

SUMMARY RECORD OF CONFERENCE ON CAPITAL STOCK MEASUREMENT, CANBERRA, 10-14 MARCH 1997

PREAMBLE

1 The issue of capital stock measurement was one of 15 so-called critical problems in economic statistics as recognised by the 18th meeting of the United Nations Statistical Commission's Working Group on International Statistical Programmes and Coordination which met in New York in April 1996. The Australian Bureau of Statistics (ABS) had volunteered to host a conference on the issue.

2 The agenda for the meeting had been developed after informal canvassing of the issues among a number of prospective participants. A copy of the final agenda and the list of contributed papers is at Attachments A and B, respectively. Invitations to participate had been sent to 8 international agencies and 38 countries, representing a wide geographic coverage and diversity in statistical development. Attachment C provides a list of participants.

ITEM 1: OFFICIAL WELCOME

3 In his opening remarks, during which he welcomed all participants to the international conference on capital stock statistics, the Australian Statistician, Mr Bill McLennan, also provided some background on the broad context for the conference. A copy of his remarks is at Attachment D.

4 Mr McLennan noted that copies of the papers and proceedings of this conference will be made available to the United Nations Statistical Division for wide distribution within the international statistical community. He emphasised the importance of a wide cross-section of countries being given an opportunity to contribute to statistical developments, including ensuring that Regional Commissions were able to deliberate on the outcomes of the various informal groups now in existence.

5 Mr McLennan noted that one of the issues to be decided by the conference was how further work on capital stock statistics should be advanced. The establishment of an appropriate working group could be useful, but only if it had realistic and finite terms of reference and if participants were prepared to commit themselves to undertake the necessary research and development work between group meetings. If the definite prospect of such commitment emerged during the conference, it would be necessary for a country or international agency to volunteer to host a further meeting.

ITEM 2: ADMINISTRATIVE ARRANGEMENTS

6 Dennis Trewin, Deputy Australian Statistician, ABS, chaired the meeting. The ABS had undertaken to prepare a draft report of the meeting which would be cleared with conference participants before being finalised for submission to the United Nations Statistical Division for wider circulation.

ITEM 3: TOUR DE TABLE - REVIEW OF COUNTRY PRACTICES

7 The item consisted of a 'tour de table', with each country making a brief presentation on the broad methodology it used, or was proposing, for the compilation of capital stock statistics. The meeting discussed these methodologies, the problems associated with them, and, broadly, possible future initiatives. While there was some degree of consistency between methodologies, no two countries were approaching the valuation of capital stock in exactly the same way. The consistencies included a general reliance on the perpetual inventory method (PIM) (with a lesser use of direct measurement); extensive use of Laspeyres price indexes (albeit at a fine level of disaggregation) and fixed-weighted volume indexes; and straight line depreciation assumptions. A simplified summary of the methods used in each country, as represented at the Conference, is included as Attachment E. For more detailed information, reference should be made to the individual country papers.

8 Similar broad asset types were used by most countries, with the main differences being in the treatment of some agricultural assets (such as breeding stock) and the degree of detail in which assets were reported. The institutional sector classification used was also similar for most countries, although the reporting of data varied substantially, particularly concerning the coverage of both the government and the household sectors. While industry (branch) classifications were also similar, the degree of detail in which these were reported varied substantially. It was acknowledged by a number of countries that valuation of capital stock for service industries was of poorer quality than for other industry groups.

9 There was a significant degree of commonality in the problems reported by countries concerning their current systems for deriving capital stock estimates. These problems included:

- a lack of empirical data directly relevant to individual countries on asset service lives for different types of assets;
- b inadequate dissection of estimates by type of equipment;
- c privatisation - difficulty of satisfactorily implementing inter-sectoral capital stock adjustments;
- d difficulties in redistributing capital stock acquired through financial leases to industry of use;
- e lack of data on second-hand transactions; and
- f inadequate treatment of extraordinary events and unforeseen obsolescence.

10 Conference participants confirmed that one problem in valuing capital stock was determining asset lives. A number of other parameters were seen as affecting the level of capital stock, such as the type of survival function used.

11 Difficulties in determining asset lives centred around the high cost and respondent load associated with obtaining and maintaining good measures. The conference recognised that this was further complicated by significant differences between countries affecting asset service lives, such as climate and culture, necessitating each country individually determining asset lives appropriate for its own environment. Concern was expressed about the increasing reliance on OECD estimates which, in turn, were largely dependent on 'second-hand' estimation

methods used (and reported) by individual member countries. This inevitably affected the accuracy of the estimates of capital stock.

12 A number of countries indicated that they were currently measuring declining asset service lives. The meeting's attention was drawn to the importance of being able to distinguish between actual decline in asset service life for individual types of assets and the decline of average service lives caused by the changing composition of assets in order to accurately estimate capital growth. Apart from the standard factors affecting asset service lives, such as durability and obsolescence, new factors were increasingly likely to impact, such as environmental legislation, which could effectively accelerate the obsolescence of some asset types. Research in determining the cause of declining average asset service lives was not yet extensive.

13 It was suggested that a suitable alternative to obtaining asset service lives directly was to use age-price profiles to estimate them. A collection strategy would need to be developed to pursue this approach.

14 The OECD provided the meeting with background on its use of capital stock estimates, particularly the use in comparisons of performance and capital output ratios between countries. As such, the OECD was encouraging comparability between capital stock estimates, indicating that accuracy of estimates, rather than standardisation of methodologies was the priority in the short term. Several delegates commented on the problems that were arising as a result of international comparisons being based on country estimates derived from differing methodologies, and stated that these issues could not be discounted.

15 Several countries reported future developments under consideration aimed at improving the quality of their capital stock series. There was wide recognition of the need for a firmer basis to underpin the assumptions on asset service lives and active consideration was being given by a number of countries to the development of direct surveys of businesses to obtain relevant data which would provide reliable benchmarks. Other future developments reported included extension of the asset types covered and the adoption of chain volume indexes.

ITEM 4: CONCEPTS OF CAPITAL

16 This session of the conference was devoted to a discussion of alternative concepts of capital stock and their relationships to the flows of services contributed by fixed capital assets to production. The discussion was centred on four papers: namely, those by Peter Hill, Jack Triplett, Michael Harper and Derek Blades. This section of the report is intended to provide a synthesis of the main points emerging from the papers and the discussion.

Capital Stock Concepts in National Accounts and Productivity Analysis

17 Although there may appear to be some conflict between the concepts of capital required by different users of capital stock data, it became clear from the papers and subsequent discussions that this conflict is largely illusory as the various concepts of capital needed for productivity analysis and national accounts are fully consistent with each other from the point of view of economic theory and can all be linked to each other within a common theoretical framework. However, the nature of the theoretical interrelationships between the various concepts does not seem to be widely understood by many compilers and users of capital stock data. This may give rise to unnecessary disputes over the validity of the various concepts.

18 A consensus was reached that the best way in which to address these issues is to start with the flows of services contributed by fixed assets to production and then to examine how measures of capital stock and capital consumption, or depreciation, are related to these flows. The papers by Triplett, Harper, Hill and Blades all adopt this same basic approach although they emphasise different aspects of the underlying relationships. The same approach is also used in the 1993 SNA.

Flows of capital services

19 A 'capital service' is to be understood as the input into a process of production provided by a fixed capital asset. It is the contribution that the asset makes to the production. Fixed assets may be viewed as providing flows of these services during a given accounting period. In practice, however, it is difficult to observe and measure the quantities of these services directly.

20 It is also not easy to value the flow of services directly. In the usual case in which the producer who uses the asset is also its owner there are no transactions in the services and no prices available for them, the services being, in effect, provided for own consumption.

21 Fixed assets may be rented or leased on the market, however, so that market rentals should provide information about the value of the capital services. After deducting the operating costs incurred by the lessor, the resulting 'pure' rentals should provide estimates of the values of the capital services consumed by the lessee who uses the asset in production. The pure rentals need to be sufficient to cover not only the economic depreciation (or capital consumption) on the asset but also the lessor's interest (or capital) costs. (The measurement of economic depreciation will be explained later.)

22 Putting on one side for the moment the practical difficulties of estimation, the basic ideas up to this point may be summarised by introducing the following notation:

$$\begin{aligned} \text{Let } q_t &= \text{ the quantity of the capital service provided by an asset in a given} \\ &\quad \text{period,} \\ p_t &= \text{ the price of the capital service,} \\ f_t &= \text{ the value of the service} = p_t q_t \end{aligned} \quad (1)$$

23 In a production function relating the quantity of output to the quantities of inputs of various kinds -- intermediate inputs, labour and capital goods -- q_t measures the capital input by definition. It is a flow and not a stock variable. The asset itself is not the input. The distinction between the quantity of an asset and the quantity of the capital service provided by that asset is fundamental for productivity analysis. This point is stressed in the papers by Triplett and Harper. As just noted, p_t , the price of the capital service can be equated with pure rental price in a competitive market. The next step is to examine how the q 's may be expected to behave over the life of a capital good or fixed asset.

Rate of decline in the efficiency of an asset

24 In general, the quantity of services provided by an asset may be expected either to remain constant from period to period or to decline as the asset gets older. The service falls to zero when the asset is retired or scrapped. The sequence of quantities of services provided by the asset over its service life shows the rate at which the efficiency of the asset declines. It is often described as the 'age efficiency profile'. The shapes of these profiles are extremely important.

25 There are various possibilities: for example,
(1) the flow of services remains constant until the asset disintegrates;
(2) the flow of services declines at a constant linear rate;
(3) the flow of services declines at a constant geometric rate;
(4) the flow of services declines slowly at first and then at an accelerating rate.

26 One of the main conclusions of the conference was that much more information is needed on rates of decline in efficiency for different kinds of assets as they are crucial both for productivity analysis and capital stock measurement. These points are elaborated in the papers by Triplett and Harper.

27 In order to know the total quantity of services provided by an asset over its working life it is obviously not sufficient simply to know the length of life of the asset as the shape of the age efficiency profile is equally important. This information is also essential for the correct measurement of the capital stock in national accounts.

28 For simplicity, it will now be assumed that prices of the services remain constant in the future so that for any given asset the profile of the *values* of the service flows, i.e., the f 's as defined above, is the same as that for the quantities of services, the q 's. In other words, the values of the services decline at the same

rates as the quantities.

Valuation of fixed assets

29 The value of a fixed asset is determined by its usefulness in production: that is, by the value of the flow of capital services it provides. More precisely, the value of a fixed asset at any given moment of time is given by the present (i.e., discounted) value of the flow of remaining services that the asset will provide over the rest of its remaining service life. This method of valuation, based on standard economic principles, is used in all four papers referred to above. It is also used in the SNA.

30 Let v_t denote the value of a fixed asset at the start of period t . Then,

$$\begin{aligned}
 v_t &= \sum_{i=t}^n (p_i q_i) / (1+r)^{i-t+1} \\
 &= \sum_{i=t}^n f_i / (1+r)^{i-t+1} \quad (2)
 \end{aligned}$$

where r is the rate of interest. This fundamental capital theory equation shows explicitly the links between the flows of capital services needed for productivity analysis and the values of the associated assets that are used in national accounts. The v_t 's are the appropriate values to be recorded in the balance sheets of the SNA (see paras. 6.181 to 6.183 of the 1993 SNA).

Depreciation, or consumption of fixed capital

31 Capital consumption in national accounts is the same as economic depreciation. It is defined as the decline in the value of the asset over the accounting period as a result of its use in production, assuming the asset is valued at any moment of time by the present value of the remaining stream of services. The decline in the value of the asset can be deduced from equation (2) above, providing there is no inflation or deflation or other reasons for revaluations, as follows:

$$v_t = \frac{f_t}{1+r} + \frac{f_{t+1}}{(1+r)^2} + \frac{f_{t+2}}{(1+r)^3} + \dots \quad (3)$$

$$v_{t+1} = \frac{f_{t+1}}{1+r} + \frac{f_{t+2}}{(1+r)^2} + \dots$$

$$v_t = \frac{f_t}{1+r} + \frac{v_{t+1}}{1+r} \quad (4)$$

$$d_t = v_t - v_{t+1} = f_t - rv_t \quad (5)$$

32 It follows that economic depreciation, d_t , is equal to f_t , the value of the capital services provided by the asset during period t , **minus** the term rv_t . This is one point on which there is often confusion. Depreciation is **not** the same as the value of the capital services contributed to production during the period in question. It is always less than the value of the capital services.

33 The term rv_t measures the return to the owner of the asset. In equilibrium, it also equals the interest (or capital) cost of holding the asset. Thus, the value of the service has not only to cover depreciation but provide a return to the owner of the asset sufficient to cover the interest cost. This is exactly what the pure rental must do in a market situation.

34 The advantage of (5) is that it shows explicitly the relationship between depreciation and the value of the service flow. In particular, it can be used to deduce how depreciation varies over the life of the asset in relation to the variation in the flow of services. Just as depreciation is not equal to the value of service in any given period, so the *rate at which the value of the asset declines (which determines depreciation)* is **not** the same as the rate at which the efficiency of the asset declines. There is probably more confusion on this point than any other.

35 It is useful to clarify how depreciation behaves in the case of each of the four possible rates of decline in efficiency considered above.

- (1) A constant flow of services implies that depreciation is increasing over the life of the asset. If f_t in (5) is constant from period to period, depreciation increases from period to period as the value of the asset, v_t , and hence the term rv_t , gradually decreases over the life of the asset.
- (2) Linearly declining flows of services may be consistent with either increasing or decreasing depreciation. To obtain constant, i.e., straight line depreciation, it can be deduced from (5) that the service flows must decline at a linear rate up to some point when the asset disintegrates: the services stop before they decline to zero.

- (3) If the service flows decline geometrically at a constant rate, say $x\%$ per period, it can be shown that the value of the asset and the value of depreciation also decline at $x\%$ and that depreciation in each period is also equal to $x\%$ of the value of the asset at the beginning of that period. This is very convenient mathematically but not necessarily always very realistic. Notice also that depreciation is not equal to the value of the service flow, even in this special case.
- (4) If the services decline slowly at first and then decline at an accelerating rate, depreciation may sometimes be not very different from straightline but the exact profile of depreciation depends on the exact profile of the services.

36 The main conclusion to be emphasised at this point is that the rate at which the value of an asset declines over its lifetime is not the same as the rate of decline in efficiency even though the rate of decline in the asset value obviously depends on the rate of decline of efficiency. As just noted, however, the two rates can coincide in the special case in which the rate of decline in efficiency is geometric, or exponential. This coincidence, while convenient for some economic purposes, may perhaps have led to some confusion in so far as it may have led some people to conclude that the two rates are always the same, or at least that there will not be much difference between them. In practice, the two rates may diverge substantially.

Alternative Capital Stock Measures

37 After the issues discussed above had been clarified, the conference recognised that three measures of capital stock could be distinguished and not just the traditional gross and net capital stock measures compiled in national accounts.

Gross Capital Stock

38 This is conceptually the easiest to understand and may be a necessary first step in the calculation of the other two capital stock measures. The gross capital stock is obtained by valuing each asset still in use at the current price of a new asset of the same type, irrespective of the age of the asset. All assets of the same type are valued equally as if they were all new, no matter how many years they have been used. The gross capital stock seems to be the least useful of the three stock measures for analytic purposes.

39 Having valued all assets at their estimated current prices if they were new, there are two ways to proceed, one of which leads to the productive capital stock and the other to the net capital stock.

Productive Capital Stock

40 Suppose all fixed assets still in use in production are valued as new at their current prices in the way just indicated. (It is not being suggested that this is easy, of course, but it is necessary to focus on conceptual rather than practical issues here.) If we are interested in their productive potential, as reflected by the capital services that they provide to production, the value of each asset should be written

down as it gets older in accordance with the rate of decline in its efficiency. For example, if an asset provides a constant flow of services until it disintegrates its *productive* value does not get written down at all until it disintegrates. If the services decline at a constant rate throughout its life, then halfway through its life its *productive* value is half that of a new asset. (At the risk of some repetition, it is worth noting that this case is not the straightline depreciation.)

41 The productive capital stock is aggregated from the productive values of all the assets in the stock calculated in the way just described, using service price weights. The resulting aggregate is appropriate for productivity analysis. Except for assets of the "one-hoss shay" type, the productive value of an asset will tend to decline over its life so that the aggregate value of the productive capital stock may be substantially lower than that of the gross capital stock. This is another point on which there may be some confusion as the gross stock may be mistaken for the productive stock by some analysts. Of course, if all the assets in existence were one-hoss shays, the value of the productive stock would be equal to the value of the gross stock, but most assets are patently not one-hoss shays in practice.

Net Capital Stock

42 The first step, as before, is to value all fixed assets still in use in production as if new at their current prices. The value of each asset is then written off as it ages according to the rate at which its value (not efficiency) depreciates. The value of each asset is reduced by the accumulated depreciation up to that point in its life. This is equivalent to simply valuing each asset on the basis of the present value of its remaining service flows, bearing in mind that economic depreciation is defined as the decline in the present value between the beginning and end of each accounting period. As the value of an asset does not decline at the same rate as its efficiency declines, the net stock is not equal to the productive stock.

43 If markets function efficiently, the net stock measures the current market values of the assets to their owners. These values are recorded in their balance sheets. The net stock is essentially a measure of wealth rather than a measure of productive capacity.

Distinction between the three measures

44 The conference concluded that the distinction between the productive capital stock and the gross and net capital stock measures, which emerged very clearly from the four papers and discussions, was an important clarification. As this distinction does not seem to be widely understood, it was felt that it should be widely disseminated for the benefit of both compilers and users of capital stock data. Another point on which further work may be needed is what implications there may be for the production account of the SNA, a point touched upon in two of the papers.

Additional Comments on Individual Papers

45 In introducing his paper, *Concepts of Capital for Production Accounts and for Wealth Accounts: The Implications for Statistical Programs*, Jack Triplett (US Bureau of Economic Analysis) referred to debate on the measurement of the cost of

capital, particularly the interpretation of depreciation, or capital consumption. On the one hand, there were the national accounts concerns with the consumption of fixed capital in national accounts and on the other hand the productivity analysis concerns with measuring the cost of capital services in productivity analysis. He suggested that at the core of this debate was the issue of the definition of 'capital used up'. He explained that the valuation of capital used up in production was equivalent to capital consumption, but that this did not equate to a measure of the flow of services for the purposes of production accounting.

46 Estimates of change in multifactor productivity could be derived either by using parametric methods or non-parametric methods. The latter, based on fairly recent developments in index theory, had become the most common. The non-parametric approach was to form an index of the outputs and an index of the inputs and divide the latter into the former.

47 An example of a truck company managing a fleet of trucks was cited to demonstrate the concepts. The company would purchase a number of identical trucks each year for three years. Over time, the trucks would become less efficient (perhaps they would haul less per hour of use); he referred to this concept as 'output decay'. He defined 'input decay' as the increased maintenance that the vehicles would require as they aged. This loss of efficiency over time (input and output decay combined with retirements from the fleet) was termed 'deterioration'.

48 It was pointed out that there was a compatible set of needs for both production and wealth accounting. As a result, it was important to measure both the decline in efficiency and the decline in value of capital stock in order to enable full accounting for production.

49 Conference was reminded that although there was wide recognition of the need to construct reliable estimates of wealth stock and productive stock, little 'hard' data were currently available of either actual stock levels or the service lives and depreciation rates (for wealth stock) or deterioration rates (for productive stock) required for the PIM. It was suggested that this unsatisfactory situation could only be rectified by a determined effort to collect reliable data.

50 In discussing the deterioration of productive capital stock, a distinction was made between "output decay", where a capital asset no longer performed its tasks as efficiently in quality terms as it did when new, and "input decay", where more inputs were needed in the form of maintenance etc, to maintain the useful life of the asset. It was pointed out that if the flow of services from the capital stock declined geometrically over time, then consumption of fixed capital (i.e. depreciation) and both the wealth and productive capital stocks declined at the same geometric rate. It was suggested that if there was no information to the contrary, geometric decline would be an attractive option as compilers would then only need to produce one set of capital stock statistics.

51 In presenting his paper, *Depreciation in the National Accounts*, Derek Blades (OECD) explained that it attempted to resolve whether the "straight-line" or the "geometric" method was the most appropriate for measuring depreciation. He strongly advocated use of the "straight-line" method, using several tables and figures from his paper to support his argument. He concluded that, on the basis of

his analysis of the comparison between the two methods, it was unlikely that the "geometric" method would give estimates of the consumption of fixed capital that were superior to those derived by the "straight-line" method.

52 A number of conference participants were not convinced that this conclusion could be clearly demonstrated to be valid and it was pointed out that other statistical analysis, using Box-Cox transformations, had concluded that neither of the methods were entirely appropriate. However, of the two, the "geometric" method had proved to be better. It was suggested that this statistical analysis should be re-examined.

53 The discussion then centred on the merits of gross capital stock measures as against those of net capital stock and there was general agreement that gross capital stock estimates had limited value in themselves; their main purpose was to provide a basis for the calculation of consumption of fixed capital, of net capital stock and of the "productive stock" which was derived from the gross capital stock through the use of some kind of age-efficiency function. However, it was also agreed that many apparently sophisticated analysts misinterpreted the respective merits of these measures and that clarification of the issues involved would be beneficial for users.

54 In presenting his paper, *From Pleioscene to Plasticine - The Age of Capital Measurement*, Michael Ward (World Bank) addressed the fundamental reasons why it was necessary to measure capital stock. Capital stock estimates were needed for:

- factor substitution;
- total factor productivity analysis, i.e. for measuring changes in the ratio of output to relative contributions of factor inputs;
- multifactor productivity analysis, for identifying the 'quantum' (exogenous) and 'quality' (embodied or endogenous) components of factor contributions to output;
- gross output and gross capital estimates, both economy wide and by sector and industry related to employment; and
- Incremental Capital : Output (ICOR) measures, for growth analysis models and simple GDP projections.

55 He also described those aspects of output and productivity change which were of major interest. These included:

- technical efficiency change, by type of asset;
- allocative (factor shares) efficiency change, to identify the significance of higher quality in both labour and capital inputs;
- economic efficiency (costs); and
- scale economies related to output (and input) levels.

56 After reminding conference of the distinction between the concepts of stocks and flows, various methods of measuring capital input flows were discussed. One was the development of annualised capital values, approximated by depreciation; another was the use of energy consumption as a proxy. However, while the latter had some attraction in terms of data availability, it ignored environmental differences (e.g. climate) and was really only useful for manufacturing and other power-using activities; not for infrastructure like roads and bridges. Performance indicators, such as vehicle carrying capacity for roads and occupancy

for buildings, to identify the real level of services provided, could be developed to accommodate these types of asset.

57 It was further pointed out that, in pursuing conventional approaches to Total Factor Productivity (TFP)/Multi-factor Productivity (MFP) measurement, labour and capital were treated similarly but that, in fact, they were quite different variables; the first was clearly a real quantity measure reflecting annual levels of labour but the latter was essentially a value concept reflecting cumulative capital outlays. In this sense, using a rate of return vector (for different components of capital) introduced an undesirable element of "circularity".

58 In discussing the issue of leasing of assets and its treatment in the National Accounts, it was pointed out that owners (lessors) provided a service, the price for which was a form of rental which was treated in the National Accounts as a purchase of services in intermediate consumption. Hence, the gross value added of the user (lessee) was less than it would be if the asset were owned by the user. In the "real world", with increasing functional specialisation, leasing arrangements were becoming more common. Some repair and maintenance costs showed up in intermediate consumption but others did not. It could be argued that since the asset owners were in the business of providing the asset services themselves these costs should be attributed to them. There was a market element in leasing; the price of rental was not simply the price of capital services - it also covered interest charges, maintenance expenses and profit. On the other hand, rented or leased equipment might be used more intensively and thus effectively "purchased" by the lessee more cheaply than would be the case if the ownership option were adopted.

59 The Chairman said that the Conference had taken a big step forward in addressing several interdependent complex conceptual issues. Further open discussion was needed to draw the related conceptual issues into a coherent framework. This would ultimately lead to an improvement in the interpretation of the measures used and provide a firmer basis for the compilation of capital stock estimates.

ITEM 5: PIM - PRACTICE AND PROBLEMS

Mortality and survival functions

60. Derek Blades (OECD) presented the paper, *Mortality and Survival Functions*, originally published as Chapter 3 of 'Methods Used by OECD Countries to Measure Stocks of Fixed Capital'. He described four main types of mortality and survival functions - linear, delayed linear, bell shaped and simultaneous exit.

61 The simplest survival function was the simultaneous exit, (i.e. where all assets of a given age were removed from capital stock at the end of the average asset service life). Few countries currently used this method.

62 The linear survival function represented a constant removal of assets from the capital stock starting immediately after installation. Delayed linear survival differed in that removal was delayed, (e.g. commencing five years following installation).

63 The final survival function was the bell shaped function which assumed that asset retirements occurred at a slow rate initially and gradually speeded up, reaching a peak at the mean service life. The retirement rate then slowed gradually. The Winfrey S3 curve was an example of a bell shaped function.

64 During discussion it was suggested that there was a fifth survival function, geometric. However, it was pointed out that while this function had occasionally been used on an experimental basis, it was not currently used by any OECD country for its capital stock estimates. It was suggested that use could be made of installation dates collected in surveys in estimating both the type of survival distribution and the asset service life. It was also pointed out that if the PIM estimates could be matched with data directly collected, exact service lives could be determined.

65 Conference was advised that the OECD was encouraging countries to improve estimates of asset service lives. Either the bell shaped or delayed linear survival functions appeared to be the most plausible assumptions to be used. As final capital stock estimates compiled using PIM were relatively insensitive to either of these functions, there was little to be gained from conducting further empirical research in this area. One option to improve asset service life estimates would be to collect more information from producers of assets than was currently the case, rather than concentrating entirely on obtaining data from owners/users of assets.

66 Finally, the impact of increased utilisation of assets on asset service lives was discussed. An example was given of implementation of twenty-four hour shifts. The conference agreed that this was an important issue on which little empirical research had been undertaken to date, and that more could be done on this topic.

Practices and problems with the PIM method in the UK

67 In his presentation of the paper, *The Use of the Perpetual Inventory Method in the UK; Practices and Problems*, Graham Jenkinson (UK Office for National Statistics) concentrated on key developments shortly to be made in the UK's use of

PIM, following recent investigations into a number of apparent problems associated with its use. In particular it was felt that the reasons for apparently falling asset service lives were being misunderstood. Arbitrary cuts, of 25% to asset service lives (except for motor vehicles) had been made in the mid 1970's (phased in over 20 years) in a crude attempt to address the problem. This had since been seen as an over simple procedure attempting to account for a number of changes to the structure of capital that were better taken account of in other ways. Also the phased reduction in asset lives had the effect of depressing the growth in capital stock.

68 The investigations indicated a need to allow for special treatment of assets held by insolvent businesses, an increasing phenomenon in recent years. As a result it would be assumed in future that, upon liquidation, 50% of plant and equipment in manufacturing industries would be scrapped, with the remaining 50% sold on the second hand market. For non-manufacturing industries 25% would be scrapped. All motor vehicles and buildings would be assumed to be sold. The research also indicated a need to create two new asset categories to cope with the shorter asset lives of computers (4 years in future) and computer controlled equipment.

69 It was envisaged that adoption of these measures would initially reduce overall capital stock estimates by about 4% (up to 20% for some manufacturing industries) but that the extent of this reduction would become more significant as goods in the new asset types reached the end of their service lives.

70 While these improvements had been introduced in response to criticisms of the effectiveness of PIM they were not seen as a permanent solution. PIM depended on assumptions which, to be valid, needed to be responsive to the operating environment. The UK was considering selective direct collection of data to support PIM.

71 Conference participants discussed other reasons for premature retirement, apart from insolvency. However, it appeared that lack of data was a problem in adequately incorporating them in any model. The adjustments based on insolvency rates could be considered to be a proxy for all premature scrapping caused by the economic cycle.

72 In considering the distribution of prematurely retired assets the question of the adequacy of the current treatment of installation costs was raised. This led to a general discussion of the treatment of transfer costs, such as real estate transfer expenses, which did not enhance the value of an asset (e.g. agents' fees, taxes). Some reservations were expressed about their current treatment (as gross fixed capital formation) in the SNA as it was difficult to view such expenses as assets in the balance sheet.

73 It was also pointed out that transfers from the business to the household sector were frequently involved in the case of disposals of assets from companies liquidated. Some doubt was expressed about the adequacy of the treatment of such inter-sectoral transfers.

Computer prices adjusted for quality change

74 In presenting his paper, *Computer Prices: How Good is the Quality Adjustment?*, Paul McCarthy (OECD) said that its purpose was to stimulate the interest of those with appropriate experience to empirically investigate the variety of issues introduced. Compiling a reliable price index for computers had for many years been a very difficult task because of large falls in the prices of computers in conjunction with large improvements in their quality. The traditional "matched model" method of adjusting price indexes for quality change involved pricing the old and new models in the same period and assuming that any difference in price reflected different quality levels. For computers this method was inappropriate because, typically, new models were both significantly cheaper and of higher quality.

75 For motor vehicles, where a similar situation existed but to a lesser degree, adjustments could be made on the basis of price data from manufacturers on the quality effects of change between models, but this practice was only acceptable where quality changes were not large over time. A different method was needed for computers.

76 In the mid 1980's BEA and IBM produced hedonic price indexes for computers, based on their major characteristics (such as speed, memory and hard disk capacity). Use of these indexes revealed rapid and significant price falls (halving within 6 years). These indexes (adjusted for changes in the \$A/\$US exchange rate) were introduced into the Australian National Accounts (ANA) in 1988 as the deflators used to obtain constant price estimates of computers. While they did not necessarily ensure absolute accuracy, the results from this process were considered to be much better than previously. The effect on the ANA had been significant. However, in more recent years concerns had arisen within the ABS about the way in which computers had driven investment growth and the question of the need for further refinement had been raised.

77 Given that software prices were not explicitly taken into account in the hedonic approach to pricing computers, the implication is that software prices and quality were assumed to have changed in line with those for hardware. In the 1970s and 1980s, when software development occurred rapidly, this may have been a reasonable assumption but it was felt that this was no longer the case because software developments during the past 6 years had probably been more marginal in terms of quality improvement. Indeed, some of the changes had the effect of occupying much of the increased capacity of the hardware (e.g. speed, memory). Another point to consider was the extent to which software upgrades were being used as a marketing strategy to stimulate demand. The implication of this was that the quality-adjusted falls in computer prices had overstated the real situation for the hardware/software package (leading to overstatement in the Capital Stock estimates). However, the impact of completely new software (as distinct from upgrades) could well be more like that of hardware. This would require empirical investigation.

78 The impact of computer quality adjustment would differ between countries depending on the extent to which they were producers or importers of computer equipment. The impact in Australia (described in paras 22-29 of the McCarthy paper) was non-trivial, particularly since 1990 when most divergence between hardware and software prices was likely to have occurred.

79 Several issues were raised in the discussion of this topic, including the extent to which the consumption by complex software of a large proportion of the increased growth of hardware capacity was perceived to be an overall quality improvement (e.g. in terms of user-friendliness) or of little (or negative) benefit (e.g. slower response times) and the reasons why many purchasers chose to upgrade with new equipment (often with features they would not use), before they needed to (e.g. to guard against premature obsolescence and to maintain contact with other purchasers of the latest models).

80 It was suggested that future investigations would need to look beyond computers and address other features of rapidly changing technology such as Scanners, World Wide Web, Internet, and a large array of telecommunications equipment. Another suggestion was that the total cost of computation (including all forms of associated hardware, software communications features and people) should be examined. It was also suggested that there could well be merit in subjecting other kinds of capital undergoing rapid technological change (e.g. specialised mining equipment) to similar intensive scrutiny.

81 Further, in recognition of the extension of the SNA capital boundary to include computer software, it was noted that software price indexes would need to be developed and applied by countries in the course of implementing the 1993 SNA. Because there was insufficient time for a full discussion of the issues of deflation of high technology capital and of software investment, it was suggested that these issues should be reviewed at a later meeting.

ITEM 6: ALTERNATIVE APPROACHES

The Netherlands' direct collection experience

82 In his presentation, which referred to three papers prepared by Statistics Netherlands (*How to Measure Tangible Capital Stock; Disinvestments; and Statistics on Tangible Capital Stock - Direct Observations at Statistics Netherlands*), Bert Verlinden described the direct collection methods currently used in the Netherlands to obtain data on Capital Stock in the manufacturing industry. Three related surveys of enterprises were involved; the annual Investment and Disinvestment Surveys and the quinquennial (from the respondents viewpoint) Survey on Tangible Capital Stock. The first two of these were mail surveys, but interviewers (using lap-top computers) were needed for the third. About 1,500 enterprises with 100 or more employees were interviewed once every five years to obtain data not only on capital stock, but also on investment and disposals in the preceding year. Between the five yearly interviews the data were updated annually using the benchmark capital stock data and adding the investments data and subtracting the disposals. Employment size was used as a basis for raising the data on non-responding units and for smaller enterprises not included in the surveys.

83 One feature of the Investment Survey was that, in addition to data on purchases of capital goods, it collected information on the acquisition of capital through leasing and rental arrangements (financial leases were treated the same way as ownership). In the Disinvestment Survey respondents had to report the purchase price and year of purchase (including for goods obtained second-hand) for each asset disposal.

84 In the Survey on Tangible Capital Stock, data were obtained for eight categories of capital. Adjustments were made for inter-industry transfers. Three full-time interviewers were needed for the survey, involving visits to about 300 enterprises each year. The total annual cost of this survey was about 650,000 Dutch guilders.

85 A case study of the paper and paper board industry compared data derived by updating the previous benchmark capital stock, using investment and disposals data, with those obtained by direct collection. Although, in the case study, there was little difference in the results obtained by the two methods, it was pointed out that this could be a coincidence. To prove the reliability of the method of actualising data, more analysis was needed in the coming years when more benchmark data became available.

86 During the discussion which followed, the question was raised as to whether the PIM methodology used in other countries (i.e. investment flows, estimated service lives etc) could be simulated on the Netherlands' data and compared with the 1996 benchmark data. It was pointed out that if this could be done analysts would be in a position to say which improvements contributed, and to what extent, to the improved accuracy of Netherlands data compared with earlier years (e.g. the relative contribution to improved accuracy of the Disinvestment Survey). Such a study would provide useful guidance to other countries on what approaches to adopt to improve their own measures.

Simplifying calculations in Sweden

87 Michael Wolf presented the Statistics Sweden paper, *Suggestions for Simplified Fixed Capital Stock Calculations at Statistics Sweden*. He explained that with the implementation of SNA93, more focus was now being given to measures of the wealth value of capital stock and that the current PIM used by Statistics Sweden did not adequately measure the level of fixed capital stock. Users in Sweden were demanding measures of both net and gross stock. This implied more effort on improving age-price profiles and asset service life estimates.

88 One of the main problems not addressed by the current framework was capital transfers between sectors and activities. A possible solution, if only the value of net stock were known, was to estimate the value of gross stock for the remaining life span of the stock. Another option would be to construct the gross and net stock to be added and withdrawn from the sector or activity, by using past gross fixed capital formation figures. Both options would require reclassifications for each year of the remaining life span.

89 Michael Wolf detailed several methods of calculating capital stock. He explained their advantages and disadvantages, emphasising that only one method could be used for making the corrections once and for all. He mentioned the importance of incorporating changes in capital. The impact of growth rates in relating the value of new investment to the value of discarded stock caused both some underestimation and some overestimation.

90 He urged caution in relating the simplified gross and net stock to each other, as he believed that they were not strongly related and any view that they were should not be encouraged. The difference between gross and net stock, in the theoretical sense, is accumulated capital consumption but this does not hold for the simplified method.

91 The impact of both depreciation and pricing on the calculations made at Statistics Sweden was raised, with the suggestion that these issues needed to be pursued further and not only in relation to this approach. A view was also expressed that many users did not understand the concepts of gross and net stock, and were therefore using gross stock estimates inappropriately. It was difficult to think of legitimate uses of gross stock alone but it was noted that gross stock was required to calculate consumption of fixed capital as required by the SNA.

The UK's direct collection experience

92 In introducing the paper, *An Account of the UK's Research into Direct Collection as an Alternative to the Perpetual Inventory Method*, Graham Jenkinson (UK Office for National Statistics) mentioned that the rationale for seriously investigating this approach was the UK experience with PIM. Since its introduction in the 1950s, major amendments to it had been required at about 10 yearly intervals. A pattern of periodic failure to meet user expectations appeared to have developed.

93 It was therefore decided to test the feasibility of direct collection from companies' asset registers which, in the UK, were generally kept as a separate part of business accounting systems. Over a period of 6 months, 212 visits were made

to enterprises of various sizes in most industries. While the conclusions of this study revealed that asset registers contained the necessary information (i.e. asset description, date and cost of acquisition) it was found that there was little information kept on disposals (only 15 out of 212 businesses) and that the registers of smaller companies were generally less well organised. Other problems included the use of varying value thresholds for admission to the register and the tendency to overwrite the old entry in the case of revaluations of buildings (in which case the information recorded did not refer to the whole life of the asset).

94 Following this test and discussions with providers of asset register software, which revealed that all such software packages could produce reports of assets, totalled by year of acquisition and broad asset type, a mail/phone pilot survey was conducted, involving the despatch of diskettes to 65 businesses, together with a request to provide a summary of their asset register (or, failing that, an ordered list of it or a copy of the register itself). While this pilot test was voluntary and only 45% response was achieved, its results indicated that mail collection of capital stock data was feasible.

95 Several detailed questions concerning the data obtained in the UK's feasibility studies were raised during discussion, many of which could not be authoritatively answered because of the small sample sizes involved. These included whether the asset lives obtained by this method had proved to be significantly lower than those used by PIM (they were not); whether assets acquired second-hand could be identified; and whether there was a commonly used threshold below which assets were not included on registers (£500 and £1,000 were said to be popular figures).

ITEM 7: EXPERIENCE WITH MULTI FACTOR PRODUCTIVITY

US estimation experience

96 In introducing his paper, *Estimating Capital Inputs for Productivity Measurement: An Overview of Concepts and Methods*, Michael Harper (US Bureau of Labor Statistics (BLS)) said that he recognised the confusion caused by differences in the terminology used in the capital concepts field and that his paper was an attempt to spell out very complicated technical equations. The BLS approach in measuring multi factor productivity (MFP) conformed closely with the neoclassical production model which dealt with the treatment of capital services in a production function. Several diagrams were used to illustrate the concepts used by BLS to measure capital and how they helped to determine the choices made on practical issues of empirical implementation.

97 In drawing the attention of Conference to a diagram depicting both wealth and production accounts, and showing the relationship of productivity in the process, Michael Harper stated that the real interest was in the service flows, but that not enough emphasis had been given to this issue.

98 Income issues were also discussed, particularly property income and rental prices (which in some circumstances were equal). He explained the role of rental prices as weights in multi factor productivity calculations and discussed a rental price formula that could be used. He further explained that this rental price formula was an ex-post formula.

99 Conference agreed that it was important to reach a common understanding among countries on a number of concepts relating to capital stock, including deterioration and productive capital stock. The discussion returned to the differences between gross and net capital stock. The importance of discount rates and investment weights, using geometric or hyperbolic functions was also discussed at some length.

100 The 'lemon theory' suggested that goods on the second hand market were of a lower standard (and therefore of lower productivity and value) than equivalent goods still in use, and therefore did not provide a good measure of the productivity and value of the goods still in use.

101 It was stated that longitudinal data could assist in determining age-efficiency functions. Collecting data from manufacturers of assets could also assist. In further discussing age-price profiles, it was queried whether the fall in price in the first year of asset life was consistent with price changes during the remainder of the asset life. It was agreed that more research was needed on this issue.

Use of level or flow variables

102 In presenting his paper, *How Should Capital be Represented in Studies of Total Factor Productivity*, Derek Blades (OECD) provided background on some usage of capital stock level data in multi factor productivity studies in conjunction with flow data (gross domestic product and labour). A more appropriate capital measure would be either consumption of fixed capital or capital services. In

discussing the advantages and disadvantages of each of the alternatives, the best option was considered to be capital services.

Singapore's experience

103 In introducing his paper, *Total Factor Productivity Growth in Singapore: Methodology and Trends*, Soon Teck Wong (Department of Statistics, Singapore) emphasised that his Department had only recently become involved in this field and that the work it had undertaken to date was very preliminary. Simple estimates of capital stock and labour input were used to compile TFP in Singapore without any adjustments for quality. The quality of factor inputs was known to be a significant feature in the growth of the Singapore economy and future work would attempt to estimate TFP growth by removing the effects of changes in factor input quality. The asset service lives hitherto used were considered to be too high. Three alternative assumptions for service lives were used to simulate the impact of asset service lives on TFP estimates. These simulations suggested that the estimates were not very sensitive to the changes in asset lives.

104 During the discussion of this paper it was suggested that, in view of the fact that financial and other services industries (which were large users of computers and other electronic equipment) were very important to the Singapore economy, significant improvements in the quality of the estimates were likely to result if machinery and equipment could be disaggregated so that electronic equipment with short service lives could be properly taken into account.

105 The discussion revealed that the government sector was included in the estimates, unlike the situation in many other countries. This led to a debate on the main components of the government sector, how it should be treated and what the effects of its inclusion or exclusion would be.

An economic policy perspective in Australia

106 In introducing his paper, *Australian Capital Stock Estimates as Input into Multi-factor Productivity Analysis: a 'Wages Policy' Perspective*, Owen Covick (Flinders University, Australia) pointed out that it was rather different from the other papers on multi-factor productivity because it had been prepared, not from the perspective of the compiler of statistics, but from that of the user who was concerned with economic policy development issues.

107 In particular, Owen Covick addressed the key policy question of what degree of wages growth was warranted on the basis of productivity growth, and what concepts and measures of productivity were most appropriate for resolving that question. "Average labour productivity" had been the principal focus of attention during the Accord period but, now that the Australian Government had turned away from any attempt to centrally coordinate wages growth, and the inflation target of the Reserve Bank of Australia was seen as a prime determinant for economic policy, it seemed clear that a multi-factor productivity concept would be more appropriate to address the important relationship between wages growth and productivity growth.

108 A number of key issues in the construction of a multi-factor productivity indicator were raised, including the deterioration of capital in use, price and quality

changes, and the contribution of the unincorporated sector. Owen Covick argued that the appropriateness of any measure that was developed depended crucially on the purpose for which it was used.

109 In the discussion which followed it was suggested that the issue of accounting for quality change was sufficiently important to deserve a separate session at any subsequent meeting on capital stock measurement. Other issues discussed included the difficulties associated with inclusion of the unincorporated sector, the treatment of inter sector transfers and the advantages and disadvantages of including elements of the public sector.

ITEM 8: BALANCE SHEETS

110 Pressure of other business prevented other than a brief discussion of this item for which the agenda paper was the ABS Occasional Paper, *Australian National Accounts: National Balance Sheet, 30 June 1995* (ABS Cat. No. 5241.0). John Joice (ABS) introduced the paper and subsequent discussion covered the treatment of two types of produced asset: real estate transfer costs, where it was agreed that their inclusion in the balance sheet needed reconsideration; and sub-soil assets, about which most of the discussion was concentrated.

111 The difficulty of calculating reasonable values for sub-soil assets, many of which were subject to significant price fluctuations and varying market conditions, was widely acknowledged. A further significant factor was the tendency for mining companies to effectively manage the timing of proving of new reserves so that they were available to maintain stable production levels. It was agreed that any valuations attributed to sub-soil assets needed to be interpreted very carefully and that a good appreciation of physical measures of the resources involved was also required.

ITEM 9: NEW MEASURES OF CAPITAL

112 Barbara Dunlop (ABS) introduced a set of ABS working papers, *Australian National Accounts: Implementation of SNA93 Changes to Gross Fixed Capital Formation and the Asset Boundary*, the components of which were presented by several ABS officers. These papers related to produced fixed tangible assets (livestock, speculative construction, defence expenditure and monuments); produced fixed intangible assets (mineral exploration, computer software and film originals); valuables (gold); and non-produced intangible assets. The primary concern of the papers was with the implementation of SNA93 recommendations in the Australian National Accounts, particularly with the treatment of gross fixed capital formation and the capital boundary. The changes to the Australian National Accounts as a result of SNA93 were expected to be implemented by late 1998.

113 Conference participants noted that the working papers raised interesting measurement issues. Insufficient time was available for extensive discussion, but issues raised in relation to particular asset types are set out below.

Mineral Exploration

114 Conference was advised that Australia would implement the SNA93 recommendation to treat mineral exploration (including unsuccessful mineral exploration) as gross fixed capital formation. Several conference participants reported the treatment of mineral exploration in the accounts for their own countries, with treatment varying widely. A number intended to bring their treatment in line with the recommendations of SNA93, although the practical difficulties of doing so were recognised. It was generally agreed that the most practical approach was to collect what was reported in business accounts, and that varying from this would cause data quality problems. It was also agreed that unsuccessful exploration should be capitalised and then written off in accordance with the business accounts, as for other unsuccessful capital investment. A one-year asset life for unsuccessful mineral exploration was seen as a useful expedient.

Computer Software

115 Some of the problems of treating software as an intangible fixed asset were mentioned, including differentiating between hardware and software and data collection difficulties. Another issue was whether software should more appropriately be classed as an intangible produced asset or as a tangible produced asset. It was suggested that software was definitely an intangible - the value of the software was in the development, rather than in the actual distribution of it in the market.

116 The issue of upgrades was discussed and it was suggested that these should be capitalised.

Defence Expenditure

117 Conference participants were reminded that the SNA93 recommendation was that certain types of defence expenditure, for example construction of buildings, roads, airfields, docks, transport equipment and other equipment similar to that used by civilians, were to be included in gross fixed capital formation. However, expenditure on combat hardware, including weapons, weapon delivery systems, ships, aircraft and tanks, was to be treated as intermediate consumption.

118 While Australia intended to implement this recommendation it had some reservations about doing so; Australia's preferred treatment would have been for all defence hardware to be capitalised, including combat hardware. While it could be argued that some items had a single use and were not used for production but for destruction (e.g. missiles), it was clear that combat hardware generally had a service life greater than one year, was continuously used in times of peace to provide a stream of services by way of deterrence and was productive by definition (i.e. it contributed to general government output and GDP). In addition, to counter the 'single use/destruction' argument it was pointed out that in times of war there was inconsistency in the decision to capitalise items such as airfields and docks when they could have very short life spans.

119 During discussion of this topic considerable support was expressed for the treatment preferred by Australia. However, it was recognised that the decision to capitalise at least part of defence expenditure represented a step forward. It was suggested that the issue should be raised for consideration at the Joint OECD/UN/ECE/Eurostat meeting on national accounts in June.

Speculative Construction

120 At present Australia treated all building and construction activity, including speculative, as gross fixed capital formation. However, SNA93 recommended that speculative construction be treated as work-in-progress (i.e. an addition to inventories) of the producer. Australia would continue its present treatment and not implement this recommendation mainly because of the lack of relevant data. However, because of the short-term nature of most speculative activity in Australia, this was considered to be only a minor departure from the spirit of SNA93.

121 During the discussion it was generally acknowledged that the treatment of unfinished structures was a difficult "grey" area to address, both conceptually and practically. While it was clear that gross fixed capital formation occurred when the user acquired the asset, this was based on the presumption that the asset could be used when acquired. In practice, there were a variety of contractual and financial arrangements where this was not the case and this was further complicated when the original intentions of the parties concerned changed. The treatment of long term projects and partial use of assets before their completion were seen as additional complicating factors.

122 While many Conference participants supported the Australian position on this recommendation, in the absence of a clear, unambiguous solution to the host of difficulties in this area, there was general agreement that there was no pressing need to seek to change the SNA93 recommendation.

Intangible Non-Produced Assets

123 It was pointed out that the area of intangible assets, both produced and non-produced, had raised several complex conceptual issues which had not been fully resolved by SNA93 recommendations. One of these issues was the apparent blurring of the distinction between produced and non-produced intangibles; while SNA93 classified entertainment originals as "produced" and patents as "non-produced", there was in fact little difference in the processes that created them. There could also be problems in the valuation of both types of intangible asset. For example, an artistic original (a produced intangible) and the rights to distribute it (a non-produced intangible) were treated separately by SNA93 although each would in practice be virtually worthless without the other. In addition, if both were to be valued at the discounted future stream of income, there was potential for double-counting.

124 Other issues raised concerned difficulties in the valuation of different types of internally generated non-produced intangibles (e.g. goodwill and trademarks) and the lack of a recognised accounting standard on intangible, non-produced assets.

125 During the discussion it was suggested that the double-counting issue needed to be addressed but that a practical way of avoiding it would be to value non-produced intangibles at their cost.

126 It was pointed out that the so-called intangible economy was one of 15 issues recently identified as a critical problem in economic statistics by the United Nations Statistical Commission (UNSC) and that the UK had agreed to collaborate with countries in the elaboration of the issues.

Film Originals, Own Account Production

127 Since, under SNA93, artistic originals were classified as intangible produced assets, their production was to be capitalised and reflected as an acquisition of produced assets. Australia intended to implement this recommendation using a net present value (rather than a production cost) approach. However, although the necessary data were available, this approach raised a number of issues which needed to be resolved in respect of film production on own account, the largest area of production of artistic originals in Australia.

128 Under the present value approach the future income generated from films was calculated and then discounted to obtain the present value of film income in any given year. Three charts showing the use of this method in respect of the value and consumption of fixed capital over a 5 year period for an average film, a "blockbuster" and a "flop" were presented for consideration by Conference participants.

129 Much of the discussion focused on the diagram illustrating the performance of a "blockbuster", which showed an initial period of negative consumption of fixed capital. Many Conference participants expressed serious reservations about the concept of negative consumption of capital, pointing out that it made no practical sense. It was suggested that a revaluation, rather than negative consumption of capital, was the appropriate treatment in the circumstances. Reservations were also expressed about the treatment of the problem on an individual film basis; it was argued that if it were approached on the basis of all activities of film producing businesses many of the difficulties would be avoided. It was pointed out that in the real world accounting practices in the film industry were notoriously suspect and that this, together with the difficulties inherent in predicting the performance of individual films, was the root of the problem, which would remain regardless of the SNA93 recommendation. There was support for the suggestion that the topic be raised at the Joint OECD/UN-ECE/Eurostat meeting on national accounts in June.

Livestock

130 Conference participants were reminded that SNA93 recommended the calculation of gross fixed capital formation and work in progress for livestock, a treatment which differed from the current Australian approach which did not bring livestock to account in the production account until their slaughter or export. However, Australia intended to implement the SNA93 recommendation, which would effectively move the recognition of farm animals in the accounts from the time of

their disposal to their birth and would increase GDP to the extent that some animals (e.g. dairy cows) would have an acquisition value above their slaughter value.

131 A major problem in valuing livestock was the significant extent of own account production and the scarcity of reliable data on acquisition prices. A future economic returns approach to valuation was proposed, where the returns included a disposal price. An acquisition price was then established as a function of the current disposal price. This function was described by a capital factor, the decline of which over time would be used to measure consumption of fixed capital. A chart was presented to illustrate this approach using the valuation of a dairy cow as an example.

132 In practice there were many risks and uncertainties associated with livestock production, brought about by environmental and market conditions. These affected the quality and marketability of livestock and livestock products and the intentions of producers often changed as a result. Much of the discussion centred on these difficulties and a number of assumptions on the valuations adopted at different stages of the life-cycle of various types of livestock were challenged. It was agreed that further consideration of this matter was warranted.

ITEM 10: FUTURE DIRECTIONS AND PROPOSED FUTURE WORK

133 Conference participants agreed that this Conference had addressed significant issues and had advanced the understanding of capital stock concepts. Participants discussed the need for further conference(s) to discuss capital stock issues. The opening remarks by Mr. McLennan were endorsed, particularly that a clearly defined purpose and work program were required to justify further meetings.

134 There was general agreement that there was a significant work program required to address outstanding and emerging capital stock issues. It was agreed that the results of this work could usefully be incorporated into a handbook on capital stock measurement which would cover both conceptual issues and suggested best practices in compilation of capital stock statistics. The Intersecretariat Working Group on National Accounts could be encouraged to publish such a handbook as part of its reference documentation on national accounts issues. It was further agreed that a deadline of (perhaps) end 1999 should be set for completion of such work, with publication of the handbook as soon as possible thereafter. As a by-product of this work, valuable suggestions for revisions to, and the further elaboration and development of, SNA93 might result.

135 It was agreed that focussing on the development of such a handbook would define the purpose and agenda for two further conferences of the group. Derek Blades, on behalf of the OECD, offered to provide a venue and administrative support for a further Conference in about August or September 1998. He indicated that invitations would be extended to both OECD member and non-member countries, but that facilities would limit the number of attendees to no more than fifty people. It was further agreed that, dependent on the final agenda, the organising committee should aim for a three day duration. An informal organising committee, comprising representatives of the OECD, the Australian Bureau of Statistics, Statistics Canada, the United States Bureau of Labour Statistics, Statistics Netherlands, the Department of Statistics Singapore and the Central Bureau of

Statistics Indonesia, was agreed.

136 The Russian representatives offered St. Petersburg as a venue for a third conference on capital stock measurement in 1999, if needed. The conference accepted the offers from both the OECD and Russia and extended its thanks to both for their generous offers.

137 It was noted that the report of this Conference would be an agenda item for the Joint OECD/UN-ECE/Eurostat Meeting on national accounts to be held in June. As papers for that meeting were required very soon, a draft report would be submitted to the UN-ECE shortly. Copies would also be distributed to Conference participants, whose comments would be taken into account during preparation of the final version to be tabled as a room document at the June meeting.

138 Mr. Trewin thanked all delegates for their attendance, and for their active participation. Authors of papers were also thanked for their contribution to the success of the meeting.

Australian Bureau of Statistics
July 1997

CAPITAL STOCK CONFERENCE: AGENDA

MONDAY 10 MARCH 1997

- 9.00 am - 10.00 am Registration
- Agenda Item I - Official Welcome
Chair: Dennis Trewin
Welcome Address: Bill McLennan, Australian Statistician
- Agenda Item II - Administrative Arrangements
- 10.30 am - 5.00 pm Agenda Item III - Tour de Table: Review of Country Practices
Chair: Dennis Trewin

TUESDAY 11 MARCH 1997

- 9.00 am - 12.30 pm Agenda Item IV - Concepts of Capital
Chair: Peter Hill
- 2.00 pm - 5.00 pm Agenda Item V - PIM: Practice and Problems
Chair: Michael Ward

WEDNESDAY 12 MARCH 1997

- 9.00 am - 10.30 am Agenda Item V -continued
- 11.00 am - 4.00 pm Agenda Item VI - Alternative approaches
Chair: Soon Tek Wong
- 4.00 pm - 4.30 pm Agenda Item VII - Experience with Multi Factor Productivity
Chair: Kusmadi Saleh

THURSDAY 13 MARCH 1997

- 9.00 am - 12.30 pm Agenda Item VII - continued
- 2.00 pm - 5.30 pm Agenda Item IX - New Measures of Capital
Chair: Derek Blades

FRIDAY 14 MARCH 1997

- 9.00am - 10.00am Agenda Item IX - continued
- 10.00am - 10.30am Agenda Item VIII -Balance Sheets
Chair: Derek Blades
- 10.30am - 12.00 noon Agenda Item X - International Comparability and Cooperation / Future
Work
Chair: Dennis Trewin
- 12 noon - 12.30 pm Agenda Item XI - Any Other Issues
Agenda Item XII - Close of Conference
Chair: Dennis Trewin

ATTACHMENT B

CAPITAL STOCK CONFERENCE: LIST OF PAPERS

Agenda Item	Author	Organisation
III: Tour de Table: Review of Country Practices		
German Practices in Estimating Capital Stock	Liane Ritter	Federal Statistical Office, Germany
Estimation of the Capital Stock in Norway	Steinar Todsén	Statistics Norway
Review of Country Practices - UK Contribution		UK, Office for National Statistics
Fixed Capital Stock in the Swedish National Accounts	Michael Wolf	Statistics Sweden
Estimate of Capital Stocks, Depreciation and Formation of Gross Fixed Capital in Mexico		National Inst. of Statistics, Geo. and Info. Mexico
National Wealth Survey in Korea		National Statistical Office, Korea
Australia's Methodology for Compiling Estimates of Capital Stock and Consumption of Fixed Capital		Australian Bureau of Statistics (ABS)
Computation of Capital Stock Estimates in Singapore - A Methodological Note	Soon Teck Wong & Benson Sim Soong Seng	Dept. of Statistics Singapore
Definitions and Methodology Used in Denmark for Estimating Capital Stock and Consumption of Fixed Capital	Jens Holst Jensen	Statistics Denmark

Capital Stock Measurement in New Zealand		Statistics New Zealand
Capital Stock in Argentina - Measurement and Conceptual Problems	S. Goldberg & B. Ianchilovici	Planning Secretariat, President Office of the Argentine Republic
Statistics on Tangible Capital Stock - Direct Observations at Statistics Netherlands	B Verlinden & G Meinen	Statistics Netherlands
Fixed Capital Flows and Stocks, Historical	Stewart Wells	Statistics Canada
Methods for Evaluation of Capital Stocks and Consumption of Capital Assets in Russia		State Committee of the Russian Federation on Statistics
The Measurement of Gross Domestic Fixed Capital Formation in Indonesia	Kusmadi Saleh	Central Bureau of Statistics
Estimation of the Capital Stock and Investment Matrix in Indonesia		Central Bureau of Statistics
The Capital Stock in the European Union		
Developments in Fixed Capital Stock: 1960-1995	J. W. Prinsloo & H. Smith	Eurostat South African Reserve Bank
IV: Concepts of Capital		
Concepts of Capital for Production Accounts and for Wealth Accounts: The Implications for Statistical Programs	Jack Triplett	US Bureau of Economic Analysis
From Pleioscene to Plasticine - The Age of Capital Measurement	Michael Ward	World Bank
Economic Depreciation in the SNA	Peter Hill	Consultant to ABS
Depreciation in the National Accounts	Derek Blades	OECD

V: PIM - Practice and Problems		
Mortality and Survival Functions		OECD
The Use of the Perpetual Inventory Method in the UK; Practices and Problems		UK. Office for National Statistics
Computer Prices: How good is the quality adjustment?	Paul McCarthy	OECD
VI: Alternative Approaches		
How to Measure Tangible Capital Stock?	Jim Frenken	CBS Netherlands
Disinvestments	E. Smeets & N. V.D. Hove	CBS Netherlands
Suggestions for Simplified Fixed Capital Stock Calculations at Statistics Sweden	Michael Wolf	Statistics Sweden
An Account of the UK's Research into Direct Collection as an Alternative to the Perpetual Inventory Method		UK Office For National Statistics
VII: Experience with Multi Factor Productivity		
Estimating Capital Inputs for Productivity Measurement: An Overview of Concepts and Methods	Michael Harper	US Bureau of Labor Statistics
How Should Capital be Represented in Studies of Total Factor Productivity	D. Blades & J. Meyer-zu-Schlochtern	OECD
Total Factor Productivity Growth in Singapore - Methodology and Trends	Soon Tek Wong & Benson Sim Soon Seng	Dept. of Statistics Singapore
Australian Capital Stock Estimates as an Input Into Multi-factor Productivity Analysis: a 'Wages Policy' Perspective	Owen Covick	Head of School of Economics, Flinders University of South Australia

VIII: Balance Sheets		
Australian National Accounts: National Balance Sheet, 30 June 1995 (ABS Cat. No. 5241.0)		ABS
The London Group: Aims and Functions		ABS
IX: New Measures of Capital		
Australian National Accounts: Implementation of SNA93 Changes to Gross Fixed Capital Formation and the Asset Boundary		ABS
Background Papers		
Some Peculiarities of Capital Stock Reproduction in Russia in 1992-1996		State Committee of the Russian Federation on Statistics
Depreciation in Production Analysis and in Income and Wealth Accounts: Resolution of an Old Debate	Jack Triplett	US Bureau of Economic Analysis
Productivity Measurement with Changing-Weight Indices of Outputs and Inputs	E. Dean, M. Harper, M. Sherwood	US Bureau of Labor Statistics (BLS)
Capital Input and Capital and Labour Share		BLS
The Measurement of Business Capital, Income and Performance	Erwin Diewert	University of British Columbia
Reform of the Measurement of All Aspects of Fixed Capital	Michael Jaffey	Statistics Canada
Accounting for the Use of Financial Capital as an Input in Production; with an application to multi-factor productivity change estimation	S. Keuning & T. Reininga	Statistics Netherlands
Estimation of the Capital Stock and Investment Matrix in Indonesia		Central Bureau of Statistics

ATTACHMENT C

CAPITAL STOCK CONFERENCE: LIST OF PARTICIPANTS

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**CONFERENCE ON CAPITAL STOCK MEASUREMENT
10-14 MARCH 1997**

**OPENING REMARKS BY AUSTRALIAN STATISTICIAN,
BILL McLENNAN**

It gives me great pleasure to welcome you to Australia and Canberra for this international conference on capital stock statistics hosted by the Australian Bureau of Statistics.

2 This conference has its origins in the deliberations of the 1995 United Nations Statistical Commission on the so-called "critical problems in economic statistics". I would like to speak briefly about this for two reasons:

- it will give you some background on the broader context within which your discussions will be taking place this week; and
- I think the process by which the Statistical Commission dealt with this matter is a good example of how, with a collaborative approach and goodwill on all sides, the international statistical community can fairly quickly respond to emerging statistical issues.

3 As you may know at the 1995 Statistical Commission Kathy Wallman, Chief Statistician, Office of Information and Regulatory Affairs - Office of Management and Budget, spoke about the problems emerging with key economic statistics in the United States, whether they be perceived or real. The discussion which followed at the Commission showed that the problems, to greater or lesser extents, occurred in a wide range of countries.

4 The Commission recognised that dealing with these problems which relate to the production and dissemination of timely, relevant and accurate economic indicators, as well as their interpretation and use, was crucial to the continued integrity of statistics. For this reason, a group of countries and international agencies - to become known as the "expert group on critical problems in economic statistics" - was convened to systematise the various ingredients. It reported back to the executive of the Statistical Commission in April 1996.

5 I should point out that Rob Edwards of the ABS chaired this expert group, and I have been told by Hermann Habermann, the Director of the UN Statistical Commission, that he did a good job. I know the report he and Stefan Schweinfest of the United Nations Statistical Division prepared as a result of the meeting was first class.

6 In the report, the expert group identified 14 issues and proposed courses of action on how the international statistical community might best deal with them. The executive of the Statistical Commission added a 15th issue - the so-called

"intangible economy" to the list.

7 I will not dwell in detail on the 15 issues as I understand that a copy of the paper on the topic which was presented to the 1997 Statistical Commission meeting, held about a month ago, is available as a room document. However, the 15 issues can be categorised into:

- the important statistical policy issues of integrity, transparency and public access to statistics generally, and
- particular issues in defined areas of economic statistics relating to:
 - coverage, periodicity, timeliness
 - quality and relevance

8 Capital stock measurement was one such defined area of statistics, and it is one of the areas where we in the ABS have concerns about our present practices. It was therefore opportune for the ABS to host this seminar, and I thank you for the interest and support you have given to this initiative.

9 While I cannot claim to have studied the conference papers closely, a quick scan of them indicates their very high quality and I congratulate and thank the authors. They will provide a very good basis for what I am sure will be a very useful week's discussions.

10 This brings me to the second theme that I wanted to talk about. Over the last ten years or so, we have seen the emergence of so-called "city groups" - for example, the Voorburg Group on services; the London Group on national resource accounting; the Ottawa Group on prices. These groups comprise representatives of national statistical offices and international agencies interested in sharing views and experiences aimed at advancing particular fields of statistics. This is a very healthy development. Clearly without the voluntary participation of the members of these groups we would not be able to progress as quickly as we would like in these problematic areas of statistics.

11 There are some concerns however about relying on the "city group" approach as it has emerged to date. First, questions have been raised about what countries are included in the groups. I know this is a concern in a number of our neighbouring Asian countries. There are various elements to these concerns. On the one hand are all national statistical offices with relevant experience in the field being given an opportunity to contribute? On the other hand, if the participation in such groups is limited to essentially western, industrialised countries, how relevant will the outcomes of the deliberations be to the wider cross-section of countries? These are important and sensitive issues, but I am pleased to see on this occasion there are a wide range of countries and international agencies represented here today. I think this is quite important.

12 Also valid concern has been expressed about the lack of knowledge of what is going on within these city groups and the difficulty of access to their papers and

proceedings.

13 These matters received a lot of sympathy at the Statistical Commission's last meeting in February. As a result, the UN Statistical Division has undertaken to promulgate all papers and proceedings within the international statistical community. Indeed all of the papers for this conference are being made available to UNSD. We also need to ensure that the Regional Commissions are given an opportunity to deliberate on the outcomes of the city groups.

14 This brings me to the second last point I want to make. One of the main issues you will be asked to consider during this week is to reflect on the question: "Where to from here with capital stock statistics?" We have not yet proposed any course of action beyond holding this conference. We are not averse to the formation of an interest group if it is felt that useful continuing progress could be achieved by such a group. We would be strongly opposed, however, to the formation of such a group if there was no realistic and finite agenda established and/or there was a lack of commitment by prospective participants to undertake research and development work outside of group meetings. There is also a need for a country or agency to volunteer to hold a further meeting. This matter will be picked up on Friday and I will be very interested in the outcome.

15 Finally, let me wish you well for a productive conference and a very enjoyable stay here in Canberra. We will do whatever we can to ensure that the Australian reputation for hospitality is lived up to during the week. In that respect, I think we got off to a good start last night.

16 If I don't see you before, I hope I will meet with you again at the dinner I am hosting on Thursday evening.

Thank you.

10 March 1997

ATTACHMENT E

ITEM 3: TOUR DE TABLE - REVIEW OF COUNTRY PRACTICES - SUMMARY OF COUNTRY PRACTICES

COUNTRY	BROAD METHOD	DEPRECIATION FUNCTION	SURVIVAL FUNCTION	LEVEL OF DETAIL	DATA SOURCES FOR MEAN ASSET LIVES	MEAN ASSET LIVES	TYPE OF PRICE INDEXES USED	TYPE OF VOLUME INDEXES USED
Australia	PIM	Straight line	Mainly Winfrey S3	For each institutional sector, 4 broad asset types; for each industry 2 broad asset types	Tax lives benchmarked to OECD data	Construction fixed, equipment declining by 0.5% per annum	Laspeyres at fine level of detail	Fixed-weighted
Canada	PIM	Geometric, straight line and delayed	Truncated normal	Broad sector by industry by 4 broad asset types	Direct survey supported by tax lives	Declining annually	Paasche	Fixed-weighted
Denmark	PIM, direct measurement and registers		Winfrey, with log-normal and specific functions	Sector by investment type by industry by commodity by 4 broad asset types		Generally fixed, some declining	Laspeyres	Fixed-weighted
Germany	PIM	Straight line	Gamma distribution density function	2 broad asset types by industry	Tax lives	Declining	Paascheized Laspeyres	Fixed-weighted
Indonesia	PIM	Straight line	Gaussian distribution	Sector by commodity	Tax lives, supplemented by survey data	Declining	Laspeyres	Fixed-weighted

COUNTRY	BROAD METHOD	DEPRECIATION FUNCTION	SURVIVAL FUNCTION	LEVEL OF DETAIL	DATA SOURCES FOR MEAN ASSET LIVES	MEAN ASSET LIVES	TYPE OF PRICE INDEXES USED	TYPE OF VOLUME INDEXES USED
Korea	Direct measurement	Declining balance	n.a.	Highly detailed (Economic activity sector by industry, asset type, acquisition year, ownership and user, first- and second- hand goods and region)	Tax lives	Fixed	Laspeyres	n.a.
Malaysia				Industry	Annual survey			
Mexico	PIM	Straight line	Simultaneous exit	Private sector only	Annual survey	Direct survey	Laspeyres	Fixed-weighted
Netherlands	PIM and some direct measurement	Straight line		8 asset classes by industry			Laspeyres	
New Zealand	PIM	?	-20% to +20% of mean	2 asset types by industry	OECD estimates	Fixed	Laspeyres	Fixed-weighted
Norway	PIM	Geometric	Simultaneous exit	17 asset types by industry	Mainly based on Statistics Sweden and OECD estimates		Paasche	Chained-volume
Russia	Annual census			6 asset types				
Singapore	PIM	Straight line	Simultaneous exit	7 asset types	Tax lives	Fixed		

COUNTRY	BROAD METHOD	DEPRECIATION FUNCTION	SURVIVAL FUNCTION	LEVEL OF DETAIL	DATA SOURCES FOR MEAN ASSET LIVES	MEAN ASSET LIVES	TYPE OF PRICE INDEXES USED	TYPE OF VOLUME INDEXES USED
Sweden	PIM		Winfrey		Several, modified by practices of other countries			
United Kingdom	PIM	Straight line	Delayed linear (-20% to +20% of mean)	9 asset types by industry	1950s tax allowance data with some updating	Variable	Laspeyres	Fixed-weighted
United States	PIM	Geometric	Simultaneous exit	Highly detailed	Treasury and tax lives			