

- To obtain estimates of the number of services of each type, we would have to be able to tell when two treatment episodes have involved provision of the "same" service type. Given the almost unlimited variability in the mix of treatment and ancillary care that can be provided to patients, this is not a straightforward task. For example, an inpatient in a hospital receives both direct treatment (such as a surgical operation, medical attendance and drugs) and associated care (such as accommodation and food). Although the direct treatment and care components can be grouped into *broad categories,* any particular episode may involve an almost unique combination of complexity and intensity of treatment and care.

- We would have to be able to aggregate the numbers of different types of services into a composite measure of output.

84.   The heterogeneity of health services poses even greater problems when one attempts to monitor service output from one year to another - changing medical technology and institutional arrangements may entail significant changes in the quality of services to which the same label (say, "hip replacement" or "CAT scan") is attached. If these quality changes are not recognised when the output measure is being constructed, the change in productivity may be under-estimated or over-estimated.

85. In recent years, Australian health experts have expended a great deal of effort on defining detailed, standardised classification schemes for health services (such as AN-DRG, the Australian National Diagnosis Related Group classification for acute-care hospitals). They have also attempted to derive weights that will assist construction of aggregate measures of the services provided. These tools have been of considerable assistance to the ABS's health services productivity project. It must always be kept in mind, however, that any such scheme for defining and classifying services is a simplifying grid laid over a complex, heterogeneous reality.

86. Some analysts with an interest in government health services think of "productivity" (broadly construed) in terms of *outcomes* - that is, in terms of the changes in the condition of patients (say, changes in their health or life expectancy) that result from the patients' "consumption" of health services. Because one of the major goals of our project is to enhance the measurement of health services in the Australian national accounts, we shall concentrate on developing *output* measures - that is, "process" measures of the services provided rather than measures of their effects. But the notion of outcome will inevitably arise in the course of our investigations:

> First, because that notion underlies many of the independently-developed performance indicators with which ABS productivity estimates will be compared.

> Second, because some elements of outcome may provide a gauge of the changing quality of services.

G.   Conceptual Frameworks

87. Two conceptual frameworks were considered in defining and determining appropriate output measures for Public Acute Care Hospitals:

- the United Nations System of National Accounts (SNA93), a national accounting framework; and

- the National Health Information Model Version 1 (NHIM) released by the Australian Institute of Health and Welfare (AIHW), which provides a framework for the management of national health information.

The National Accounts

88. The national accounts are designed to provide a systematic summary of national economic activity. At present, the Australian national accounts use an input-based method to proxy output for many service industries (especially government service industries) because of the difficulties in measuring the volume of output.

89. For general government, including Public Acute Care Hospitals, where a significant proportion of the output is provided free of charge or for charges which cover only a small proportion of costs, national accounts estimates are based on two conventions. In the absence of a market valuation of general government output:

1. General government output at current prices is valued in the accounts at its cost of production. This involves measuring the output of those sectors in terms of the inputs used in their production. An obvious implication of this approach when applied to volume measurement is the implicit assumption of zero productivity growth. A reduction in factor input costs is reflected directly as a reduction in outputs. An increase in inputs is reflected directly as an increase in outputs.

2. General government is regarded as the **final consumer** of its own non-marketed output. In reality, general government output is available for either:

   individual consumption, the case for most health services;

   collective consumption, e.g. defence; or

   intermediate usage by private or government producers.

90.   To overcome these shortcomings, the revised SNA93 recommends the development of output indicators to obtain an output measure for service sectors. SNA93 advocates a "process" type rather than outcome oriented approach for defining public sector output:

The objective is to measure the quantities of services actually delivered to households. This should not be confused with the benefits or utility derived from those services. SNA93 (para. 16.135)

91.   SNA93 also recommends the allocation of government final consumption expenditure between collective and individual consumption, thus facilitating international comparisons between countries with different institutional and financial arrangements for the provision of government services.

National Health Information Model

92.   In November 1995, the AIHW released Version 1 of the NHIM. The model was developed through a working group process; it is an agreed representation of the Australian health system, and provides the elements (or "entities") around which databases can be developed. Developed using a "top down" method, the NHIM shows how health information could and should be structured, rather than necessarily reflecting how it is currently structured. It is a person-centred framework, where the notion of "person" encompasses individuals, members of families, groups and communities.

93.   Within the framework of the NHIM, the output of the Health Services industry is identified in terms of Health and Welfare Service Events. (This is, however, only one component of the NHIM, which allows for describing many other aspects of the Health Services industry.) (1)

94.   While the majority of health events are characterised by individual consumption there are instances of collective delivery, e.g. health awareness and education programs.

95.   The NHIM allows for the "collective delivery" of health services in its definition of the entity *Party* (those persons, groups or organisations who are part of the health and welfare

systems, e.g. as a recipient of services, provider of services, purchaser of services, funder of services, etc.)

96.   The NHIM also allows for the recording of "outcomes" from health care with the entity *Outcome* which is defined as a recorded change in the well-being of a party which is expected or presumed to be caused by a Health and Welfare Service Event.

Do the SNA and the NHIM Provide Consistent Views?

97.   Within the framework provided by the NHIM, the output of health service providers could be defined by the aggregation of individual health service events, delivered by health providers, and occurring during the specified reference period.

98.   Adoption of the Health and Welfare Service Event as the key element defining output of Health service providers appears consistent with the SNA93 recommendations for the measurement of output of service providers in terms of the quantities of services actually provided to consumers.

99.   Areas where inconsistency may exist between the requirements of health analysts and of national accountants are in the delineation of outputs into production for intermediate and final consumption and the delineation of producing units into institutional sectors. The output estimates in this paper tend to be more closely aligned with those most useful to health analysts rather than national accountants - not by design, but due to the way existing data have been compiled. This paper pays considerable attention to how our current estimates might be adjusted to align better with the national accounting framework.

H.   Issues in Measuring Public Acute Care Hospital Outputs

100.   A key issue in developing measures of output appears to be the appropriate grouping of "activities" into component products for which indicators are available or can be developed. Similarly to the marketed output of the goods producing sectors, outputs are not viewed in terms of a collection of component processes or parts but as recognised final products. In the NHIM framework, this corresponds to the distinction between the *Component* and *Aggregate* Health and Welfare Service Event Types. For health, the notion of casemix classification represents an approach to the definition of known aggregate products or services (which are combinations of component products or services).

101.   "Casemix" is a generic term for classification of patient care episodes.   The Department of Health and Family Services' National Casemix Education Series indicates that a casemix classification should be characterised by:
- clinical meaning (patients in the same class should have clinical similarities);
- resource homogeneity (patients in the same class should cost roughly the same to treat); and
- the right number of classes.

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102.   The best known Australian casemix classification is the Australian National Diagnosis Related Groups (AN-DRG) which is used for the classification of acute care hospital episodes.   Each DRG represents a class of patients with similar clinical conditions requiring similar hospital services.

Activity Indicators for Inpatient Care (2)

103.   The National Hospital Morbidity (Casemix) Database provides activity data for public acute hospital inpatient care for the years 1991-92, 1992-93, 1993-94 and 1994-95. (3) The following indicators of activity are available for the 667 Diagnosis Related Groups in version 3.0 of the AN-DRG classification:

- Separations - a separation occurs when a patient is discharged, transferred to another institution, absconds, dies while in care, changes status (e.g. from acute to nursing home type) or leaves hospital for a period of seven days or more;

- Occupied bed days;

- Same day separations;

- Average length of stay; and

- Average cost, Relative cost weight and Cost by volume.

For our first-cut experimental estimates, we have adopted the number of separations, dissected by DRG, as our primary measure of activity.

104.   As the time of writing, data are available only for 1991-92 through 1994-95. To obtain a longer time-series, other indicators of inpatient activity would have to be used. Possible sources are: the Jamison Report, which includes data on occupied bed days and inpatients treated; and the Household Utilisation and Costs Survey (HUCS), which is discussed below. (4)

Activity Indicators for Non-Inpatient Care

105.   Casemix classifications are also being developed for other categories of patient care episodes. There are several, including the Australian Ambulatory Classification (for use in outpatients) and the Non-Acute Inpatient Classification (for use in palliative care, rehabilitation and other sub-acute areas). Use of such classification systems to collect activity data will, in the future, enable a more sophisticated activity indicator to be constructed that will better complement our inpatient indicator.

106.   Currently, however, for non-inpatient episodes of patient care in public acute care hospitals, activity indicators are limited to information from HUCS. (5) Non-inpatients are patients who are treated on the hospital site, and include accident and emergency patients, outpatients and day program patients.

The activity measure adopted for our first-cut experimental estimates is the total number of non-inpatient occasions of service in public acute hospitals.

107.   A non-inpatient occasion of service occurs when the non-inpatient attends a functional unit of the hospital for the purpose of receiving some form of consultation, treatment, or other service, but is not admitted as an inpatient.

108.   Historically the HUCS has used one of two measures to record the number of non-inpatient occasions of service :

- Visits - each visit is counted as one occurrence of service, although the patient may attend more than one individual clinic during the visit.

- Treatments - each attendance at a non-inpatient clinic is counted as one occurrence of non-inpatient service; hence, a patient may have a number of treatments between arrival at the hospital and departure.

109.   From 1991-92 HUCS, the States have consistently counted non-inpatient occasions of service as treatments.

Components of Hospital Output not Classified as a "Service Event"

110.   While the dominant activity of hospitals is patient care, hospitals also engage in other activities, principally related to research and education.

Research

111.   Research activity is undertaken under the assumption that current expenditure will generate a stream of future benefits which justifies that cost. In the field of health, these could involve improved procedures and health outcomes or reduced costs and increased efficiencies which are likely to be generally applicable and not linked to a specific health care provider. They are, however, generally uncertain, intangible and difficult to measure and value.

112.   SNA93 recommends that research expenditure output be treated as an item of intermediate consumption and that it be valued in terms of its costs of production:

Research and development are undertaken with the objective of improving efficiency or productivity or deriving other future benefits so that they are inherently investment- rather than consumption- type activities. However, other activities, such as staff training, market research or environmental protection may have similar characteristics. In order to classify such activities as investment type it would be necessary to have clear criteria for delineating them from other activities, to be able to identify and classify the assets produced, to be able to value such assets in an economically meaningful way and to know the rate at which they depreciate over time. In practice it is difficult to meet all these requirements. By convention, therefore, all the outputs produced by research and development, staff training, market research and similar activities are treated as being consumed as intermediate inputs even though some of them may bring future benefits...Because of the difficulty of obtaining price data, the output will usually have to be valued at cost of production, as in the case of most other own account production. [SNA93 para. 6.163]

113.   SNA93 also recommends that, if research activity is significant, it would be desirable to identify a separate establishment for it, so that the relevant inputs and outputs could be distinguished for analytical purposes. This approach is broadly consistent with the recommendations of The Department of Health and Family Services' *Product Costing:*

the Costing of Health Care Services which recommends the identification of separate costing centres for research and education activities.

Education

114.   Similar arguments probably hold for education activities. Certainly, for education activity which constitutes staff training, the SNA treatment described above for research expenditure applies. For the education function of teaching hospitals, it may be possible to explore the development of activity indicators for the teaching function. However, given that this teaching activity often involves "dual production" with direct health care provision (e.g. the combination of a teaching function with "ward rounds" by specialist medical practitioners), the isolation of costs may be difficult.

Summary

115.   Our first-cut experimental output estimates for public acute care hospitals do not reflect research and education services. It appears that with currently available data it is not possible to isolate expenditure on non-patient-care products (research and training expenditure). However, as hospital costing systems improve, this situation may change. Moreover, for national accounting purposes, it is preferred that in-house research and education services be treated as an intermediate input rather than an output of hospitals.

Adjusting for Quality Change

116.   Two possible approaches to assessing "quality change" for non-marketed production have been identified:

- The first possible approach is to assess changes in the quality of output in terms of the consequences (or in effect the variations in consumer utility) from variations in those services.

- The second approach is to adopt a form of process measure. Process measures of quality tend to focus on the providers' conformity with established procedures of "good practice" and do not evaluate the adequacy or correctness of the standards themselves. Underlying this approach is the assumption that it is known what activities are required to produce desirable results.

117.   Within the Health Services industry, there are a number of initiatives aimed both at improving and monitoring changes in the quality of service provision.   These initiatives incorporate elements of both these approaches. The Department of Health and Family Services identifies quality-of-care as a measure of the extent to which the resources allocated to a patient, and the processes by which those resources were applied to a patient, resulted in outcomes which could reasonably be expected. Quality Improvement is a set of activities aimed at design and use of a set of quality of care measures, and at implementing changes where it is concluded that quality can be improved.

118.   The *First National Report on Health Sector Performance Indicators* identifies future initiatives in the development of Quality of Care and Patient Satisfaction Indicators as well

as Quality of Care Indicators developed as part of the National Hospitals Outcome Program.

119.   Initiatives are under way to determine appropriate measures for the assessment of quality of government service provision - but combining and weighting quality measures to adjust activity-based indicators of output is a complex task. *Our first-cut experimental estimates do not incorporate adjustments for quality change.*

A Measure of Gross Output

120.   Depending on the treatment of intra-industry transactions, the gross output of an industry can be defined in three different ways according to whether, and to what extent, these transactions are counted as part of output. The output of an industry may be:

- defined as the total value of all flows of commodities produced by establishments classified to the industry; or

- confined to commodities produced by establishments within the industry and sold outside the enterprise; or

- defined as net of all intra-industry transactions, i.e. excluding *not only* the transfers between the establishments in an industry belonging to the same enterprise *but also* all flows between establishments in that industry belonging to different enterprises. In this case, the definition of output will depend on the level of industry aggregation adopted.

121.   The process of constructing and aggregating indicators of activity yields a measure which approximates the gross output of the sector of interest.   Therefore, the experimental measures presented in the following section relate to the gross output (rather than the value added) of public acute care hospitals.

122.   In the health services productivity project, we propose developing both gross output and value added measures insofar as the available data will support that plan. So far, we have only produced experimental estimates of labour and capital inputs to public acute care hospitals - in the coming months we intend to derive an estimate of intermediate inputs. Issues that arise in deriving an estimate of intermediate inputs are discussed in section M.

I.   Composite Measures of Output

123.   To move from indicators of activity in specific health service areas to a composite measure of output obviously raises issues relating to aggregation. It is seldom the case that the simple addition of number of services without regard to type of service would yield a usable measure of composite output - such a simple addition would take no account of either differential input costs of delivering services or the differential valuation the community may place on those services. To reflect these factors in a composite measure requires the development of an appropriate weighting system.

Possibilities for a Weighting System

124.   Volume measures of output in market sector industries are derived, either explicitly or implicitly, by weighting together elemental volume indicators using current price output data. However, for the Health Services industry, as for many of the service industries in the scope of the current ABS project, a significant proportion of the output is the non-marketed output of general government, meaning there are no current-price output data. This poses a problem for deriving an aggregate volume measure of output. Two options for deriving output weights are to use the values of the costs associated with producing particular outputs or to use pseudo market values.

125.   If cost weights are used, the aggregate volume measure of output is consistent with the SNA convention which equates the <u>current price</u> value of output with the cost of its production. In this case, there is an explicit assumption of a zero net operating surplus. If pseudo market values are used (derived by imputation, using data from similar services produced in the market sector, for example) then the aggregate volume measure of output is inconsistent with the SNA convention and there is a non-zero net operating surplus. Partly because one of the goals of the project is to produce estimates for use in the national accounts and partly because of the difficulty of imputing market values for the outputs, *cost data have been used to derive our first-cut experimental measure of the aggregate volume of output.*

Aggregating Inpatient Services

126.   For the aggregation of casemix morbidity data classified by AN-DRG, data from the National Costing Study developed by the Department of Health and Family Services provide a weighting system. Data are provided on the average cost per episode for each DRG; this permits the calculation of weights reflecting cost shares for each DRG.

127.   In deriving an output measure for inpatient services, the weights used to aggregate the detailed separations data will reflect the proportion of total costs attributable to each DRG in the base period.   As the National Costing Study data reflect 1994-95 costs, 1994-95 is used as the weighting base period. The calculation of the weights is outlined below.

COST SHARE$_{i0}$ =   (Number of Separations$_{i0}$ * Average Total Cost$_{i0}$) /
Σ_i (Number of Separations$_{i0}$ * Average Total Cost$_{i0}$)

where *i* refers to each of the 667 Diagnosis Related Groups,
the base period (t=0) is 1994-95,
Number of Separations is obtained from the National Hospital Morbidity (Casemix) Database 1994-95, and
Average Total Cost is obtained from the National Costing Study.

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128.   We have estimated an output index for the inpatient services of public acute hospitals by applying the cost share per DRG to the number of separations for each DRG. The fixed weighted index formula has been used, as follows:

$$\text{OUTPUT INDEX}_t = \Sigma_i \, [\, \text{WEIGHT}_{i0} * (\text{ACTIVITY INDICATOR}_{it} / \text{ACTIVITY INDICATOR}_{i0})]$$

$$= \Sigma_i \, [(\text{Cost Share}_{i0} * (\text{Number of Separations}_{it} / \text{Number of Separations}_{i0})]$$

where i refers to each of the 667 Diagnosis Related Groups, and t refers to the time period, with the same weighting data being applied across all time periods.

129.   For the base period, these measures are conceptually equivalent to the Australian National Accounts (ANA) input-based approach to measuring output at current prices. Thus, our output measure can also be calculated simply by multiplying average cost per DRG by the number of separations per DRG (from NHMD), for 1991-92 through 1994-95, as follows.

$$\text{Output}_t = \Sigma_i \, (\text{Average Cost}_{i0} * \text{Number of Separations}_{it})$$
where 1994-95 is the weighting base period (t=0)

130.   The output index has been calculated for 1991-92 through to 1994-95, and has been re-referenced to 1991-92 = 100.0.

131.   The move of the Australian government health system toward output-based funding raises the possibility that casemix weights may be used as an incentive system to channel hospital resources. Since the weights represent average costs per service and not costs for individual hospitals, there may also be incentives for individual hospitals to manipulate their casemix for funding purposes. Each of these phenomena may undermine the dependability of cost weights.

Combining Inpatient and Non-inpatient Services

132.   The adopted measure of non-inpatient activity is an aggregate measure and so no further aggregation issues arise.   However, a number of issues arise in obtaining a consistent measure of non-inpatient activity prior to 1991.

133.   As described above, we have constructed an experimental index of the output of public acute hospital inpatient services for the period 1991-92 to 1994-95; we have also constructed an experimental index of the output of non-inpatient services. The next step is to calculate a composite index of the output of public acute care hospitals, covering all patient services.

134.   The experimental index we have constructed so far is neither as long nor as broad as we shall ultimately require for the national accounts and other purposes:

- Ideally, all of the outputs of public acute care hospitals would be reflected in such an output measure (i.e. output of education and research functions provided to outside users would also be included). However, we have not yet solved certain conceptual and practical problems relating to those "non-patient-service outputs". Thus, our first-cut experimental index covers inpatient and non-inpatient services only.

- In the longer run, we must compile an output index that extends back to the 1960s or 1970s, and are evaluating splicing techniques that will permit us to construct such a long time series. For the first stage of our work, however, we have concentrated on establishing data construction methods that will carry us forward through the 1990s and beyond. Our first-cut experimental index covers only the three years 1991-92 to 1993-94 (since non-inpatient activity data are not yet available for 1994-95).

135.   Many public acute hospitals do not explicitly cost patient services and, even where they do, it is not clear that all outpatient and inpatient costs are allocated appropriately.

136.   A key element in the allocation of input costs between inpatients and non-inpatients is the inpatient fraction of costs (IFRAC). The IFRAC is a ratio which indicates the relative cost of non-inpatient to inpatient episodes of care (calculated in terms of occupied bed days (OBD)).

137.   The allocation of input costs between inpatient and non-inpatient services (and therefore the weighting pattern) is highly dependent upon the assumption adopted concerning the cost equivalency ratio of non-inpatient occasions of service to OBDs. However, it is clear that inpatient services contribute a far larger weight to the output of public acute hospitals than do non-inpatient services. The inpatient services index will therefore dominate the composite index.

138.   We have constructed the composite index for patient care activities of public acute care hospitals by aggregating the subindexes for inpatient and non-inpatient services using fixed weights (the IFRACs). Our weights reflect the assumption that inpatient services account for a fixed share of input costs - 77.6 per cent, based on the *National Health Ministers' Benchmarking Working Group (1996)*. (7) The results of this assumption are reflected in table 1.

139.   While the scope of our initial estimates is public acute hospitals, the objective is to produce estimates for the whole Health Services industry. Ideally, a consistent aggregation methodology will be used for all segments of the Health Services industry. The aggregation of activity indicators across broader segments of the Health Services industry will require information on relative costs across these segments.

J   Experimental Output Estimates for the Early 1990s

140.   According to our first-cut experimental output index, growth in inpatient services has been quite strong, particularly over 1992-93 - see table 1. Closer examination of the data reveals that between 1991-92 and 1992-93 growth in separations was concentrated in relatively high cost DRGs. In contrast, between 1992-93 and 1993-94 growth was

concentrated in lower cost DRGs. Growth over the final period 1993-94 and 1994-95 indicates a return to growth in the relatively high cost DRGs.

141.   The overall change in separations between 1991-92 and 1994-95 is somewhat less than the overall change in the output measure over the same period. In the period between 1993-94 and 1994-95 separations growth has declined while output growth has remained steady at 5 per cent.

142.   It is also apparent that the output of inpatient and non-inpatient services have displayed markedly different patterns of growth between 1991-92 and 1993-94.

TABLE 1: Experimental Estimates of Growth in Output
(Change from Previous Year)

	Separations (Inpatients)	Inpatients Index	Non-inpatient Index	Total Index	National Accounts Estimates of Health & Community Services
1992-93	6.4	8.7	7.9	8.5	1.3
1993-94	6.8	5.2	- 6.3	2.8	2.8
1994-95	3.3	5.0			2.1

143.   In summary, these indicative output indexes show that growth in output is estimated to have been in the range of 8.5 per cent during 1992-93 and 2.5-3.0 per cent during 1993-94. These results are only intended to be indicative of what results might be finally obtained once some data-related problems are resolved out and the methodology finalised. Due to the many weaknesses of the data sources and due to the assumptions embodied in the adopted methodology, our first-cut experimental estimates should be treated with caution.

144.   At present the indicative output indexes cannot be updated to 1994-95, due to the unavailability of consistent data for non-inpatient services. However, the experience of the early 1990s, as well as the alternative data sources, suggests that growth in non-inpatient services for 1994-95 will be lower than growth in inpatient services. A reasonable estimate of growth in public acute hospital output during 1994-95 may therefore lie in the range of 4 to 5 per cent.

145.   The estimates of growth in GDP at constant prices for the industry 'Health and Community Services' (ANZSIC Division O) are given in table 1 for comparison purposes. No GDP data specifically relating to public acute care hospitals are available. Also, our first-cut experimental output estimates use a gross output measure, whereas the national accounts use a labour input based measure.

146.   It can be seen that the ANA data display relatively small GDP growth between 1991-92 and 1994-95 in comparison with our experimental estimates.   This difference could be due to any of the following factors:

• Other segments of the 'Health and Community Services' industry (e.g. private hospitals, medical practitioners, welfare services) are growing at a much slower rate than public acute hospitals.

• Growth in intermediate inputs accounts for much of the growth in the experimental measures of public acute hospital output, and so 'labour input based measures' grow by less than 'gross output'.

• There has been an increase in productivity which the labour input-based national accounts estimates have failed to capture.

147.   It is worth noting that the ABS's input-output tables (Cat. No. 5215.0) include an estimate of Australian production (a 'gross output' measure at current prices) for Hospital and nursing home services which show growth of 21.3 per cent (just over 7 per cent per annum on average) between 1989-90 and 1992-93. Also according to the input-output tables, Australian production for Health grew by 22.4 per cent over this period. These figures are almost the same as the growth in current price value added of 22.2 per cent for the Health and Community Services industry recorded in the national accounts over the same period. Given that the price of labour grew only a little faster than the price of intermediate inputs over the period, then this suggests that it was either the first or third factors that caused the difference between the growth rates of the experimental and national accounts measures of volume growth.

148.   Over the coming months we will be developing experimental output estimates for other segments of health and community services (e.g. private acute care hospitals, nursing homes, medical practitioners, welfare services). This will enable us to undertake

more valid comparisons with data from existing sources such as the ANA, which estimate output at a fairly aggregated level.

K. Labour Inputs

149. When estimating labour input, it is important to take account of the quality of the inputs as well as the quantity. This paper largely assumes that the work force is composed of a number of heterogeneous labour input categories, differentiated by various characteristics affecting their productivity. The quality of a work force is captured through its composition (that is, the proportions accounted for by the various labour input categories). In theory, constructing an aggregate quality adjusted input measure involves weighting the input of each category of labour by its relative productivity.

150. Methodologies for estimating labour input examined in this paper include:

(a)   Unadjusted measures, including total hours worked, total employee numbers and total labour cost; and

(b)   Quantity indices of labour inputs, in the form of weighted sums of the quantity of each input weighted by relative productivity.

<u>Issues in Estimating the Labour Inputs of Health Services</u>

151. As discussed in earlier sections, a number of important issues arise when attempting to define the output of public agencies. The problem of poorly defined or non-priced outputs can affect the estimation of labour input quality - because it affects the measure of marginal productivity and this in turn is, in theory, related to the price and/or volume of the output of the agency. If marginal productivity is difficult to observe or measure, the conventional assumption that wages are related to marginal productivity must be called into question. Nevertheless, this assumption (relating to the "perfect" or theoretical operation of the labour market) is the basis for the aggregation of labour inputs and the quality/compositional adjustments presented in this paper. It will be important not to ignore the problems affecting the measurement of labour input produced that may result from the violation of this important assumption.

152. The main question is what constitutes a good measure of marginal productivity. Even though a number of labour market distortions may affect the theoretical equality between wages and marginal productivity, it may still be reasonable to use wages as a proxy for relative (if not absolute) marginal productivity. (This is particularly so in the absence of any alternative measure of productivity when, for example, it is difficult to define the outputs of an agency.)

153. For our first-cut experimental estimates, we have assumed that wage rates do provide a fair measure of relative productivity between different types of labour input - and this underwrites our use of wage rates as aggregation weights in the index number approach.

154. In addition to these conceptual problems, other problems arising from the estimation of labour inputs in the public health sector include: the treatment of privately practising visiting medical officers (VMOs) in public acute care hospitals, the problems

associated with differential labour hoarding, and short term capacity under utilisation. The issue of VMOs is discussed in detail in section M of the paper.

155.   An issue which needs to be addressed when attempting to measure labour inputs is labour hoarding. Due to the inherent costs of hiring and firing personnel it may not be economically optimal (in the long run) for a firm to reduce the level of a work force in periods of low demand (and similarly to increase the work force level in periods of high demand). This may lead to counter cyclical short term variations in productivity measures which make use of labour input measures affected by cyclical labour hoarding. One such instance is differential labour hoarding, which occurs when higher quality (productivity/wage) labour inputs experience a relatively lower turnover in periods of low demand for product than do lower quality labour inputs. While this phenomenon may be a problem in some industries, the steady nature of demand for health services and outcomes suggests that labour hoarding may not have a significant effect upon measures of labour input, both in the short and long run. *This issue is not addressed in the first-cut experimental estimates reported in this paper.*

Data sources, issues and problems

156.   The study is primarily based on data from the ABS Survey of Employee Earnings and Hours (EEH) (Cat. No. 6306.0). The dataset used to construct our first-cut experimental estimates consists of employee numbers, average total hours weekly hours paid for and average total hours weekly earnings cross-classified by State, industry, occupation and employment status.

157.   Once it was decided to adopt hours worked as a measure for physical labour input, we had also to decide upon the definition of the hours worked measure adopted. The EEH survey has two such measures, average ordinary time and average total time (average ordinary time plus overtime hours) hours worked. Since ordinary time is based on award conditions, the series gives a good idea of the long term trend in hours worked while removing any irregular component. On the other hand, total hours worked gives a measure of actual total physical input for each category, however if the month sampled for the survey has an irregularly high overtime component measure of input using this series may be upwardly biased. *In this paper, we present results based on total hours worked.*

Experimental Estimates of Labour Input

158.   For our first-cut experimental estimates the population of the dataset considered comprises of annual data for Australia, cross-classified by ASIC (Australian Standard Industrial Classification (Cat. No. 1201.0)) 8141 (Hospitals excluding Psychiatric), ASCO (Australian Standard Classification of Occupation (Cat. No. 1221.0)) major group (1 digit) occupation codes and total of full- and part-time employees. The data relate to the years 1991 through 1995. Table 2 illustrates the sort of data used; it shows the occupational dissection by ASCO major group.

Table 2: EEH data for year 1991, Total Employees, ASIC 8141

ASCO	Group	Employees	Earnings	Ordinary hours	Total hours
Major	Description	('000 s)	($/week)	(/wk)	(/wk)
1	Managers & Administrators	10.8	855.5	37.7	38
2	Professionals	43.5	705.2	32.8	34.9
3	Para-professionals	96.6	542.6	31.7	32
4	Tradespersons	10.7	467.9	37	38.2
5	Clerks	35.2	414.7	33.8	34.2
6	Sales & Service workers	32.2	406.9	31.4	31.5
7	Plant & Machine operators	2.4	415.4	34.8	35.4
8	Labourers & related workers	52.6	368.2	32.6	33

159. Table 3 gives the results of the index number construction for a dissection by ASCO major occupational grouping. The unadjusted index is the ratio of current year total hours worked to base year (1991) total hours worked. Several observations can be made about the quantity and quality of inputs and the relationship between the two:

(a) The variations between the different index number forms for each year appear to be negligible, implying that wage levels over the period are relatively stable.

(b) For the year 1992, adjusted quantity rises by approximately 5 per cent from the base year, whereas actual labour input (as measured by total hours worked) rises by 6 per cent. This implicitly indicates that although overall input has risen, the quality of the labour inputs has fallen relative to the base year.

(c) Input quantity falls from 1993 to 1995, corresponding with a rise in the quality of input (using the implicit analysis above). This indicates that a higher proportion of the reduction of input quantity from 1993 to 1995 is borne by lower paid work categories.

Table 3: Estimates of Labour Input

Year	Unadjusted	Paasche	Laspeyres	Fisher	Tornqvist
1991	100	100	100	100	100
1992	105.82	104.88	105.02	104.95	104.94
1993	101.95	101.44	101.19	101.32	100.99
1994	93.08	92.68	92.72	92.7	92.65
1995	91.56	91.93	92.02	91.88	91.95

160.   The results of this preliminary analysis suggests that, along with a decline in the physical input of labour to the public hospital sector in the period 1992 to 1995 there has also been a steady increase in the quality of labour inputs over the same period. Overall, the effect of these trends in labour inputs and quality imply that, at least in some measure, increases in quality are compensating for decreases in overall input quantity.

Labour Inputs Outstanding Issues and Future Actions

161.   In this section, some of the issues and problems which have arisen in the construction of our experimental estimates are summarised. Because each of the methods discussed in this paper have problems arising from various assumptions there is great merit in producing measures of labour input from as many different sources and methodologies as possible.

Index number methods

162.   As discussed earlier, productivity weights are constructed assuming a perfect labour market and wages paid according to marginal productivity, and therefore quality. Where this assumption does not hold, that is, if wage rates do not reflect productivity differences, then results of the index number construction may not reflect actual changes in quality for the work force. In this case, different data would need to be constructed which more accurately represents individual or group productivity.

163.   Following this experimental analysis, a number of additional studies are planned for the estimation of labour inputs to public hospitals. These include:

Testing the sensitivity of the various measures to the use of alternative data sources and definitions and labour force dissections. Additional sources of data, in particular employee and hours worked data, include Census of Population and Housing data relating to health related occupations and Hospital Utilisation and Costs Survey (HUCS) data relating to Full Time Equivalent (FTE) staffing numbers. Additional analysis is also planned on the use of alternative data definitions.

Examining the effect on the various measures by assuming departures from the assumptions outlined previously. In particular, searching for an alternative methodology for forming productivity weights; and

The ways in which the experimental estimates, which cover the period 1991 to 1995, can be extended backward in time to produce a time series, either by exploring alternative data sources or employing an extrapolation technique.

L.   Capital Inputs

164.   Our experimental estimates of capital inputs are at an early stage of development; we propose further work to refine and test them.

165.   Ideally, for productivity studies, we should like to obtain a measure of the *flow of capital services* - that is, the contribution that capital makes to production in each reference period. In practice, the flow of capital services usually cannot be measured directly, and it is necessary to base estimates on the *stock of capital* adjusted for, say, variations in the intensity of use (or it may even be necessary to assume that the flow of capital services is simply proportional to the stock).

166.   Broadly, there are four methods of compiling capital stock estimates: cumulating stocks from time series of investment data using the Perpetual Inventory Model [PIM]; using book values or data from the asset registers of service providers; using data compiled for or by taxation authorities; and using direct estimates.

167.   We have used the PIM to compile our first-cut experimental estimates of capital stock, but we shall also have regard to estimates constructed using other methods especially when testing the plausibility of our results.

What Concept of Capital is Most Relevant to Productivity Analyses?

168.   In March 1997, the ABS hosted an international conference on the measurement of capital stock. One of the questions discussed was what concepts of capital are most appropriate for different analytical uses. A broad consensus emerged that the most appropriate measure for productivity analyses is the "productive capital stock" - broadly, this is the gross capital stock less any deterioration in the flow of outputs from the capital stock and the cost of inputs to adequately maintain the capital stock.

169.   For our first-cut experimental estimates we have constructed two sets of estimates, namely:

- net capital stock; and

- an average of net (obtained using straight line depreciation) and gross capital stock.

In later stages of this project, we intend pursuing the possibility of deriving alternative estimates of the productive capital stock.

Capital inputs to health services – data and methods

170.   For our experimental estimates, we have adapted the PIM used to compile capital stock estimates for the Australian national accounts. The inputs to the PIM include:

- time series of investment

- time series of price indexes

- assumptions about the mean asset lives, depreciation profiles and retirement profiles.

171.   Broadly, we have used the same data and assumptions as underlie the national accounts estimates of capital stock, except that we have compiled investment series specifically for public acute care hospitals (rather than using the more highly aggregated series that underlie the national accounts estimates).

172.   Our aim has been to compile indexes of capital stock for at least the early 1990s - when combined with our indexes of output and labour input for the early 1990s, this permits us to do multifactor productivity analyses. The data have in fact permitted us to derive a considerably longer time-series for capital stock - these will be useful in later stages of the project.

The data

173.   The ANA provides us with capital stock estimates for General Government Health. These estimates are derived from price deflator and investment time-series, which relate to the total general government health sector, using PIM. However, in order to compile a capital stock estimate which relates specifically to Public Acute Care Hospitals, more detailed investment and price data are required.

174.   From the ABS's Government Finance Statistics system, estimates of expenditure on new fixed assets and net expenditure on second-hand fixed assets by General Hospitals (Government Purpose Classification (GPC) subdivision 0511) are available for -

- Commonwealth general government non-dwelling construction

- State and local general government non-dwelling construction

- Commonwealth general government equipment

- State and local general government equipment

175.   It should be noted that -

- The GFS data are consistent with the ANA data, and are the source for the more aggregated ANA estimates.

- Expenditure on new fixed assets and net expenditure on second-hand fixed assets sum to give gross fixed capital expenditure (GFCE).

- The GPC (purpose-based classifications) do not match precisely the industry classifications we require, but the information is sufficiently detailed to develop a reasonable approximation to GFCE for public acute care hospitals and other segments of the Health Services industry.   Investment data for the GPC 'General Hospitals' has been used to approximate investment by Public Acute Care Hospitals. This may understate investment somewhat, due to the exclusion of some specialist acute care hospitals (e.g. children's hospitals) from the 'General Hospitals' classification.

- The investment time-series extend back to 1962. This is adequate for our purpose in relation to equipment (maximum asset life 22 years), however for non-dwelling construction (maximum asset life 88 years) we require a data series which extends back to 1907. In the absence of benchmark estimates of capital stock, it is necessary to devise a means of generating a series for Public Acute Care Hospitals prior to 1962, based on the total health capital series for those years.

- Both land and inventories are excluded from the capital stock estimates.

- The capital stock of dwelling assets for general government health is zero.

- Local government makes no contribution to investment for Public Acute Care Hospitals.

176.   Our experimental capital stock estimates reflect investment data relating to Public Acute Care Hospitals. However, ANA price deflators, relating to total Health, have been used to develop the estimates. Future work will look at developing price measures which relate specifically to the different segments of the Health Services industry.

177.   It is preferable to run the PIM at the most disaggregated level possible when compiling capital stock estimates. Therefore, it would be preferable to break the State and local general government data down by individual States. However, such data have not been obtained yet. It may be possible to extract them from the GFS system or from individual State documents - we intend pursuing this possibility in 1997, both because it may allow us to improve (or better understand) the Australia-wide estimates and because an analysis of Health Services industry productivity for individual States is of interest to some clients.

The methods

178.   The net capital stock series for Health and community services in the Australian national accounts are compiled using the PIM model as follows:

- straight-line depreciation is assumed for all asset types

- the mean asset life for buildings is assumed constant at 54 years (a weighted mean of 65 years for new buildings and 30 years for alterations and additions)

- the mean asset life for equipment is assumed to have declined by 0.5 per cent per annum since the 1950s:

Period	Mean asset life
1879-80 - 1957-58	16 years
1958-59 - 1970-71	15 years
1971-72 - 1985-86	14 years
1986-87 - 2001-02	13 years

- it is assumed that all assets (except alterations and additions) are retired according to a "Winfrey S3" distribution of asset lives (with 75 per cent of assets retired within 30 per cent of the mean asset life); alterations and additions are retired according to a "Winfrey S0" distribution.

- the deflator for equipment used in Commonwealth government health services is assumed to be the same as the deflator for equipment used in all other Commonwealth government service "industries" (eg, law and order, education). A si
- milar assumptions applies to Commonwealth government non-dwelling construction, State and local government equipment, and State and local government non-dwelling construction.

179.   Our experimental estimates for Public Acute Care Hospitals were developed by applying this PIM methodology to the investment and price data outlined in the previous section. Some minor modifications to the ANA methodology were made:

- A constant mean asset life of 13 years has been adopted for equipment. This assumption was adopted for ease of computation, and as our aim is develop capital stock estimates for the early 1990s, should not appreciably affect our results.

- In order to calculate retirements and depreciation, Public Acute Care Hospital investment prior to 1962 has been estimated as a constant proportion of investment for total Health (for which ANA data are available back to 1874).

180.   The index of capital inputs for the early 1990s is calculated by indexing the total net capital stock (at constant prices) series. This, in turn, is calculated simply as the sum of the four component net capital stock series. Ideally, the component net capital stock series would be weighted together according to the user cost of capital - this issue will be examined in future work.

181.   If we continue to use the national accounts methods as the foundation on which to construct our measures of capital inputs, we shall have to review (and may choose to modify) these assumptions to better reflect conditions in segments of general government health services such as public acute care hospitals, psychiatric hospitals and nursing

homes. Moreover, the ABS's national accountants are undertaking a comprehensive review of their own methods during 1997 and 1998.

Productive capital stock

182.   The Australian national accounts' net capital stock series measure primarily the economic value of capital, not the "contribution" of capital to production in such-and-such a period. An item of capital which is near the end of its life may have a low economic value (because it has largely been depreciated and the value of the future income stream it can generate is small), but it may still be used effectively in current-period production - an extreme example is a light bulb near its mean-time-to-failure.

183.   If net capital stock is used as the capital input measure, the contributions of assets to production are assumed to decline at the same rate as the assets' decline in economic value (say, in conformity with a straight-line depreciation profile). While if gross capital stock is used, the decline in capital's contribution to production is not recognised at all until assets are retired.

184.   As noted above, the ABS assumes straight line depreciation over an asset's service life to obtain its estimates of net capital stock. This is consistent with a flow of capital services that declines at a fixed linear rate, i.e. the flow of capital services from an asset declines by an ever increasing amount until the asset is retired. This implies that the productive capital stock should lie in between the gross and net capital stock. Accordingly, the ABS's multifactor productivity computations use a weighted average of the gross and net capital stock estimates, with weights of 1:1 for buildings and structures and 1:3 for equipment. For public acute care hospitals, we have used the same weightings of gross and net capital stocks.

Weighted average capital stock at constant prices - **non-dwelling construction**
= (0.5*net capital stock at constant prices) +(0.5*gross capital stock at constant prices)

Weighted average capital stock at constant prices - **equipment**
= (0.75*net capital stock at constant prices) +(0.25*gross capital stock at constant prices)

185.   We have also used net capital stock for comparison purposes.

186.   As discussed earlier, we also intend pursuing the possibility of constructing alternative estimates of the "productive capital stock".

Experimental Estimates of Capital Inputs

187.   Our four experimental series (two asset types by two levels of government) for the net capital stock of public acute care hospitals show that:

- non-dwelling construction assets are of a far greater magnitude than equipment assets; and

- State and local government net capital stock is of a far greater magnitude than Commonwealth government capital stock, which has declined over recent years.

190.   The experimental estimates for output and labour are focused on the early 1990s. The estimated growth in productive capital stock (derived by averaging gross and net capital stock) and net capital stock between 1989-90 and 1994-95 are shown in table 4.

191.   For further comparison, the weighted average series for General Government Health Services for the same period is also included in table 4. Hospitals have shown slightly higher capital stock growth throughout the nineties than the total health sector. It is expected that this will be shown to have been caused by a winding back of other services traditionally covered by this category.

Table 4: Estimated Growth in Capital Inputs - Public Acute Care Hospitals

Year	Public Acute Care Hospitals - Net capital stock (percentage growth from previous year)	Public Acute Care Hospitals - Weighted average of net and gross capital stock (percentage growth from previous year)	General Govt Health Services - Weighted average of net and gross capital stock (percentage growth from previous year)
1990-91	2.89%	3.41%	3.22%
1991-92	4.03%	3.72%	2.64%
1992-93	4.76%	4.34%	2.82%
1993-94	4.23%	4.46%	3.02%
1994-95	5.14%	4.67%	3.00%

Possibilities for Refining the Experimental Estimates Data and Methods

192.   The experimental capital stock indexes for Public Acute Care Hospitals have allowed us to do a first-cut analysis of productivity. However, there are several directions in which we intend to further develop our experimental estimates over the coming months - these are discussed below.

Sources of Segmental Price Data

193.   While our experimental estimates reflect investment data which relate specifically to public acute care hospitals, the price data used in deriving these estimates relate to all of

general government health. Ideally, we wish to obtain **price deflators** for capital which relate specifically to the public acute care hospitals segment of government services. The national accounts provide distinct deflators for:

- the two levels of government (Commonwealth government | State and local government) and

- the two types of assets (equipment | non-dwelling construction)

but not for the different government service "industries" (so the deflator for health is the same as the deflators for, say, education and law and order).

194.   This has two consequences. First, the deflators we have used for our experimental estimates reflect prices for a variety of capital items (eg, agricultural machinery) not relevant to health services. Second, even for capital items that are relevant to health services, the relative weights applied to the component price indexes are probably inappropriate.

195.   Broadly, the national accounts deflators for government capital are compiled using the following price indexes:

Equipment

- producer price indexes for articles produced by manufacturing industry [APMI]
- import price indexes (IPI)

Non-dwelling construction

- a pseudo output price index for government non-dwelling building and using weighting data from the ABS's input-output tables.

196.   If we were to attempt constructing deflators specific to the segments of government health services (such as public acute care hospitals), we would have to obtain both the low-level price indexes and suitable weights to combine those indexes.

197.   We may attempt constructing weights based on such data sources as annual reports of service providers, studies by health economists and administrators and the ABS's Public Authority Finance [PAF] database system. But even if this were to yield deflators which, in our view, reflected more accurately the mix of capital items used by, say, public acute care hospitals, that would not be the only consideration. Ultimately, our experimental estimates of outputs, inputs and productivity must be co-ordinated with corresponding estimates for other public and private sector industries *within an input-output framework* to yield economy-wide estimates - this requirement may constrain the degree to which we can choose data construction methods specific to particular industries.

Combining the Estimates of Different Asset Types

198.   To obtain an index of overall capital input to hospitals, the different assets should be weighted together according to the capital services they provide. Capital stocks of the different asset types are usually combined as a Tornqvist index, using rental prices as

weights. Rental prices can be calculated using measures of price change, the internal rate of return, economic depreciation and the effects of tax laws, and also potentially investment allowances and the Tobin "Q" ratio.

199.   The Australian national accounts, in estimating multifactor productivity for the market sector, adopt a simplified rental price formula that includes only price change, depreciation and the internal rate of return:

The basic formula for rental prices is -

$$C=P*(r+d) - Q$$

where

C is the rental price of capital
P is the price deflator for new capital goods
r is the nominal rate of return
d is the average rate of economic depreciation [= total annual depreciation divided by the net capital stock (K)] and
Q is the revaluation of assets due to inflation in new goods prices (i.e. change in P).

An *internal* rate of return can be solved for, by assuming Y=CK, where Y is capital income, and rearranging the equations to obtain -

$$r = Y/KP - d + Q/P$$

Sometimes, for simplicity, market interest rates are used to proxy the rate of return

Indexes of stocks of each asset type are combined into a Tornqvist index, using rental prices as weights.

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200.   The methodology (namely, the calculation of an internal rate of return) does not translate readily to the general government sector. In other studies, such as the report of the National Health Ministers' Benchmarking Working Group (1996), the market interest rate has been used to proxy the rate of return in calculation of the user cost of capital.

Testing Our Experimental Estimates and Future Work

201.   Australian and overseas experience shows that PIM estimates can diverge appreciably from the true levels of capital stock - the estimates are sensitive to errors in the investment series and, especially, to errors in assumptions about asset lives. We have used other data to test the plausibility of our PIM-based estimates; the results are available on request.

202.   Work we shall undertake in the future includes:

   (a) Compiling aggregate estimates of capital stock, by weighting the individual asset types according to the user cost of capital specific to those asset types.

(b) Testing the sensitivity of our experimental results to assumptions and alternative data constructions by:

- varying the mean asset lives

- varying the deterioration and retirement profiles

- compiling price indexes specific to public acute care hospitals (or at least specific to government health services).

- assessing quality adjustment bias in capital goods price indexes

- exploring the consequences of departures from perfect competition in the markets for capital inputs.

- attempting some adjustment for variations in the utilisation of capital.

M   Intermediate Inputs

203.   The experimental output estimates described in this paper are essentially estimates of gross output. The following section describes how estimates of intermediate inputs might be derived for this segment of the Health Services industry. Once estimates of intermediate inputs are available productivity analysis can be conducted and estimates of value added derived.

Treatment of Private Medical Services in Public Hospitals

204.   In the national accounts, transactors and their associated transactions are classified to institutional sectors. For medical services provided by medical practitioners, this raises some issues and potential differences in treatment for measuring output for national accounts purposes and for Health Services industry analyses of output and productivity. Specifically, one important issue that needs to be addressed is the input, and associated output, of medical officers providing services to patients (either public or private) in public hospital beds, but not explicitly employed by that hospital.

205.   The medical services provided by non-salaried medical practitioners in public acute care hospitals are of two types:

Type 1 services provided by visiting medical officers who are "contracted" by hospitals to provide services to public patients in hospitals.

Type 2 services provided to private patients. Private patients are those who are treated by a doctor of their choice (as opposed to a hospital nominated doctor) or choose to be accommodated in a single room. These patients are billed directly by the medical practitioner for services provided although charges for such private medical services are reimbursed up to 100 per cent of the Medicare schedule fee for service through a combination of Medicare and private health fund rebates, and not included in hospitals' recurrent expenditure figures. Although Medicare data on

in-hospital services are available, they are not sufficiently detailed to allow the allocation of costs to individual hospitals or groups of hospitals.

206.   The issue of services provided to private patients is significant. In 1991-92, "private patients" accounted for 21.1 per cent and "public patients" accounted for 69.4 per cent of patients in public acute care hospitals, as can be seen from table 5.

Table 5: Public Acute Hospitals
(Shares of patient population, 1991-92)

Patient Charging Category	per cent
Public	69.4
Private	21.1
Nursing Home Type	7.3
Other	2.2
TOTAL	100

Source: Hospital Utilisation and Costs Survey

Conceptual Issues

207.   In the national accounts, the appropriate treatment of **Type 1** Medical services, (given that the visiting medical officers are independent economic agents engaged by the hospital to provide a service and are not employees of the hospital) would be to regard them as the purchase of a service from outside the establishment and consequently as a component of intermediate consumption.   Such services would therefore be reflected in hospital gross output but not in value added by the hospital.

208.   This point is clarified in SNA93:

The boundary between intermediate consumption and value added is not a rigid one fixed purely by the technology of production. It is also influenced by the way in which production is organised and distributed between different establishments and enterprises. If an establishment obtains the services from outside instead of from ancillary activities, its value added is reduced and intermediate consumption increased, even though its principal activity remains completely unchanged. [SNA93 (paras 6.176-177)]

209.   In the case of **Type 2** Medical services, the appropriate national accounting treatment is less clear. Since the contract for supply of medical services is between the medical practitioner and the private patient, the role of the hospital in this transaction is unclear. While the hospital is the supplier of the capital and other labour inputs involved in

the patient care episode, it appears that the medical service element in this case should not be included as a component of the gross output of the hospital.

210.   For Australian health services analysts, the national accounting approach does not appear appropriate:

- For **Type 1** medical services, the 1991-92 HUCS classifies payments to visiting medical officers as salary payments, whereas the national accounting view would regard this payment as an intermediate expense.

- For **Type 2** medical services, it appears the desired approach is to incorporate the costs and presumably the output associated with private medical practitioners services to private patients in an overall measure of hospital activity. This contrasts with the National Accounting view which would appear to regard them as independent economic agents whose productive activity is recorded in another sector. For example, the Department of Human Services and Health Casemix Education Series Publication, *The Costing Bridge: Data Issues in Product Costing* (pp79-81) emphasises the potential difficulties but importance of including medical costs (costs associated with the labour input of doctors) in product costing studies. It states that while much of these costs (especially for private hospitals) will not appear in hospital accounts, use of other data sources such as private patient billing systems is needed. Similarly, the *First National Report on Health Service Performance Indicators,* indicates that a proposal for dealing with medical costs was endorsed at the March meeting of NHMBWG. In summary, the method "converts" actual medical costs to those which would be required if 100 per cent of bed-days were for public patients. Again the approach is that the measurement for hospitals should reflect the activity of private medical practitioners.

Data Issues

211.   In practical terms, consideration must be given to how the input (or output) of private medical services are reflected in the experimental output indicators, input measures and productivity estimates.

212.   For labour input measures based on ABS employer surveys only salaried doctors (that is, those medical practitioners who are "employees" of the hospital) will be included. Therefore, they would exclude visiting medical officers who are contracted on a fee for service basis and would not be regarded as employees. Similarly, these measures would not account for the medical input to private patients.

213.   In constructing estimates of productivity, it is essential to ensure estimates of inputs and outputs have consistent coverage. This means that we must be able to match estimates of inputs and outputs - either by including all output and "non-employed" labour inputs, or by discounting the level (or total value) of gross output by the expenditure of contract services.

214.   This discussion is chiefly concerned with the treatment of Type I services, namely visiting medical officers "contracted" to public hospitals to provide services to public patients. As discussed above, the planned treatment of the input of private medical

specialists is to consider it as a third, intermediate, input separate from the labour and capital measures already derived, to match the output indicator produced in this study.

215.   In terms of gathering data, the Hospital Utilisation and Costs Study (HUCS) 1991-92 contains published data relating to the average recurrent expenditure ($) per adjusted separation for salaries, wages and related payments for the following hospital staffing categories: salaried medical officers, visiting medical officers, nurses, diagnostic and health professionals, administrative staff, domestic staff.

216.   Coupled with data for total adjusted separations for 1991-92, it is possible to construct the total recurrent expenditure for each staffing category. This will give an idea of the relative size of the input of VMOs in comparison to the employed staffing categories already included in our experimental estimates, as well as producing a measure of the total expenditure by public hospitals on Type I (contract) services. Table 6 shows data from the 1991-92 HUCS publication for public acute care hospitals - Australia:

Table 6: Public Acute Care Hospital Expenditure

	Recurrent expenditure	Total expenditure	% of total expenditure
Staffing category	($)/adj separation	$ millions	
SMO	200	789.5956	12.51
VMO	118	465.8614	7.38
Diagnostic & health professional	213	840.9193	13.32
Nursing staff	705	2783.3245	44.09
Administrative & clerical	154	607.9886	9.63
Domestic & other	209	825.1274	13.07
Total	**1599**	**6312.8168**	
Total adjusted separations:	3947978		

Source: AIHW Hospital Utilisation and Costs Survey (1991-92)

217.   The table indicates that in 1991-92 the total expenditure on visiting medical officers in public hospitals was $466 Million, or 7.5% of the total expenditure on wages and salaries for public acute care hospitals.

218.   The figures in the table above give the relative size of the intermediate input of contract medical labour to public hospitals, allowing the incorporation of visiting medical officer input into the existing measures of input and output. This approach ensures a level

of consistency between the experimental measures of input and output in any studies of public hospital productivity.

Other Intermediate Inputs

219.   Our experimental work has so far taken account of only two classes of inputs to public acute care hospitals, namely labour and capital. Of course, hospitals use a wide variety of goods and services produced by other industries. If we were able to compile suitable estimates of the other intermediate inputs, we could use these estimates with estimates of inputs of VMOs, labour and capital.

220.   In principle, the estimates of goods and services flows between industries are all recorded in Input-Output tables. In practice, however (as we have also observed when discussing output and capital estimates), the Australian Input-Output tables are at a much coarser level of aggregation than we require for our study. It may be possible to use ratios derived from Input-Output tables to provide some broad indicator of the proportion of intermediate inputs to outputs for, say, government health services in total - but we would not be able to obtain accurate estimates of the trends in those proportions for segments of government health services such as public acute-care hospitals.

221.   Two data collections conducted by the ABS may assist our analysis of intermediate inputs.

The first is a survey of the amounts spent by government agencies on (among other things) goods and services produced by other industries. This survey is conducted in the base years used for national accounts constant price estimation (eg, 1989-90 and 1994-95). At the time of writing, the 1994-95 data had not been processed, but when they are, it may be possible to ascertain broad trends in current-price intermediate inputs.

The second is a price index for the goods and services supplied to public hospitals. This index has been compiled for the early 1990s, and may assist us to compile constant price estimates of intermediate inputs.

N.   Conclusion

222.   The experimental estimates of outputs and inputs presented in this paper are a first step toward the ABS's goal of improving the measurement of non-market segments of the economy. Better definition and measurement of non-marketed output would not only facilitate productivity analysis but would also contribute to improving the estimation of output for the Australian National Accounts. However, as can be seen from our preliminary analysis of public acute care hospitals, many problems arise when attempting to measure non-marketed segments of the economy including: adjusting for changes in the quality of inputs and outputs, defining the boundaries between producers, establishing prices or other weights for aggregating outputs and inputs, obtaining data of adequate quality, and defining and constructing suitable output or activity indicators.

223.   While acknowledging these difficulties, the ABS plans to expand its analyses to encompass first the remainder of the Health Services industry then other government-funded service provision, public administration and defence. The results of these

analyses, which will be made available over the next two to three years, should provide a foundation from which the ABS can continue to meet the needs of economic analysts, policy makers and other users and refine its own methodological practices.

Endnotes

(1) **NHIM: Definition of Health Event Entity and Related Classifications**

Health and Welfare Service Event: an instance of an event which is part of the delivery or receipt of health and welfare services and care. These events include delivery of community programs, consultations with service providers, diagnoses, treatments, operations, delivery of care and rehabilitation, delivery of palliative care, counselling services and voluntary care.

Health and Welfare Service Event Type: a classification system for Health and Welfare Service Events.

Individual event types are known as Component Health and Welfare Service Event Types, and the grouping of these is referred to as an Aggregate Health and Welfare Service Event Type.

Component Health and Welfare Service Event Types: a classification system for the events, services and activities that occur within the health and welfare system

Aggregate Health and Welfare Service Event Type: the grouping or aggregation of one or more than one, health and welfare events, often into a known service. These services are often composite structures, comprising individual events, other services or activities.

An example of an Aggregate Health and Welfare Service Event Type is the classification of a "consultation" with a general practitioner (rather than the actual instance of a consultation), which may include elements of a "diagnosis" and a "treatment", being classifications of a Component Health and Welfare Service Event Type.

(2) Inpatients refers to admitted persons and outpatients to non-admitted persons.

(3) The 1994-95 National Hospital Morbidity (Casemix) data base covers public acute hospitals for Australia and private acute hospitals in New South Wales, Victoria, Queensland, South Australia, Tasmania and the ACT. The data were collected through a census of State and Territory health authorities. The data used in this report is based on data reported in the *Australian Casemix Report on Hospital Activity 1994-9* which is in turn drawn from the National Hospital Morbidity (Casemix) data base. Many of the limitation of the data discussed below apply to the data presented in the report and not to the source data base.

The data for private hospitals contained in the *Australian Casemix Report on Hospital Activity 1994-95* will be of use later in the ABS productivity project when we shall compile estimates for other segments of the health industry. In this stage of the productivity project we focus on the data relating to public acute hospital inpatient care which is available from this report.

Inpatient activity measures consist of data on separations, bed days, same day separations, average length of stay and costs by 667 Diagnosis Related Groups (DRG) codes. These activity measures are available at both the national and State levels. A consistent classification system (AN-DRG Version 3.0) is used over all three years. Cost data are estimates based on results of National Costing Study, which is discussed in the following section.

The 1993-94 and 1994-95 data systematically exclude non-acute and sub-acute episodes of care, while this is not the case for 1991-92 and 1992-93.

(4) The report of the *Commission of Inquiry into the efficiency and administration of hospitals* (the "Jamison Report") provides information for the following items for each State/Territory and for repatriation hospitals over the period 1970-71 through 1978-79 :

Public acute hospital outpatient services per 1000 population (assuming three treatments per visit for Victoria and South Australia)

Public acute hospital inpatient occupied bed days per 1000 population

Public acute hospital inpatients treated per 1000 population This data can be converted to an activity measure by multiplying by population data.

(5) The Hospital Utilisation and Costs Surveys (HUCs) provide a comprehensive national dataset covering activity, financial and staffing data for health care institutions. Information on recurrent (non-capital) expenditures and revenues is collected. Costs are allocated between inpatients and non-inpatients using inpatient fractions (IFRACs) see Section 4.4.

HUCS covers the following types of institutions:

  acute public hospitals

  Commonwealth Department of Veterans Affairs Hospitals

  public psychiatric hospitals

  nursing homes and hostels for the aged and young disabled

  private hospitals (limited data)

Data are collected from all State and Territory health authorities at the institution level. Medical costs associated with private patients are excluded from HUCS, although the 1991-92 study contains supplementary data on private patient medical costs.

HUCS includes activity data for both inpatient and non-inpatient services. The reported data refer to all activities of acute care hospitals, not just acute care episodes, and so the inpatient data differ from those reported in the Hospital Morbidity (Casemix) Database.

HUCS were conducted by AIHW for 1985-86, 1987-88, 1989-90 and annually from 1991-92 (the last published report relates to 1991-92), although there were appreciable changes in the data collected and definitions. From 1991-92, the definitions applied are those in the National Health Data Dictionary.

(6) **National Costing Study & AN-DRG Cost Weights**

The National Costing Study provides estimates of average total costs, component costs (e.g. ward nursing, medical, pathology, drugs, catering, depreciation), standard errors, average length of stay and cost weights for each DRG. The cost weight for each DRG is an estimate of the average cost of an episode for that DRG relative to the average cost of all episodes.

The study is based on a survey of public and private acute care hospitals with more than 50 beds   it included 68 public and 29 private hospitals, stratified by public/private, metropolitan/ non-metropolitan, State and size of hospital (number of beds). Smaller hospitals were excluded from the survey, as it was believed that their costs are not representative of the majority of hospitals. This exclusion introduces an inconsistency between the activity dataset and the cost weights dataset.

Separate tables are published in the *Report on the Development of AN-DRG Version 3 Cost Weights* for public and private hospitals at the national level, and for public hospitals at the State level.   Costing information is not separately reported for the ACT, Tasmania or the Northern Territory, as only one or two hospitals were sampled from each.

The casemix cost weights are derived using an approach termed "cost modelling", which produces average cost estimates for each DRG. Aggregate cost data from hospitals' general ledgers are assigned to a group of inpatient episodes which are classified in the same DRG. The latest cost weights were produced by DHFS by updating the 1992-93 National Costing Study using data collected more recently from the following related projects:

A price index was developed to measure the change in hospital input prices between December 1992 and December 1994. The AN-DRG Version 3.0 cost weights have been updated using this price index to reflect 1994-95 costs.

Service weights for diagnostic imaging, pathology, operating rooms, critical care and nursing services were compiled over 1994-95, and replaced the previous weights which were based on Maryland (U.S.A.) data. The 1992-93 National Costing Study included Australian service weights for nursing services, but these were also updated. Service weights are scales which provide resource use relativities by DRG for services provided in hospitals. In cost modelling they are used to allocate hospital costs for these services between DRGs.

For the remaining service areas, service weights continue to be based on the Maryland data, but were updated to Version 3.0 of the AN-DRG classification and reviewed by Australian clinicians.

Where substantial classification changes occurred, the data are supplemented by the results of a micro-costing study of 31 DRGs.
Where anomalies had been identified in the initial data collection, source data were resubmitted by hospitals.

(7) **National Health Ministers' Benchmarking Report** & **IFRACs**

According to the *National Health Ministers' Benchmarking Report,* inpatient fractions (IFRACs) were provided by State and Territory Health Authorities at the hospital level for Victoria, Queensland, South Australia, the principal hospital in ACT and for teaching and non-teaching groups of hospitals in Western Australia. For all other hospitals, the IFRAC was estimated using Health and Allied Services Advisory Council (HASAC) formula. The HASAC ratio which was established in 1971 is:

*   5.753 non inpatient treatments with one OBD

*   1.917 non-inpatient visits with one OBD

A consistent approach to estimating inpatient fractions was not used for all States. Further, the HASAC ratio differs considerably from the data supplied by State health authorities.

The HASAC ratio leads to an Australia-wide IFRAC estimate of <u>73.9 per cent</u> for 1993-94. A ratio of 7.102 non-inpatient treatments per OBD was derived from the hospital level IFRACs provided by Victoria, Queensland and South Australia only. This led to an estimated Australia-wide IFRAC for 1993-94 of <u>77.6 per cent</u>. The Report includes a further estimate of the Australia-wide IFRAC of 75.5 per cent, based on specific hospital IFRACs where supplied and the HASAC ratio elsewhere.

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
ANA	Australian National Accounts
ANZSIC	Australian New Zealand Standard Industry Classification
APMI	(Price Index of) Articles Produced by Manufacturing Industry
ASCO	Australian Standard Classification of Occupation
ASIC	Australian Standard Industrial Classification
BEA	(United States) Bureau of Economic Analysis
BLS	(United States) Bureau of Labour Studies
COAG	Council of Australian Governments
DHFS	Department of Health and Family Services
EEH	Survey of Employee Earnings and Hours
FTE	Full Time Equivalent (hours worked)
HUCS	Hospital Utilisation and Costs Survey (AIHW)
GFCE	Gross Fixed Capital Expenditure
IPD	Implicit Price Deflator
MUMI	(Price Index of) Materials Used by Manufacturing Industry
NHMBWG	National Health Ministers' Benchmarking Working Group
NHIM	National Health Information Model
NHDD	National Health Data Dictionary (AIHW)
PAF	Public Authority Finance
PIM	Perpetual Inventory Model
SNA	United Nations System of National Accounts
SMO	Salaried Medical Officer
TFP	Total Factor Productivity
TT	Tornqvist-Theil index form
VMO	Visiting Medical Officer

Appendix Source Data for Constant Price Estimation of Services Output

Industry Constant Price Information	Plans
Construction (21) Base year gross product is extrapolated by quarterly constant price estimates of output which are weighted together using value added weights from the 1988-89 Construction Industry Survey. The measures of output are quarterly estimates of value of work done, based on data from the Building Activity Survey and the Engineering Construction Survey.	♦ Periodic Survey 1996-97 ♦ Only one planned between 1991 and 2001
Engineering construction	♦ PPI feasibility work to be completed March 97
Retail Trade (23) A constant price estimate of gross product is extrapolated by the aggregate of constant price value added estimates for 18 industry groups. Quarterly estimates of constant price value added are derived by extrapolating current price estimates of value added for each industry group (obtained from data collected in the 1991-92 Census of Retail Establishments) by constant price estimates of retail turnover. The estimates of retail turnover at constant prices are derived through deflation (using price data largely from Consumer Price Index (6401.0)) of current price estimates of industry turnover published in Retail Trade, Australia (8501.0) and data on motor vehicle registrations and operation. This assumes that the quantum of services in distributing a commodity is a fixed proportion of the quantum of turnover of industry groups.	♦ Periodic Survey 1991-92 and 1997-98 ♦ Monthly retail survey ♦ Motor vehicle retailing due for inclusion in expansion of Survey of Stocks & Sales - pilot study due Oct 96
Wholesale (22) The base year value of gross product is extrapolated by the aggregate of constant price value added estimates derived at the ANZSIC group or class level. Constant price estimates of value added are obtained by extrapolating 1991-92 estimates of wholesale value added for various industry groups or classes by constant price estimates of wholesalers' sales (except petroleum wholesalers where quantity revalued data from ABARE is used as the extrapolator). The wholesale sales data used are current price data underlying those published in Stocks, Selected Industry Sales and Expected Sales (5629.0). Sales by public marketing authorities, obtained from the ABS Public Finance System, are also included.	♦ Survey 1991-92 and 1997-98 ♦ Quarterly collection (Survey of Stocks and Sales) ♦ Study into combining a number of surveys into quarterly EAS

Accommodation Cafes and Restaurants (25) Separate quarterly output estimates are derived for cafes and restaurants and accommodation and are weighted together using value added weights. The sum of the weighted output estimates is used to extrapolate base year gross product. Cafes and restaurants turnover, revalued by a component of the CPI, is obtained from the monthly retail survey. For accommodation, annual output indicator derived by deflating revenue estimates for motels, hotels, caravans and units by the holiday accommodation component of the CPI. These annual estimates are interpolated by quantity revalued number of guest nights for the same types of accommodation. Value and quantity data are obtained from Tourist Accommodation, Australia (8635.0).	♦ Accommodation (5710) Surveys 1991-92, 1995-96, 1997-98, 2000-01 ♦ Cafes and Restaurants (5730) Surveys 1991-92, 1997-98, 2000-01 ♦ Pubs, Bars and Taverns (5720), Clubs (5740) Surveys 1991-92, 1994-95, 1997-98, 2000-01 ♦ Accommodation due for inclusion in expansion of Survey of Stocks & Sales - pilot study due May 97
Transport and Storage (26) Annual and quarterly gross product-Sum of constant price gross product estimates for Road Transport and Services to Road Transport (ANZSIC 61 and 661 respectively), Rail Transport (ANZSIC 62), Water Transport and Services to Water Transport (ANZSIC 63 and 662 respectively), Air and Space Transport and Services to Air Transport (ANZSIC 64 and 663 respectively), Other Transport (ANZSIC 65), Other Services to Transport (ANZSIC 664) and Storage (ANZSIC 67).	♦ Road, water, air: PPI work to continue until Aug 97 ♦ Rail PPI work completed Oct 96 ♦ Other transport: PPI work to commence June 97 ♦ Storage: PPI work for completion Mar 97 ♦ Travel Agents Surveys 1996-97 and 1999-00 ♦ Transport and Storage due for inclusion in expansion of Survey of Stocks & Sales - pilot study due Oct 96

Road Transport and Services to Road Transport (61 and 661) Sum of constant price gross product estimates as described below. *Road Freight Transport* (611) Base year gross product is extrapolated by the sum of constant price road freight margins. These are derived at a detailed level by extrapolating a base year estimate of the margin by constant price wholesale sales. The base year margins are obtained from the ABS Input-Output System. *Long Distance Bus Transport (6121)* and *Short Distance Bus Transport (Including Tramway)* (6122) Base year gross product is extrapolated by constant price estimates of expenditure on bus and tram transport. Current price estimates of private final consumption expenditure on bus and tram transport are deflated by components of Consumer Price Index (6401.0). *Taxi and Other Road Passenger Transport (6123)* Base year gross product is extrapolated by constant price estimates of expenditure on taxi transport. Current price estimates of private final consumption expenditure on taxi transport are deflated by components of Consumer Price Index (6401.0). *Services to Road Transport (661)* Base year gross product is extrapolated by constant price estimates of the output of major carpark operators. Current price carpark revenue is deflated separately by carpark operators charges and then summed.	♦ See Transport and Storage
Rail Transport (62) Sum of constant price estimates of public and private rail gross product, as described below. *Public rail services* Base year gross product is extrapolated by constant price estimates of expenditure on passenger and freight services combined. Constant price estimates of expenditure on passenger services are derived by deflation of estimates of private final consumption expenditure on rail fares by components of Consumer Price Index (6401.0). Constant price estimates of expenditure on freight services are derived by extrapolating base year revenue by tonne-kilometres of freight carried, obtained from the State and Commonwealth rail authorities. *Private rail services* Gross output method. Base year gross product is extrapolated by quarterly estimates of the quantity of freight carried. The quarterly estimates of quantity are derived by interpolating annual tonnes of freight carried, obtained from Australian Non-Government Railways: Operating Statistics (Department of Transport and Communications), by a quarterly index of private rail activity published in Transport Indicators (Department of Transport and Communications).	♦ See Transport and Storage

Water Transport (63) and Services to Water Transport (662) Sum of constant price gross product estimates of : *Water Transport* (63) Base year gross product is extrapolated by quantities of cargo carried by Australian registered vessels, (coastal and overseas) measured in revenue tonnes and weighted by the revenue earned in the base year. The quarterly estimates of quantities of cargo carried by Australian registered vessels are collected from six major ports, namely: Sydney; Melbourne; Fremantle; Brisbane; Adelaide and Gladstone. *Stevedoring (6621)* Base year gross product is extrapolated by the quantities of different types of cargo handled by stevedores weighted by the revenue earned in the base year. Quarterly data by type of cargo loaded and discharged by stevedores were published in the Waterfront Industry Reform Authority report 'Performance Indicators' up until September 1992, when they ceased operations. Since then the Association of Australian Port and Marine Authorities Incorporated (AAPMAI) have been providing some of these data. *Port Operators (6623)* and *Services to Water Transport n.e.c. (6629)* Output is measured as the revenue of major port and harbour authorities. Data are obtained on all major revenues specific to the port authorities for example, pilotage, cranage, tonnage, wharfage, etc. Unit charge and quantity data are also collected for each revenue item for price deflation or quantity revaluation. The base year gross product is extrapolated by the sum of constant price output estimates of the major ports and harbour authorities. Estimates of overseas cargo loaded and unloaded are obtained from Shipping and Air Cargo Commodity Statistics, Australia (9206.0) *Water Transport Terminals (6622)* - assumed to have the same growth rate as the above 3 components combined.	♦ See Transport and Storage
Air and Space Transport (64) and Services to Air Transport (663) Output is measured as the sum of constant price passenger, freight and mail revenues of major airlines. Constant price estimates of passenger traffic revenue, and freight and mail traffic revenues combined are obtained by extrapolating base year revenue by data on passenger-kilometres and tonne-kilometres, respectively [Where tonne-kilometre data are unavailable, tonne data are used]. Revenue and quantity data are obtained from the major airlines and from the Department of Transport and Communications. *Services to AirTransport*Revenue from the Civil Aviation Authority is deflated by an index of prices obtained from the same authority.	♦ See Transport and Storage
Other Transport (65), Storage (67), and Other Services to Transport (664) Base year gross product is extrapolated by the sum of constant price gross product estimates for Road Transport (ANZSIC 61), Services to Road Transport (ANZSIC 661), Rail Transport (ANZSIC 62), Water Transport (ANZSIC 63), Services to Water Transport (ANZSIC 662), Air and Space Transport (ANZSIC 64) and Services to Air Transport (ANZSIC 663).	♦ See Transport and Storage

Communication Services (27)	♦ Surveys 1992-93, 1995-96, 1996-97, 1997-98, 1998-99, 1999-00, 2000-01
Output is measured as the sum of constant price revenues of the OPTUS, Australia Post and Telecom Australia. Revenue (and quantity) data are obtained directly from these authorities, as outlined below.	♦ Communication services due for inclusion in expansion of Survey of Stocks & Sales - pilot study due Oct 96

Communication Services (27)

Output is measured as the sum of constant price revenues of the OPTUS, Australia Post and Telecom Australia. Revenue (and quantity) data are obtained directly from these authorities, as outlined below.

Output of OPTUS - Domestic and International
Telephone call revenue: The number of paid minutes of telephone service is multiplied by the base year unit price.
Telephone rental revenue: The number of customers is multiplied by the base year unit price.
Equipment sales: The amount of equipment sold is multiplied by the base year unit price.
Leased services and other income Current price values are deflated by the implicit price deflator for domestic final demand.
Output of Australia Post
Domestic mail revenue: Base year revenue is extrapolated by the number of articles handled.
Overseas mail revenue: Base year revenue is extrapolated by the sum of the number of articles posted in Australia for places abroad and the number of articles received from abroad.
Postal money order revenue: Base year revenue is extrapolated by the number of postal money orders issued.
Revenue from agency services: Current price values are deflated by a Commonwealth wages and salaries index.
Other Australia Post revenue: Current price values are deflated by the implicit price deflator of all the above Australia Post items combined.
Output of Telecom Australia - Domestic
Telephone rental revenue: Base year revenue is extrapolated by the number of telephones in service.
Telephone call revenue: Current price values are deflated by a CPI telephone calls price index.
Telephone connection revenue: Base year revenue is extrapolated by the number of telephone connections.
Other domestic revenue: Current price values are deflated by the implicit price deflator of all the above Telecom items combined.
Output of Telecom Australia - International
Telephone call revenue: Base year revenue is extrapolated by the number of paid minutes.
Leased and Other services revenue: Current price values are deflated by the implicit price deflator of telephone calls.

Finance and Insurance (28) Base year gross product is extrapolated by quarterly estimates of hours worked, which are derived by multiplying average hours worked (published in The Labour Force, Australia (6203.0)) by employment data, as described below. Employment estimates are based on the numbers of employees published in Employed Wage and Salary Earners, Australia (6248.0) and the numbers of non-wage and salary earners published in The Labour Force, Australia (6203.0).	♦ Annual survey data being collected from 1996/97 year ♦ Quarterly and annual output indicators are under development
Property and Business Services (30) Base year gross product is extrapolated by quarterly estimates of hours worked, which are derived by multiplying average hours worked (published in The Labour Force, Australia (6203.0)) by employment data, as described below. Employment estimates are based on the numbers of employees published in Employed Wage and Salary Earners, Australia (6248.0) and the numbers of non-wage and salary earners published in The Labour Force, Australia (6203.0).	♦ Selected Property and Business Services Surveys 1992-93, 1995-96, 1998-99 ♦ Other Property and Business Services Surveys 1998-99 ♦ Cleaning Services Surveys 1996-97, 1999-00 ♦ Property Operators and real estate PPI due for completion Dec 96 ♦ Property machinery leasing PPI work to be completed Mar 97 ♦ Business Technical & other PPI work to commence Mar 97 ♦ Business Computing PPI work to commence Oct 96 and end Jul 97 ♦ Business Accounting PPI work to commence Jan 97 and end Sep 97 ♦ Property and Business Services due for inclusion in expansion of Survey of Stocks & Sales - pilot study due May 97
Government Admin and Defence Annual estimates are derived by summing deflated estimates of wages, salaries and supplements and constant price estimates of consumption of fixed capital. Quarterly. Quarterly estimates are derived by interpolating the annual estimates with estimates of hours worked, which are derived by multiplying average hours worked (published in The Labour Force, Australia (6203.0)) by employment data. Estimates of employment are derived as the sum of civilian employment and defence force personnel. The sources of the former are the same as those outlined above for Finance and Insurance (K). Data for the latter are provided by the Department of Defence	♦ This area will be evaluated as part of the programme to examine non-market sector outputs.

Education Annual estimates are derived by extrapolating base year gross product by the sum of deflated estimates of wages, salaries and supplements and constant price estimates of consumption of fixed capital. Quarterly. Estimates are derived by interpolating the annual estimates with estimates of hours worked. The sources of these estimates of hours worked used are the same as those outlined above for Finance and Insurance (K).	♦ Inclusion of education in expansion of Survey of Stocks & Sales is under investigation - pilot study due Aug 97 ♦ This area will be evaluated as part of the programme to examine non-market sector outputs.
Health and Community Services Annual estimates are derived by summing deflated estimates of wages, salaries and supplements and constant price estimates of consumption of fixed capital. Quarterly estimates are derived by interpolating the annual estimates with estimates of hours worked. The sources of the estimates of hours worked are the same as those outlined above for Finance and Insurance (K).	♦ Medical - Survey 1994-95, 2000-01 ♦ Other Health - Survey 1997-98 ♦ Community Services -1995-96 ♦ due for inclusion in expansion of Survey of Stocks & Sales - pilot study due Aug 97
Cultural & Recreational Services Base year gross product is extrapolated by the sum of the following components of output. Net expenditure on gambling: Quarterly constant price estimates of private final consumption expenditure on gambling. Other entertainment: Quarterly constant price estimates of private final consumption on other entertainment. Commercial radio and television broadcasting services Annual gross output estimates are derived by deflating total revenue from radio and television broadcasting (supplied by the Australian Broadcasting Tribunal) by the implicit price deflator for Domestic final demand. Quarterly estimates of output are obtained by linear trend interpolation of the annual estimates. Cultural and recreational services provided by government Annual estimates are obtained from the ABS Public Finance System and deflated by the implicit price deflator for government consumption expenditure (excluding defence). Quarterly estimates are obtained by linear trend interpolation of the annual estimates.	♦ Motion Pictures, TV and Radio - Survey 1993-94, 1996-97, 1999-00 ♦ Libraries, Museums and the Arts - Survey 1996-97, 1999-00 ♦ Sport & Recreation - Survey 1994-95, 1997-98, 2000-01 ♦ Due for inclusion in expansion of Survey of Stocks & Sales - pilot study due Feb 97

Personal & Other Services Aggregation of quarterly constant price estimates. Quarterly. Gross output method. Base year gross product is extrapolated by the weighted sum of the constant price expenditure estimates for the following components. The weights are derived as the ratios of value added to turnover for each component. The ratios are mainly derived from data obtained from the 1986-87 Census of Selected Service Establishments. Hairdressing and video outlets: Current price estimates of turnover from the monthly retail survey are deflated by components of Consumer Price Index (6401.0). Funeral services: Base year expenditure estimate is extrapolated by number of deaths as published in Australian Demographic Statistics (3101.0). Repairs and drycleaning: Current price estimates of private final consumption expenditure are deflated by components of Consumer Price Index (6401.0). Law, order and public safety: Annual current price estimates of government final consumption expenditure are deflated by an index of wage rates and materials prices. Quarterly estimates are obtained by linear trend interpolation of the annual estimates.	♦ Personal Services - Survey 1991-92, 1997-97 ♦ Other Services & Waste Disposal - 1996-97, 1999-00 ♦ due for inclusion in expansion of Survey of Stocks & Sales - pilot study due Feb 97