

Capital Stock Conference
March 1997
Agenda Item V

The use of the Perpetual Inventory Method in the UK; Practices and Problems

CONFERENCE ON CAPITAL STOCK - CANBERRA 1997

The Use of the Perpetual Inventory Method in the UK; Practices and Problems

Purpose of the Paper

1. The purpose of this paper is to provide a brief history of the use of the Perpetual Inventory Method (PIM) in the UK. It will describe the efforts that have been made to improve the model, and it will point out the practical limitations of a model, which, in theory, would appear to be an accurate method of measuring capital stock figures. These limitations have led to consideration of the alternative approach of direct collection which is covered in a separate paper entitled "An Account of the UK's Research into Direct Collection as an Alternative to the Perpetual Inventory Method." The main problem discussed is that of asset lives: other matters raised by this item on the agenda - deflators and depreciation functions - are covered in the brief paper under Agenda item 3; although important, they are not considered to be major areas of difficulty. Similarly, the switch of assets from one sector to another (eg privatisation) is not considered to be a problem for the UK.

The Original Perpetual Inventory Method

2. Estimates of capital stock in the UK were first produced in 1955 using a simple form of the PIM, and a series going back to 1948 was constructed. Simplicity was essential because the initial model had to be sufficiently straightforward to permit manual operation. The gross capital stock was calculated on the basis of accumulated capital expenditure less retirements; asset types were assumed to have certain fixed life spans, and were "retired" from the accumulated capital expenditure when that life span was concluded.

Sources

3. Where did the basic data come from? There was, and still is, no problem with the data on accumulated capital expenditure which was taken from capital expenditure inquiries. These estimates rest heavily upon statistics in the Annual Census of Production, the Annual Census of Construction, and on other, mostly statutory annual inquiries into the distributive and service industries. The assessment of asset lives is a different, and much more problematic area. The lives were originally based on a combination of lengths of life for accounting purposes in some parts of the public sector, and on lengths of life underlying Inland Revenue depreciation allowances. Although a number of amendments to asset lives have been made subsequently, based on the best information available at the time, it is clear that the retirement data is much less secure than that for accumulated expenditure.

The 1975 Change to the Model

4. By the mid 1970's it became clear that this model was too simple in its assumption of absolutely fixed life spans for assets. There had been an extraordinarily erratic pattern of expenditure by British industry - particularly the engineering industry - during and immediately following the Second World War. Under the simple model then in use, many of the assets acquired during these years were about to be retired

over a short period of time, and this cluster of retirements would necessarily have led to a distortion in the capital stock figures in the coming years. It was therefore decided to modify the model to phase retirements so that they would be evenly distributed over a period of years around the actual expected service life. The period chosen was from minus 20 percent to plus 20 percent of the expected life. Thus, where a group of assets of the same class is expected to have a service life of 25 years, retirements are spread evenly over a period from 20 to 30 years.

5. The principles that underlie this revised model are still in operation. It is obvious that not all assets of the same type will reach the end of their lives at exactly the same time, and, by phasing retirements, this revision to PIM not only made the time series less erratic, but also more realistic. The operation of the revised model is, of course, more complex than described in this paper, and, indeed, it would have been difficult to introduce it without computerisation. A more detailed description of the changes made and methods employed can be found in an article in *Economic Trends* for October 1975.

The Problems of PIM

6. In theory, HM should provide accurate results, but in practice it is, as with any model-based approach, only as accurate as the assumptions which underpin it. It has always been possible to collect reasonably accurate figures of capital expenditure from industry. It is not so easy to obtain accurate and current information on the life span of different classes of asset. In an ideal situation of a totally stable economy, and limited technological change, provided the initial estimate of life spans was reasonably accurate, there would be no problem with PIM. But, that type of industrial environment does not exist, and never will. In practice actual asset lives change over time, and sometimes they change very rapidly.

7. There are two main reasons:

a) Firstly a downturn in the economy leads to both voluntary and compulsory company liquidations. When a company is liquidated, it is likely that some, if not all, of its fixed assets will be prematurely scrapped. Obviously creditors try to obtain the best price for the assets of a company, but in practice this may often mean selling as scrap an asset which had many years of productive life left in it. In 1975, when the current PIM model was introduced, there were 1275 voluntary and compulsory liquidations in manufacturing industry in the UK; in 1992 the figure was 5449, and in that year the total number of liquidations for all industry was more than 24000, compared with around 5400 in 1975. Although the majority of these liquidations were likely to involve smaller companies with limited fixed assets, some larger establishments were also affected. In addition to this many large companies, during

periods of economic difficulty, close individual plants, and this too often leads to the wholesale scrapping of assets. The assumptions of asset lives which underlie PIM do not allow for such premature asset death.

b) The second phenomenon which undermines the reliability of PIM is rapid technological change. This is also unpredictable and leads to the scrapping of fixed assets earlier than would otherwise have been the case. It is much harder to quantify this, but there is no doubt that increasing and accelerating automation has occurred over the last years. This has led to the purchase of ever more sophisticated plant and equipment by industry, leading once again to unexpectedly early asset disposal.

8. The result of these changes has been, as far as we can tell, for PIM to overestimate the level of capital stock in the UK, possibly by as much as 10 percent for some industries. The scale of the error varies between asset types, but PIM appears to be most accurate in measuring capital stock in buildings, and most prone to error in measuring capital stock in plant and equipment, with computers probably the greatest problem area.

9. How, then to keep up with these changes? It is not possible to follow the original route of Inland Revenue depreciation allowances. Since PIM was first introduced, depreciation allowances have been used by successive governments as a tool to encourage capital investment, and assets are therefore written off by companies, often long before their useful lives are over. Nor is the use of a company's annual report and accounts likely to be of great assistance. Although many firms do include a breakdown of their assets in their annual report, the details given are seldom sufficient for the purpose, and where overseas assets are held, it is rare for the annual report to distinguish them from assets held in the UK.

Research by the National Institute for Economic and Social Research

10. Because of these doubts about the reliability of the estimates, and the lack of obvious data sources to correct them, the Office for National Statistics (ONS) asked the National Institute for Economic and Social Research (NIESR) to investigate the problem, and to suggest solutions. A paper² in the National Institute Economic Review summarised their findings. In brief, they confirmed the likely inaccuracy of recent PIM estimates. Their principal recommendation was that a feasibility study should be conducted to determine whether it was possible to collect capital stock data direct from industry; subject to the results of this there should be a full benchmark survey designed to establish both the value and the age of capital stock. They suggested that the benchmark should be supplemented annually by information on the capital stock that has been scrapped. Further information on how this recommendation has been pursued, is contained in a separate paper produced for this conference, and referred to above (Para 1).

11. The NIESR paper notes that the ONS had recognised the problem relating to retirements, and in 1983 had reduced the asset life assumptions for certain items of plant and machinery to three quarters of their original length, and made a similar change for buildings. Further study was, however, thought to be necessary in order to improve the current PIM estimates pending any action on direct collection. This research showed that, although there was not a general feeling among experts that the service lives of assets have been declining over time:

a) There may have been an increasing amount of investment in assets with shorter lives, in particular numerically controlled machinery and computers.

b) The effects of company deaths and closures had indeed led to the premature scrapping of assets in a way not allowed for in the PIM model.

12. The result of allowing for these factors would be a reduction of around 4 per cent in the level of gross capital stock in real terms for 1992. This relatively modest figure would however be mainly the consequence of a significant reduction for plant and machinery. There would be little change in the estimates for buildings or vehicles.

13. NIESR have also recommended that the delayed linear retirement pattern in use since 1975 be changed to a normal distribution pattern. This was because, with no clear evidence to the contrary it seemed to them reasonable to assume that a normal distribution would give a closer approximation to the pattern of retirements.

14. The ONS has been working closely with NIESR to improve the current PIM based estimates on these lines.

The Long term Reliability of PIM

15. As stated above, any model-based approach to the estimation of capital stock,

however logical it may be, is only an effective tool if the assumptions built into it are sound. Whereas data on capital expenditure can be collected from industry on a regular quarterly and annual basis, data on retirements cannot. This is not because industry does not know what it is scrapping; it is rather because the usual practice of asset managers is to destroy the records relating to an asset when it is disposed of, or, at best, shortly afterwards. Thus all information about the historic cost of an item and its date of purchase is lost.

16. This means that any model for PIM must have as its basis estimates of asset service lives which are based on indirect evidence and research. This in turn means that such estimates can only be changed after further evidence and research has taken place. In the nature of things, therefore, these assumptions are likely to be changed infrequently, and such changes will be (as in the present instance) retrospective reactions to the factors they are attempting to allow for. Future economic cycles and future changes, in either direction, of the speed of technological development will require research-based adjustments to the assumptions of asset lives.

David Mayes and Garry Young "Improving the Estimates of Capital Stock" *National Institute Economic Review*, London, February 1994

17. To sum up, whatever is done to improve the basis of the estimates produced by PIM, is only likely to provide a medium term solution, at best. In the longer term PIM is almost certain to get out of step with reality again, and further retrospective adjustments will be inevitable.

January 1997

UK, OFFICE FOR NATIONAL STATISTICS