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INTRODUCTION TO THE MEASUREMENT OF CAPITAL SERVICES

MEASURING CAPITAL STOCKS AND CAPITAL SERVICES

Note by the Organization for Economic Co-operation and Development¹

Summary

The measurement of consumption of fixed capital remains a key reason for capital measurement but two additional objectives have increasingly gained in importance: establishing balance sheets for economic sectors and measuring capital services for the analysis of production and productivity. The paper presents some of the main issues relating to measurement of capital stocks and capital services based on the draft version of the revised OECD Manual *Measuring Capital*, which takes account of new developments to ensure consistency with the revised System of National Accounts.

¹ Prepared by Paul Schreyer (OECD) at the invitation of the UNECE secretariat.

I. BACKGROUND

1. In 2001, the Organization for Economic Co-operation and Development (OECD) published the Manual *Measuring Capital (2001a)* to provide guidance to the concepts and practice of capital measurement. Since then, a number of developments have taken place, and most notably the revision of the 1993 System of National Accounts (SNA). The revision entailed many issues with regard to non-financial assets that also affect the original Capital Manual. The revision of the 2001 Manual takes account of new developments and to ensure consistency with the revised SNA.

2. In the past, in many statistical offices, the main purpose of measuring capital was to provide a basis for the calculation of consumption of fixed capital so that net measures could be derived in the national accounts. The measurement of consumption of fixed capital remains a key reason for capital measurement but two additional objectives have increasingly gained in importance: establishing balance sheets for economic sectors and measuring capital services for the analysis of production and productivity.

3. The main objective of the revised *Manual* is to deal with these additional objectives and to present an integrated and consistent approach towards capital measurement that encompasses different measures of capital stocks (gross, net and productive stock) alongside with the relevant measures of economic flows (investment, depreciation and capital services). The present note provides a brief overview of some of the main issues relating to capital stocks and capital services. For greater detail, the reader is referred to the draft version of the revised OECD Capital Manual.

II. CAPITAL STOCKS AND CAPITAL SERVICES

4. Many of the measurement concepts in the *Manual* reflect a fundamental *dual nature of capital* which is both *storage of wealth* and a *source of capital services* in production. In other words, there is a value or wealth side to capital and there is a volume or quantitative side to it. Depending on analytical purpose, it is either the value side in the form of the net capital stock or the volume side in the form of the productive capital stock that is the appropriate measure.

5. While the wealth and the production side of capital are different aspects that help analysing different questions, they are not independent of each other. Quite to the contrary, there is a clear link between the value of an asset and its current and future productive capacity and consistency in capital measures means taking account of this link.

A. Capital stock as a measure of wealth

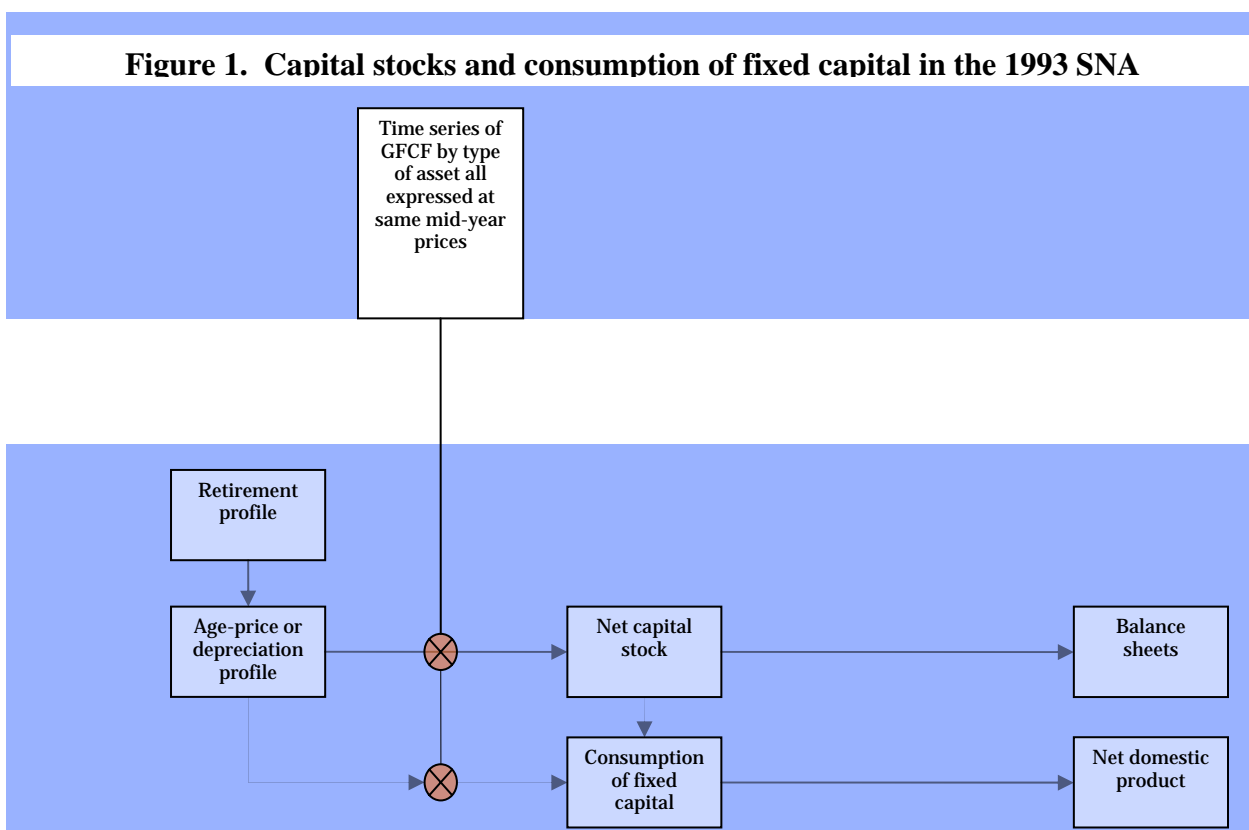
6. Capital stock features in two places in the 1993 SNA. It is needed to compile the balance sheets and it is needed to derive an estimate of consumption of fixed capital. Not all countries do compile estimates of capital stock and some use very crude methods to approximate a value of consumption of fixed capital using only flow data. However, there is no question that the SNA suggests that this is not what is recommended and there is increasing interest in having better estimates of both capital stock and consumption of fixed capital. Many of the arguments about

whether an economy is sustainable or not depend on measures of income which must exclude consumption of fixed capital.

7. How is capital stock estimated? Basically by cumulating gross fixed capital formation (GFCF) year by year and deducting retirements. Because it makes no sense to aggregate expenditures undertaken in different years without adjusting for the difference in prices between those years, all capital stock figures are in “constant prices”. These prices may be the prices of the current year, in which case past expenditures are up rated to the current price level or may be expressed at the prices of a given year, usually the one which is the base year for constant price national accounts.

8. Retirements are calculated by postulating a life length and pattern of decline in value over this time. This is called an age-price profile (see Figure 1). The relevant factor for each cohort of assets is applied so that the aggregate stock figure reflects both the chosen price level and also the fact that similar assets of different ages have different values. A further complication is that apparently similar assets of different ages often incorporate improvements as compared with earlier models. Thus adjusting for prices has to incorporate adjusting for quality change also.

9. Once net capital stock figures on a consistent basis exist for two successive years, it is possible to calculate the difference between them and after deducting new investment, this is what appears as the estimate of consumption of fixed capital as currently recommended in the SNA.



B. Capital as an input into production

10. At present, there is no explicit link between capital stock and value added except the entry of consumption of fixed capital to explain the difference between gross value added and net value added. Yet it has always been recognised that operating surplus is income deriving from the use of capital in production just as compensation of employees is income deriving from the use of labour. There is increasing interest in exploring exactly how different levels and types of capital stock influence the level of operating surplus. This has led to increased attention being paid to the (previously) academic interest in capital services because of its application to productivity studies. The aim of this paper is to show that the capital service approach can be integrated with the current SNA practice of determining consumption of fixed capital in a way which does not disrupt the present system but which allows for more insightful analysis and possible improvements in the underlying data on capital stock.

11. Whereas the introduction of costs of capital services into the accounts is of interest in itself, they should also be internally consistent with measures of the net capital stock so that the volume and price measures of capital services, depreciation and net income aggregates in the national accounts as well as balance sheets form a coherent entity. This will also allow researchers and statistical offices to produce consistent indicators of multi-factor productivity (see OECD (2001b)) which are of significant analytical interest.

12. An important statement of this interest in setting up integrated system of accounts, capital measures and productivity has recently been formulated for the United States. Jorgenson and Landefeld (2004) outlined a “Blueprint for Expanded and Integrated U.S. Accounts” where they state as their *‘first and foremost objective to make the National Income and Product Accounts (NIPAs) consistent with the accounts for productivity compiled by the Bureau of Labor Statistics and the flow of funds accounts constructed by the Federal Reserve Board. The boundaries of production, income and expenditures, accumulation and wealth accounts must be identical throughout the system in order to achieve consistency’*. Similar statements may well be true for other countries and have been made in the literature for many years.

13. If we wish to examine how capital contributes to production, we need an intermediate version of capital stock that is different from the net or wealth stock with which national accountants are familiar. The value recorded in the SNA balance sheets reflects two factors which cause the value of the asset to decline over time. One of these is that the efficiency of most assets declines over time. The second is that quite apart from a fall in price because of an efficiency decline, there is a fall in price because the useful life of the asset becomes shorter as time passes. For example a light bulb works at the same efficiency until it ceases to work at all but one would not pay the same price for an old, but still functioning light bulb as for a new one because it would not be expected to go on working for as long as the new one. If we wish to examine the contribution of an asset to production, we are only concerned with the efficiency decline and not with the effect of aging per se.

14. In order to do this we build a figure for productive capital stock by applying a parameter to each year's capital stock which reflects only the decline in efficiency. These parameters are described as age-efficiency profiles.

15. It is possible to relate age-price profiles and age-efficiency profiles to each other. Thus the two measures of capital stock we have discussed are different but entirely consistent, one reflecting a decline in value due only to a decline in efficiency and one reflecting the decline in value reflecting decline in efficiency and the effect of ageing. These are usually referred to as productive capital stock and wealth capital stock respectively.

16. For each type of asset, the volume flow of capital services is measured as the rate of change of the productive stock of the same type of asset. In other words, an assumption is made that the flow of productive capital services is proportional to the productive stock of each type of asset.

17. Along with the volume of capital services, a price of capital services has to be specified. Prices of capital services are measured as user costs per unit of capital. User costs are normally imputed prices because many capital goods are owned and used by the same economic unit. They are already known in the national accounts because in a number of countries, the housing services produced by owner-occupiers of dwellings have been measured with a user cost approach. To estimate user costs, a fictitious question is asked: how much would the owner of a capital good charge if he wanted to rent the capital good out on the market during one accounting period? This leads to two major elements that constitute the cost of using capital in production: consumption of fixed capital, and the real costs of financing capital. There are several ways of formulating these elements when it comes to measurement and they are presented in the draft text of the revised Capital Manual. Attention is paid to how the return to capital is measured, and the literature has suggested *ex-post* calculations based on observed measures of property income in the national accounts as well as *ex-ante* calculations based on information from financial markets. For many reasons, results are not identical but the general evidence appears to be one of robustness of capital service measures with regard to the specifications for the return to capital.

18. Given the price of capital services, and given the flow of capital services for each type of asset, the total volume of capital services can be calculated as a weighted average of the volume of capital services for each asset. The correct weights for this average are the share of each asset in total user costs. This total volume flow of capital services is the conceptually correct index of capital input into production and consequently also the correct measure to construct indexes of multi-factor productivity growth.

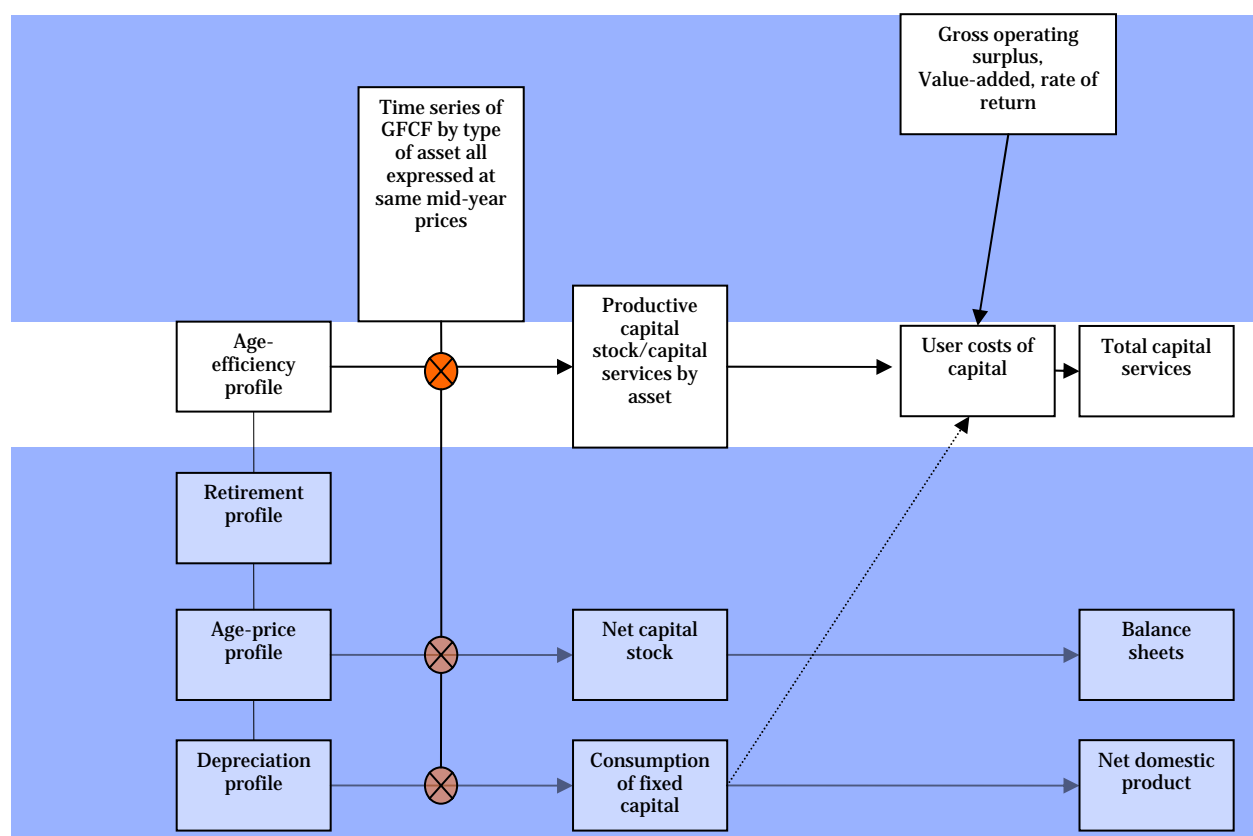
19. Figure 2 provides an overview of such an integrated framework. Starting from a set of investment data and constant-quality price indices, to which various parameters are applied, the integrated framework provides the following measures:

- (a) A set of depreciation parameters, applied to a time series of past investments (consistently valued) yields a measure for the consumption of fixed capital;
- (b) Consumption of fixed capital deducted from gross measures yields measures of net domestic product, and net value-added;

- (c) A set of age-price parameters, applied to a time series of past investments (consistently valued) yields a measure for the net capital stock;
- (d) A set of age-efficiency parameters applied to a time series of past investments (consistently valued) yields a measure for the productive stock for each type of asset;
- (e) User cost weights applied to rate of change of productive stocks yields a measure for the rate of change of capital services.

20. It is worth noting that all but the last two measures figure in the present 1993 SNA and are routinely computed by many countries. The shaded area shows those computations that are presently foreseen in the national accounts.

Figure 2. An integrated system of capital services, capital stocks and consumption of fixed capital



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