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INTRODUCTION

Rapid growth of real income has come to be regarded as a primary aim of government and in Ireland, as in many other countries, the government has assumed an active role in development planning to achieve that aim. Development planning requires accurate information on most of the important economic variables both at industry level and for the economy as a whole. In this country labour statistics are highly developed but as is so often the case usable statistics of capital are virtually non-existent. The fact that measurement of capital is more difficult does not lessen the gravity of this gap in official statistics.

The object of this paper is to evolve operable definitions of capital for use by official statisticians. This involves firstly, deciding from theoretical considerations what aspects one ought to measure and secondly, finding out what information public and private firms can supply. The early part of the paper discusses the conceptual difficulties and attempts to provide workable definitions of capital. The middle sections discuss the results of a survey of manufacturing firms together with evidence collected from firms and organisations which provide services connected with capital equipment. It culminates in detailed proposals and recommendations to the Central Statistical Office for the extension of their Census of Industrial Production to include the measurement of capital assets.

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I. THEORETICAL CONSIDERATIONS AND OPERABLE DEFINITIONS

The task of the theoretician is to provide the economic statistician with the concepts to be measured even though official statistics never achieve what theoreticians ideally require. Indeed the art of economics consists in making best use of the data one can get rather than lamenting the unattainable.

Labour, capital and real output are familiar concepts in a general way but any attempt at precise definitions runs into difficulties. The conceptual problems inherent in the meaning of homogeneous wage labour are usually neglected with an easy conscience, man hours being taken as the measure of labour input. The problems in measuring real income are mainly statistical, namely, the impossibility of finding perfect index numbers for deflation. However, with capital one is faced with both conceptual and statistical difficulties.

Capital is an inherently difficult concept. A backward glance at the diversity of definitions offered by economists confirms this. Writing in 1884, Henry George[1] says "In general discourse, all sorts of things that have a value or will yield a return are vaguely spoken of as capital, while economic writers vary so widely that the term can hardly have a fixed meaning". After consideration of the definitions offered by a number of writers mostly of the Classical school, he concludes that Adam Smith's definition has most to commend it. Adam Smith defines capital as—"That part of a man's stock which he expects to afford him a revenue, is called his capital". He goes on to specify what the capital of a country includes:—(1) All useful machines and instruments of trade which facilitate and abridge labour, (2) buildings, such as shops, farmhouses, warehouses, granaries and workhouses—"mere dwelling houses" are excluded; (3) improvements in land which better fit it for cultivation, such as draining, enclosing, cleaning and manuring; (4) the acquired and useful abilities of inhabitants or members of society; (5) money; (6) primary products in the hands of producers and dealers from the sale of which they expect to derive a profit; (7) the material of, or partially completed articles still in the hands of the merchants or manufacturers; (8) completed articles in the hands of merchants or manufacturers. The first four of these he terms fixed capital and the last four, circulating capital.

To be consistent with modern national accounting a few amendments are necessary. Nowadays we would regard dwelling houses as part of a country's

[1]Progress and Poverty. Book I. Chapter II, pp. 21–22.

capital, the revenue attributed to them being taken as the imputed rental. "The acquired and useful abilities of the members of society" has been built up over time and will clearly produce or increase a country's income, but it is more appropriate to treat this as a qualitative aspect of labour than as part of the stock of capital. For "money" to be consistent with his definition it must be used to assist the production of revenue in the future. Subject to these qualifications Adam Smith's definition is stillausable today.[2]

All capital is accumulated out of past income by foregoing consumption in order to enjoy the benefit of increased income at a later time. Part of a flow is converted into a stock which will be used in the future with other flow variables to produce a flow of income. This paper is concerned with the measurement of fixed or tangible capital in the Transportable Goods Industries, that is, with Adam Smith's first three categories. In modern national accounting these assets are classified under the headings: plant and machinery, buildings and land, and vehicles.

Measurement of the quantity of fixed assets is complicated firstly by the diversity of fixed assets. It is not possible, except in a trivial case, to add up the number of physical units and arrive at a figure for the quantity of capital. Money measurement has to be used to overcome this heterogeneity. Which money measure should be used? A second difficulty arises from the fact that fixed assets are long lived and render their services over a period of time. Capital assets are not desired for themselves as are consumption goods but for the income which they can earn. Potential income and to some extent the cost of the machine are related to its expected length of life.

Several aspects of capital present themselves. Firstly there is the real cost of producing the equipment. One could perhaps regard price as some indication of the amount of resources diverted from consumption in order to earn income at a later date. Secondly, the asset has the potential to produce real goods or services and hence earn an amount of income in a given period. This might be termed annual capacity. It will continue to produce goods and services and so earn income throughout its life span and the value of the asset to its owner at any point in time will depend on its annual capacity and the number of years that it will continue to offer that capacity. A fourth aspect of capital usually termed depreciation is the amount of the asset's potential services which are used up in the production process in a given period.

These different concepts can be more readily appreciated by an example set up in simplified conditions. Consider a group of identical machines each manned by a single operator. The machines have a lifetime, both actual and expected, of ten years and on the last day of their tenth year their services are completely exhausted. Several simplifying assumptions can be made. All prices remain constant so that the cost of replacing a machine with an identical one is equal to the original cost. The prices of all other factors of production and the

[2]The Wealth of Nations. Book II. Chapter 1.

selling price of the commodity produced are also constant. No changes take place in the existing technology so that the most efficient combination of factors at which the firm is operating remains the same. We shall further ignore producers' time preference and assume that he is indifferent between a sum of money now and the same sum ten years later. The last assumption needed is that a machine produces with equal efficiency throughout its life-time, i.e., it can produce the same physical output with the same amount of repairs and maintenance, and with the same amount of labour handling.

In this simplified situation the physical quantity, cost, annual physical output and income are completely correlated. The cost, output and income of five machines is half that of ten machines. This correlation will hold regardless of the age of the machines since their ability to produce output and income is assumed constant throughout their lives. If we are looking for a measure of the quantity of capital which will be combined in the production process with other factors of production any of these would serve as a perfect proxy in these simplified conditions. However, if these are different kinds of machines, performing different tasks and producing different goods and services, quantity can no longer be expressed in physical terms. The cost of the assets can be taken as a proxy for quantity but the purity of the measure has been lost.

Economists describe the value of a capital asset as the discounted value of the flow of future returns. It could be written:

$$V = \frac{R_1}{(1+i)} + \frac{R_2}{(1+i)^2} + \frac{R_3}{(1+i)^3} + \cdots + \frac{R_n}{(1+i)^n}$$

Where V is the value of the assets, $R(1 \ldots n)$ is the set of expected annual returns, n is the expected length of life and i is the rate of interest on long-dated securities. Economic theory tells us that, at the margin, in perfect competition the discounted value of the flow of future returns should equal the cost of the asset. Of intra-marginal assets it says little, except that it should be greater than cost. In our simple example the value of an item of capital, say a machine, is related to the annual amount of net revenue and the number of years for which the machine will produce it. Thus ignoring prejudices against second-hand assets, removal and installation costs, making all the above assumptions and assuming a perfect market, the value of a new machine with a 10 year life will be about twice what it will be when it is 5 years old. But it requires knowledge of the expected returns in order to measure the economists' definition of value. The practical approach to this measure of capital is to express the valuation in terms of costs. The cost of a new asset will represent its value with its full life before it and half way through its life its value will be about half the original cost. What in fact is being measured is the resale value or price of an asset in a perfect market and not the economists' definition of value. The value of the machines above will decrease annually by one tenth of the original cost till at the end of the tenth year their values will be zero.

Depreciation or capital consumption as it is called in national accounting can be regarded in different ways. Economists would regard it as the cost of the input of a factor of production or perhaps as the amount of the machine's services used up during a year's production. If each machine costs £100 and has a 10 year life then the annual cost of the input of capital is £10 on a straight line basis. In the simplified example the annual cost of input is synonymous with the annual reduction in resale value.

It is now necessary to relax our assumptions, one by one, and make what adjustments may be necessary. First, assume prices are rising while still retaining all other assumptions. If all prices are changing at the same rate, i.e., the cost of machines, the prices of all other factors of production and the selling price of all commodities, then the three measures of capital will not have altered in real terms, only in money terms. If prices are rising by a simple 10 per cent per annum then the cost of replacing a machine costing £100, at the end of its ten year life will be £200. No longer can quantity be indicated by original cost. If, to a five year old machine costing £100 when new, there is added a new identical machine costing £150, quantity in real terms will be doubled but the sum of the original costs in $2\frac{1}{2}$ times the former measure of capacity. The cost of replacing the machines can be used as a measure provided we deflate with a price index when comparing one year with another. Thus the quantity of a group of four identical machines, one costing £100 at the start of year 1, another costing £120 two years later, another costing £140 after a further 2 years and a fourth costing £160 at the end of year 6 can be measured as £640 in end of year 6 prices. To compare with the quantity at the start of year 3 it is necessary to use comparable money prices so the quantity of the two machines can be expressed as £320 at the end of year 6 prices, half the quantity at the end of year 6. Between year 1 and the end of year 6 the quantity has been quadrupled.

Resale value will also be expressed in current prices. The year 1 machine will be six years old at the end of year 6, i.e. $\frac{6}{10}$ ths of its life will be exhausted. It will only provide its capacity for four more years so that its value (given all the above assumptions) will be $\frac{4}{10}$ ths that of a new, identical machine with ten years life in it. The cost of the new machine in end of year 6 prices is £160 so that the value of the 6 year old one is $\frac{4}{10} \times £160 = £64$. Similarly the value of a four year old machine at the end of year 4 will be $\frac{6}{10} \times £140 = £84$ in current prices.

Depreciation will also be based on current cost. Thus in year 1 depreciation will be about $\frac{1}{10}$th of £100 = £10, in year 2, $\frac{1}{10}$th of £110 = £11, year 6, $\frac{1}{10}$th of £150 = £15 and so on, till in year 10 it will be about £19. An accountant might tot up the individual annual depreciations and remark that the total fell considerably short of the £200 needed for replacement at the end of year 10 (even allowing for the simplifications in the calculations).[3] He would of course

[3]Basing depreciation on the prices at the start of the year instead of the average over the year causes a downward bias but it has been done for simplicity in the argument.

be forgetting the changes in the real value of money. It is not adding like to like. £10 set aside for depreciation in year 1 at current prices is equivalent in real terms to £19 set aside in year 10 at year 10 prices.

Let us leave consideration of the case where prices of capital equipment, other factors of production and the selling price of commodities are rising at different rates until the effects of technical change on the measurement of capital are discussed.

A generally accepted definition of technical change is that given by J. R. Hicks.[4] Concentrating on capital and labour he classifies inventions according to whether they increase, leave unchanged or diminish the ratio of the marginal product of capital to that of labour. Labour saving inventions increase the marginal product of capital more than the marginal product of labour; neutral inventions increase them in the same proportions; and capital saving inventions increase the marginal product of labour more than that of capital. In practical terms the ratio of net income to cost of input in real terms will have risen. A change in the production function can come about in a number of ways such as a change in the quality of the final product, a change in the type, or source of supply of raw materials or an improvement in the quality of the labour supply. Any of these will alter the ratio of revenue to cost, but an alteration in equipment, say as a result of an invention causing a higher level of income for the same cost, highlights the crucial problem of measurement of capital.

So far the quantity of capital has been taken as the amount of physical assets which will be combined with other factors in a production function. Taking cost as the proxy for capital implies that the quantity of capital is synonymous with the amount of factors of production used to produce the asset. In a situation where technology is changing, this concept is no longer capable of distinguishing between different levels of productive potential. If a new machine is produced and sold for the same real cost but has double the productive capacity one can hardly regard the "quantity" of the two machines as identical because it required the same amount of physical inputs to produce them. Remembering that capital is desired, not for its own sake, but for the income which can be earned by its use it is clearly essential to incorporate potential income in the measure of quantity. The current cost of replacing existing income earning potential will be used as the proxy for the quantity of capital. If this measure is termed replacement cost and defined as the current cost of replacing the capacity to produce net income[5] it can effectively take account of changing technology, changing prices or a changed combination of factors. It is a hybrid but it measures an understandable concept of capital which is surely more useful to the government planner than the amount of factor input concept.

[4] J. R. Hicks, The Theory of Wages pp. 121–127.

[5] Net income is defined as the difference between the revenue from the production and sale of goods, and the sum of all incidental costs incurred in employing the machine, e.g., maintenance, fuel and power, labour costs, raw materials (but excluding depreciation).

Returning to the simple example above, if the new machine produces twice as much net income as the old one, the replacement cost of the old machine will be half the current cost of the new one.

Moving into a changing price world, with prices changing at different rates, allowance for technical change can be made in a similar fashion. Let us start with a £100 machine purchased at the start of year 1 producing an annual net income of £50. Four years later a new machine comes on the market at £110 producing a net income of £84. By this time the net income of the old machine may have risen to £70, perhaps due to rising commodity prices. The current cost of replacing the existing capacity is $\frac{70}{84} \times £110 = £92$ at end of year 4 prices. By relating the capacity of the old machine to the current cost and capacity of the new one the replacement cost of the old machine can be calculated. Comparison of the capacity of a new machine with an existing one should be possible in principle for many types of fixed assets. Physical output, the amount of labour and materials required and running costs are details which are usually available and are often published in the sales literature for new machines.

Assuming that the technical change is thought to be a "once and for all" improvement and retaining the assumption about second-hand assets, the resale value of the machine is easily calculated. If the new machine has a 10 year life as before, the same capacity for 10 years can be purchased for £92 at end of year 4 prices so that the value of the six years capacity remaining in the old machine is $\frac{6}{10} \times £92 = £55$. If, however, the new machine has a 12 year life then the resale value of the old machine will have declined still further. Its resale value or written down replacement cost will be $\frac{6}{12} \times £92 = £46$.

Annual depreciation is again based on current cost, i.e. replacement cost. With a ten year life, $\frac{1}{10}$th of the replacement cost will be used up in any year. Thus depreciation will be about $\frac{1}{10}$th of £92 in year 5, i.e. £9 at current prices.

So far, only the assumptions about prices and technology have been relaxed. It is often argued that the efficiency of machines declines throughout their life. If repairs and maintenance increase and output falls off with age then net income will decline. Consequently the machines' replacement cost at constant prices is decreasing over time and the resale value will fall faster than age alone would warrant. Evidence will be produced later which suggests that the problem of declining efficiency with age is not important over most of the life-time of plant and machinery. In fact, in many cases an improvement element in repairs may actually increase capacity.

Introducing time preference does not affect the capacity of a machine but it will alter the value. The further into the future the lower will be the present day value of the annual returns. In a simple example with all assumptions in operation the resale value of a five-year-old machine was half the cost of a similar new one with a ten year life. If time preference is admitted the discounted value of the returns from the five year old machine will be greater than half

that for the new machine. So the resale value will decrease more slowly when account is taken of time preference.

Resale value has been discussed up to now as if all assets were sold in a perfect market. Installation and removal costs, prejudices against second hand machinery and related problems have all been assumed away. In the real world the absence of a perfect market is likely to substantially reduce the price at which a second hand machine can be sold below that indicated by age, condition and the state of technology.

The above example has been couched in terms of machines deliberately to highlight the concepts involved. Buildings, vehicles and the several forms of liquid capital all possess similar characteristics but perhaps in a less obvious form and they often complement one another to such an extent that it is difficult if not impossible to attribute specific income to any of them separately.

Buildings are a longer-lived form of fixed capital than plant and machinery and because of the nature of the service provided by a building it is more difficult to describe capacity in terms of output or net revenue. Possible indicators of capacity might be imputed rental, floor space or cubic storage capacity. The use of these indicators is largely vindicated by the fact that technical change is not an important factor with building capacity. Their long life tends to create a problem in valuation and calculation of depreciation. The life span of a building, possibly 150 to 200 years, is well beyond the time horizon of most firms so that during the first half of a building's life its resale value is not likely to alter with age. Only when the end of a building's life or a substantial amount of expenditure on repairs appears on the firm's time horizon will the age of a building greatly affect its resale price. The condition of a building and its location are better guides to price than its age.

Vehicles have a shorter life than most forms of plant and machinery and because of the existence of an active and sensitive second hand market, and their mobility the period of retention is usually much less than their lengths of life. It might be possible to measure capacity as loading capacity for commercial vehicles and as passenger seating or horse power in private cars. Neither measure is perfect, for changes in vehicles tend to evolve gradually and are often concerned with mechanical efficiency and passenger comfort. The second hand market readily provides the value of a vehicle in terms of resale price and depreciation can be calculated from this.

What has been said so far about the concepts of capital and the variables used as their indicators should be sufficient to suggest that the measurements will be less than perfect. Realising this, one must look for the best approach to the problems of estimation and be content to admit to margins of possible error much greater than would be permitted for labour or output. Most countries which publish official statistics on capital have measures of gross capital stock and capital consumption. Gross stock is usually found by summing annual capital expenditures less the value of assets retired, at constant prices, over the estimated lengths of life of the assets. Estimated lengths of life have been

attributed to individual categories of assets and for these capital consumption is calculated and then totalled. Net capital stock, though usually not published with official statistics, can be found by deducting accrued depreciation on all existing assets from gross capital stock.

These macro-measures correspond to our micro-measures of replacement cost, depreciation and resale value. How closely they correspond depends crucially on the price indices used to deflate capital expenditures to constant prices. An index for a specific type of asset may be sufficiently sophisticated to take account of technical change but general indices of capital do not possess these qualitative refinements. Indices of capital are usually based on prices of raw materials and wage rates and take little or no account of technical improvements. If innovation enables the production of a machine at the same real cost with an increased capacity then unfortunately gross capital stock will not normally pick up that part of the increase in the production potential due to technical improvement. In any year gross capital stock at that year's prices will over-estimate the cost of replacing existing capacity with new assets. The value of assets in a perfect market will also be less than net capital stock. Gross capital stock has the same deficiency as the straightforward cost concept which was used in the static technology situation above. When gross capital stock is used in practice it usually has to be accompanied by a productivity index which, in a crude way, compensates to some extent for the deficiency in the capital measure.

The procedure of adding successive years capital expenditures at constant prices to calculate gross capital stock and capital consumption is known as the perpetual inventory method. It was pioneered by R. W. Goldsmith[6] in the U.S.A. and later applied to United Kingdom data by Philip Redfern.[7] Some years later in the light of improved estimates of early capital expenditure[8], Geoffrey Dean published a paper entitled "The Stock of Fixed Capital in the United Kingdom in 1961".[9] Dean's estimates received official recognition and have, since 1964, been published in the National Income and Expenditure Blue Book.[10]

The main alternative to the perpetual inventory method is the capital census. This direct method of measurement was carried out on a sample basis for the United Kingdom by Tibor Barna.[11] He obtained fire insurance valuations from sample firms and after any necessary adjustments, took them as equivalent to

[6]A Perpetual Inventory of National Wealth, Studies in Income and Wealth, Vol. 14, published by National Bureau of Economic Research, 1951.

[7]"Net Investment in Fixed Assets in the United Kingdom 1938–1953" Journal of the Royal Statistical Society, Series A (General). Vol. 118, Part 2, 1955.

[8]Feinstein, C. H. (1965), Domestic Capital formation in the United Kingdom 1920–28. Cambridge University Press.

[9]Journal of the Royal Statistical Society, Series A (General) Vol. 127, Part 3, 1964.

[10]H.M.S.O. London.

[11]The Replacement Cost of Fixed Assets in British Manufacturing Industry n 1955. Journal of the Royal Statistical Society, Series A (General) Vol. 120. Part I, 1957.

replacement cost new. From the replacement cost figures, capital for employee was calculated and estimates for industry groups obtained by grossing up over total employment.

It will later be argued that replacement cost obtained directly from individual firms will provide a more useful indicator of the quantity of productive capital than gross capital stock obtained by the perpetual inventory method. Barna's estimates, particularly of plant and machinery, were considerably higher than Redfern's and somewhat higher than Dean's.

II. THE SURVEY

In Ireland estimates of the stock of capital have already been attempted. Edward Nevin[12] used a variation of the perpetual inventory method to estimate the net stock of capital and capital consumption in Irish Manufacturing Industry. The present writer made similar estimates for Northern Ireland Manufacturing Industry using a further variation of that method.[13] While not without interest both sets of estimates can only be regarded as estimating broad orders of magnitude. Estimates of aggregate book value of capital for the manufacturing sector have been presented by Messrs. Henry and Heenan in a paper entitled "Capital in Irish Industry".[14] Unfortunately, as will be demonstrated below, book values are economically meaningless. In that study, which was conducted as a survey from the Central Statistical Office in an attempt to produce a composite balance sheet for Irish manufacturing industry, firms were asked to state the insurance valuation of their assets as a simple additional question. These unqualified insurance values were used by Nevin in his estimates.

It was this situation which brought about the present inquiry. It was decided to contact manufacturing firms to find out about their methods of valuation, to see the type of information which they had available and try to find common ground on which estimates of the stock of capital in Irish industry could be attempted. What data do firms possess and what can they produce with the least trouble? How closely do their measures compare with the concepts discussed above? With this type of information it should be possible to find the best approach for estimating a meaningful value of the stock of manufacturing fixed assets.

The investigation, carried out in the summer of 1968, was a pilot survey of

[12]The Capital Stock of Irish Industry, Paper No. 19. ERI Nov. 1963.

[13]A Method of Estimating the Stock of Capital in Northern Ireland Manufacturing Industry; Limitations and Applications. Paper No. 44, ESRI Nov. 1968.

[14]Journal of the Statistical and Social Inquiry Society of Ireland. Vol. XXI, Part I, 1962–63, pp. 135–190.

manufacturing firms mostly in the Dublin area. Of the twenty or so firms who were approached all but one offered to co-operate and provide the necessary information. Of the others, time permitted contacting and making use of only fifteen. The firms expressed great interest in the inquiry and one was left with the impression that Irish industry felt the need for development of capital statistics.

The selection of firms was to a large extent based on the writer's ability to make personal contact with officials who had the authority necessary to reveal detailed knowledge about the firm's operations. Most firms were first contacted by private individuals of high status who generously used their connections at board level to effect introductions. While far from random choice, a degree of selection was possible and the firms chosen provide an interesting spectrum of industry. The fifteen manufacturing firms include seven public companies, six private companies and two state owned enterprises. In size they vary from some of the largest in the country with capital in millions to those with capital measured in thousands. A wide range of trades are represented varying from food and drink to engineering, mineral processing to clothing manufacture. All the firms had one thing in common; they were prepared, voluntarily, to allow an outside observer to examine their books and working methods. This characteristic, while of crucial importance in carrying out the survey, may well be indicative of bias. Firms which are prepared to reveal their activities may do so because they are efficiently run and have little to hide while less efficient firms may be reluctant to disclose their deficiencies. This problem is of course inherent in any voluntary survey and should be borne in mind before drawing general conclusions. With hindsight, it is a pity that the sample did not include some very small firms.

Having obtained broad agreement to co-operate by this "old boy" approach, interviews were arranged by telephone. At the interviews the most useful information usually came from the company accountant often in consultation with the chief engineer. They provided the opportunity to delve into many various aspects of the firms' policies which enabled a questionnaire to be tailored to suit the individual firm. Surveys which rely on a standard questionnaire only, cannot probe deeply or they may result in unreliable answers to questions which are inappropriate to particular firms. Discussion revealed how much information the firm was prepared to disclose and how much time and effort they would put into completion of the questionnaire. The information requiring most work on their part was a list of all fixed assets in existence classified according to date of purchase, original cost and length of life. In many cases the work involved was more than they could reasonably be expected to provide. So the approach was to ask for full details, then, if refused, reach agreement with the firm on what sort of information would provide the answers sought after. Sometimes this resulted in a partial list of assets or in others several large pieces of equipment, e.g. buildings and large pieces of plant thought to be representative of the firm's main activities. A bald request by

questionnaire for the full information would in most cases have required so much effort on their part that the firms would have ignored it.

A general questionnaire was prepared in advance and it was designed to cover many aspects of the valuation of fixed assets. As well as inquiring about methods of valuation the questions ranged over such topics as depreciation policies, obsolescence, capital utilisation, repairs and maintenance, rented and second-hand assets, and the various uses of each measure of fixed assets. In all there was a dozen main headings with about five or six questions under each. Many of the questions only became relevant when amended in the light of the discussion. It helped guide the general course of the interview and served as an *aide memoire*.

The notes which were taken during each interview provided useful background material and enabled the preparation of tailored questionnaires. These were sent off within a day or so after each interview and the replies came back in some instances within days, in others not for several months. Receipt and examination of the completed returns required further communication with the firms in order to clarify particular points and answer questions arising from their initial answers.

As well as manufacturers, firms providing ancillary services in the valuation of fixed assets were also contacted. Accountants, professional valuers, fire insurance officials and chartered loss adjusters were interviewed or offered written evidence. They provided important and useful technical information.

III. VALUATIONS OF FIXED ASSETS

Balance Sheet Valuation

The best known and most universal valuation of fixed assets is the accountant's balance sheet valuation. Unfortunately in the real world of changing prices and changing technology it is economically meaningless. Its precise accuracy, while useful for strict accountability, tends to mask its ambiguity. Balance sheet valuation is usually the summation of the original costs of all fixed assets less the accumulated depreciation. Company law requires that a valuation of fixed assets and a figure of accumulated depreciation must be shown separately on balance sheets of public companies. A firm may have revalued its fixed assets in the past, in which case balance sheet valuation will be a straight summation of all the assets at revalued prices together with the original costs of all assets acquired year by year since the revaluation. Accumulated depreciation will again be deducted and it will be calculated from original costs and revaluations.

The original cost of a fixed asset is reasonably unambiguous. It is the tota

cost of acquiring the asset and placing it in a position ready for use, measured in current prices at the date of purchase. The definition of expenditure on fixed assets given in the annual return form of the Census of Industrial Production is: "Acquisitions should be valued at the full cost incurred, i.e. at the delivered price plus the cost of installation, including any necessary fees and taxes. . . . Fixed assets produced by the establishment should be valued at the cost of all work put in place during the year, whether completed or not". All firms should have data on the original costs for a number of years. The Central Statistical Office has obtained expenditure on fixed assets in the annual return of the C.I.P. since 1947. Unfortunately the Census requests only details of the cost of assets acquired during the census year so that any expenditure of new firms which takes place before the first census year in which production starts, will be missed. This may be a serious omission since a firm's initial capital expenditure is usually its largest for many years. It also misses expenditure on fixed assets by firms with less than three employees but this is fairly trivial.

Relief from income tax and corporation profits tax can be claimed on expenditure on fixed assets in the manufacturing industry. Initial allowances are calculated on the basis of original cost and annual allowances on either original cost or written down[15] original cost. As long as any relief is due on a fixed asset its original cost will remain in the books. In practice the reducing balance method of computing allowances for plant and machinery and vehicles usually means that allowances will be spread over most if not all of an asset's life. Allowances on buildings are usually given over a period of fifty years.

For these reasons most firms will have information on the original cost of their fixed assets over the past twenty years and often for much longer. Going further back the number of firms with complete information will diminish and the amount of data on older equipment will be smaller. However, the proportion of equipment for which firms have no original cost figures is likely to be small. Firstly, the writing-off period for balance sheet purposes is usually related to the estimated length of life of assets so that in many cases, especially plant and machinery, the assets will be disposed of a few years after they are written out of the balance sheet. Secondly, the reducing balance method of computing tax allowances usually means that less than full allowance has been given on assets before they are disposed of. Finally, the rapid growth of the manufacturing sector in the past thirty years compared with its previous size, combined with natural mortality, will make the proportion of old assets out of the total, very small.

Depreciation

The original cost of each asset is written down or depreciated in the balance sheet at whatever rate and by any method the firm decides to use. Depreciation

[15]"Written down" here means, "reduced by the amount of tax relief already given". The rate at which firms can write down their assets for tax purposes is of course strictly defined by law.

is the physical reduction in the stock of an asset's future services though it has to be measured in money value. The word is often used by accountants in a financial sense; amortisation might be a more appropriate name. This is setting funds aside from distributed profits supposedly to build a reserve for its eventual replacement. The most commonly used methods of computing depreciation are the straight line and reducing balance methods. The straight line method spreads the cost of the asset evenly over its expected life. Thus if the expected life is 20 years depreciation will be $\frac{1}{20}$th of the original cost per annum. The reducing balance method adopts a formula which results in greater amounts of depreciation in the early years and successively smaller amounts in the later years. Often it is a fixed percentage of the written-down value. The reducing balance method may give a better approximation of resale value; for resale value depends not only on expected future income but also on removal and installation costs, and market conditions. The straight line method has the benefit of simplicity. Several other methods such as the annuity system, the sinking fund, the machine hour system or the sum of years' digits are used but the basic principles are unaltered. In general most firms tend to estimate the length of life of an asset and conservatively write it off over a shorter period in an attempt to allow for the unforeseen. Within any one firm assets are written down over different periods and by different methods depending on the type of asset and its expected length of life. In balance sheet valuation all assets are written down individually and then summed to give total depreciation.

In the perfect world with all its strict assumptions, gross balance sheet valuation, net valuation and annual depreciation correspond to our measures of quantity, value and cost of capital input. However, in the real world of changing prices and technology the balance sheet figures are meaningless. Original costs are lumped together regardless of the fact that they are at different years' prices. The meaning of balance sheet valuation is not improved if they are based on cost and valuation. "Valuation" refers to the fact that at some time in the past, part or all of the assets were revalued. This single revaluation can sometimes occur when a company wishes to go public and get a stock exchange quotation. The appropriate proportion of the current prices new will give the accumulated depreciation on each asset at current prices. This would provide meaningful measures of capital in that year. Unfortunately in the cost and valuation balance sheet method this valuation is not adjusted to take account of further changes, so that as time goes on that valuation loses its meaning. Each succeeding year's capital expenditure is added in at its original cost; hence the expression "valuation or cost".

If then the balance sheet valuation of fixed assets is economically meaningless, why do the majority of firms and accountants persist in using it? As mentioned above, public companies are compelled by law to publish a valuation of their fixed assets but the law does not specify that the valuation should be economically meaningful. Original cost valuation and depreciation has the

benefit of simplicity and complete accuracy. It requires none of the subjective means of valuation which are necessary for up-to-date valuations. Many firms, while showing original cost valuations in their balance sheets, will have up-to-date valuations for planning, insurance or other purposes. A negative reason for the persistence of the original cost balance sheet valuation is that the alternative, periodic revaluation, can be costly, either through professional valuers or internally by the firm's employees.

The Jenkins Committee on Company Law Reform[16] considered the question of valuation of fixed assets for the United Kingdom. The proposal that legislation should require annual revaluations of fixed assets to be shown in the balance sheet was considered and rejected. They summarised their objections by saying: "To require a periodic revaluation of fixed assets would, in our opinion, impose a most onerous duty on companies and require them to give information which we think would be worthless and misleading". Their objections centred mainly on the difficulties of measuring up-to-date valuations and on the problem of implementing legislation on annual valuations when valuations are often matters of personal opinion. They also felt that misleading valuations could affect share prices. They preferred to permit the present system of economically meaningless balance sheet valuations to continue rather than require meaningful valuations which might be open to abuse. The Jenkins Committee were concerned with valuation at the firm level and for publication in the balance sheet. The economic statistician, however, is more interested in aggregates at trade and industry level. At that level of aggregation the Jenkins Committee arguments are not relevant. Government planners must have up-to-date valuations of capital since only these are economically meaningful.

Revaluation

Up-to-date valuations of fixed assets are essential for the efficient running of a firm. In the planning process accurate details of a firm's capital assets are surely as relevant as the number of employees on its pay roll and their annual wage bill. Depreciation is an important cost to be charged in the calculation of profit and in a period of rising prices depreciation based on historical cost does not indicate the true cost of employing fixed assets. Revenue and other costs are measured in current prices and the profit figure is only meaningful if depreciation is also measured in current prices. From a financial point of view up-to-date valuations of fixed assets help to establish a more realistic price for a firm's equity capital and by revealing otherwise hidden appreciations in asset values, reduce the danger of take-over bids. Objections to the use of replacement cost valuation are basically the same as the reasons in favour of historical cost. There is an old accounting argument that depreciation is the natural reduction on the original expenditure, but the main arguments are centred on the practical difficulties of measuring replacement cost. In a changing world assets are seldom replaced with identical ones, the type and quality of the

[16]Report of Company Law Reform June 1962 CMND 1749. pp. 137–141.

product may change and absolute and relative prices may also change.

The three main ways of measuring the replacement cost of assets are, (1) applying index numbers to original costs, (2) obtaining details of the cost of new machines with comparable productive capacity from producers or distributors and (3) using the services of professional valuers.

In using index numbers, the original cost data may not be available for older assets or accurate indices may not go back far enough so that it may be necessary to resort to the other methods of valuation for some assets. A wide variety of index numbers are used in practice varying from general goods wholesale price indices to indices for specific assets provided by commercial enterprises. In Ireland indices of prices of plant and equipment, and buildings are published in the *Irish Trade Journal and Statistical Bulletin.* The index for plant and machinery goes back to 1938, while that for building costs only goes back as far as 1953. However, C.S.O. was able to supply indices of wage rates and costs of building materials which enabled an index to be calculated back to 1936. A useful discussion of Irish index numbers in general and including the official index of building and construction is given in "Some Aspects of Price Inflation in Ireland" by R. C. Geary and J. L. Pratschke.[17] In the United Kingdom an official price index number for "new construction" is published in the *Monthly Digest of Statistics,*[18] but there is no official series for other capital equipment. Much useful information on prices of capital equipment is to be found in Redfern's paper[19] and Feinstein's book.[20] Redfern has an index of plant and machinery dating back to 1889 and an index of building costs dating back to 1850. He also has indices for vehicles dating back to 1920. These are accompanied by an important description of sources and methods. Feinstein offers a new index number for plant and equipment for the years 1920 to 1938 and it makes a useful comparison to Redfern's figures. An index number of capital equipment for recent years can be inferred from the figures of gross fixed capital formation shown in the Blue Book at current prices and at 1958 prices. A useful summary of building indices is given in "The Long Term Measurement of Construction Costs in the United Kingdom" by M. C. Fleming.[21] He critically examines indices dating back as far as 1845 and his bibliography contains several useful references. Indices of the prices of capital goods classified into about twenty different categories are produced on a commercial basis by the Economist Intelligence Unit.[22] These indices are used widely in the United Kingdom and by some firms in Ireland. A striking international example of the production and use of nearly perfect index numbers is provided by the Philips Electrical Company of the Netherlands. The plant and equipment is manufactured and supplied by subsidiary companies and it has an organisation

[17]Paper No. 40. ESRI January 1968.
[18]HMSO London.
[19]Redfern *op. cit.*: Appendix A. p. 169.
[20]Feinstein *op. cit.* Table 2.70 p. 24 and Section 14.11. p. 259.
[21]*Journal of the Royal Statistical Society* Series A (General) Vol. 129 Part 4 1966 (pp. 534–556).
[22]The Economist Intelligence Unit. Ltd., Spencer House, St. James's Place, London, S.X.1.

to prepare index numbers of equipment and plant and distribute them to all its associated firms. All assets are revalued annually and the balance sheet shows fixed assets valued at replacement cost.

The cost comparison approach to replacement cost revaluation is usually carried out within the firm by an engineer or an official responsible for purchasing plant and equipment. The problems of definition of replacement cost are usually left to personal judgement. This usually results in a subjective evaluation which is based on the cost of replacing physical capacity. Producers and distributors of new equipment will readily supply fairly accurate details of costs and output of new equipment and details of building costs can be obtained from estate agents, auctioneers, and builders.

Valuers, loss adjusters, fire assessors or auctioneers all make valuations of fixed assets. Loss adjusters and fire assessors usually make their valuations after a fire or damage but their principles of valuation are similar to those used by valuers and auctioneers. These small firms of professionally qualified people jealously guard their independence. Although a large proportion of valuation work is carried out for insurance purposes the insurance companies take no part in the valuation. The job is left entirely to these independent experts in order to avoid disputes over valuation.

The methods of valuation used by the experts are based on cost comparison and do not include the original cost figures and usually no attempt is made to consult the firm's stock list. The valuer enters the premises and prepares a list of all assets in existence including full specifications and applies his principles of valuation to all items.

Buildings are valued differently from plant and machinery.[23] The three main valuations for buildings are reinstatement, value as part of a going concern, and indemnity. Reinstatement value is the cost of replacing the building with a similar new one on the same site and it is determined by the actual building cost at current prices. It includes all incidental expenses such as the cost of demolition of the old building and removal of rubble, architects' and surveyors' fees and all the builder's expenses. The valuer is familiar with building costs through his continual contact with contracts, tenders, estimates and the building trade, and he can estimate the cost of a building in different ways. Cost per square foot of floor area for the type of building will give a first estimate. Estimates of labour costs, costs of materials, professional fees and builders' margins of profit are available to the valuer and he can systematically cost the entire construction job. Since the existing ground preparation is to a large extent indestructible, the cost of land drainage, foundations and all ground development is excluded from reinstatement value. Thus:

$$\text{Reinstatement value} = \text{Cost of erecting a similar building on same site} + \text{demolition expenses} - \text{ground development.}$$

[23]A comprehensive account of the principles used in valuing buildings can be found in *Modern Methods of Valuation of Land, Houses and Buildings* by D. M. Lawrence, W. H. Rees and W. Britton.

In practice demolition expenses and ground development tend to cancel out. The value of the site is not included in reinstatement value.

Assets are also valued as part of a going concern and this is meant to reflect the beneficial use. Not only is the value of the building included but the site value as well. Site value varies with location and tenure and it is estimated by comparison with other sites. The value of the site will be affected by whether it is freehold or if leasehold, the length of the lease. A rental will lower the value of the site to its occupant. The "value in use" of a building is determined by the rent which it is estimated would be paid for a building of similar size, location and facilities. On a factory of 2,000 square feet, if the rental is estimated by the valuer to be 6 shillings per square foot (bearing in mind its condition and situation compared with others in the market) the annual rent will be £6,000. Grossing the rent up by ten years for purchase gives a value in use of £60,000. Add in the site value of, say £5,000, to give the asset value as part of a going concern £65,000. Again the valuer is guided by experience and continual exposure to property rentings. The fact that one building is older than another will only affect their values through different costs of repairs or obsolescence in design, not through age alone.

Indemnity is the third valuation made by professional valuers. It is the cost of replacement of the building less normal wear and tear. For the purpose of determining wear and tear, records of maintenance and the condition of the assets are taken into account. Age is used in deciding expected future life but wear and tear is determined independently of age and it is more important than age in deciding indemnity valuation. For instance, two similar buildings each fifty years old, one may be well maintained with say, a new roof, while the other is in poor condition; records of repairs and maintenance will be examined and the wear and tear deduction will be much less for the building in good condition. Indemnity is similar in concept and magnitude to the resale value of the asset though site value is not included. In making this valuation a good deal of subjective judgement must be made by the valuer.

Plant and Machinery

The reinstatement value of plant and machinery is the cost of replacing the existing assets with new ones of similar capacity. Physical output is taken as the measure of capacity, though an adjustment will usually be made where there is an obvious change in operating costs. Qualitative changes in machines and final products are taken into account and influence the valuer in a subjective fashion. The valuer works on a cost comparison approach using what information he can obtain from suppliers and distributors together with his own personal knowledge.

For plant and machinery, asset value as part of a going concern and indemnity valuation are synonymous. Age is a more important determinant in these valuations than it was for buildings. However, standards of maintenance

are important and the figure arrived at will depend both on age and condition. These valuations are close to our early definition of written down replacement cost. Valuation principles for plant and machinery leave more to the experts, subjective judgement or opinion than those for buildings.

Complete revaluations are seldom done annually but the valuer will make a year by year interim adjustment. The firm is visited to check existing assets, acquisitions and disposals during the year and their valuations are then adjusted to take account of changing prices. Index numbers are not used; the adjustment is based on the valuer's opinion of the rise in prices.

The professional valuer's concepts of replacement cost and indemnity are very close to the measures of replacement cost and written down replacement cost discussed in Section II. However, one must be a little sceptical of estimates which have been obtained by techniques which might be described as more of an art than a science. Cost comparison carried out internally also estimates the replacement cost of fixed assets. Both methods tend to take physical output as representing capacity whereas one would ideally desire net income. Up-to-date valuations made internally by applying index numbers to original costs provide comparable estimates to gross capital stock. They have the same fault in that only rarely do they take account of technical change.

Fire Insurance

It is general practice for firms to insure against fire. Insurance officials expressed the view that only rarely do firms go uninsured, though some large firms choose to carry the risk of fire as a form of internal fire insurance.

The two main types of fire insurance cover for fixed assets are reinstatement or replacement and indemnity. The cover provided under an indemnity policy is intended to recompense the insured with a sum equivalent to the market value of the existing asset, taking into account wear and tear and its expected future life. The balance necessary to replace assets with new ones must be found by the firm itself. Payment will be made at the earliest date regardless of whether the firm intends to replace the asset or not. A reinstatement policy provides for replacing the damaged assets with equivalent new ones. There is no deduction for wear and tear. It pays both indemnity, immediately, and the balance when the asset has been physically replaced.

In order to ensure that premiums are appropriate to the cover provided, the insurance companies have in recent years introduced an "average clause" into their policies. If the value for which the firm is insured is less than the up-to-date valuation of its assets, the amount paid out in the event of fire damage will be correspondingly reduced. In any instance, the proportion of the value of any asset destroyed by fire, which is paid, will be equal to the amount for which all assets are insured divided by their up-to-date valuations. Thus if a firm has a policy for £5,000 when the up-to-date value of its assets is £10,000, only half the value of any assets damaged will be paid by the insurance company.

Unfortunately not all firms use the methods mentioned above to obtain up-to-date valuations for insurance purposes, some insure at original cost and do not adjust, some adjust occasionally by some notional figure unrelated to actual price changes. However, the introduction of the average clause has made firms conscious of the need to keep up-to-date valuations and many have obtained them in recent years.

The great majority of firms insure on reinstatement basis, especially the larger companies. Indemnity is used in a relatively small number of firms. Barna,[24] on the basis of his investigation, felt that while undervaluation sometimes occurs, through neglect or attempts to save on the premiums, overvaluation could be ruled out. This was because compensation is only paid up to the full replacement cost value of the assets so to insure at a higher value and pay the additional premium would be a pointless expense. This may not necessarily be the case. Experts and amateur internal valuers may well wish to provide a margin of safety in their valuations. A chartered loss adjuster stated that in *ex ante* valuations for fire insurance purposes he tended to overvalue. He could not specify to what extent but said that each case was taken on its merits. The greater the likelihood of fire the more he would overvalue. He overvalued "to be on the safe side" and considered that, in view of the low costs of fire insurance, firms would not object to the extra premium for complete safety. One cannot assume that this is general practice but to make allowance for possible error is a normal piece of human reasoning.

Certain assets are not normally insured against fire. These may be assets of an indestructible nature. Ground preparation, drainage and foundations are of this type. So are such assets as coke ovens, blast furnaces and heavy cast iron machinery. Plant layout may be such as to prevent fires from spreading and doing extensive damage. Evidence suggests that the proportion of fixed assets in the manufacturing sector which are uninsured is small, though it varies from industry to industry.

Barna came to the conclusion that valuation of fixed assets for fire insurance purposes was a good basis for estimating the replacement cost valuation of assets in an economically meaningful sense. Additional information to the fire insurance valuations was required such as the basis of valuation, the possible extent of undervaluation and estimates of the value of uninsured assets. This approach has much to commend it but direct questions about the replacement cost value of all assets with insurance mentioned as an example may be more direct and productive.

[24]Barna, *op. cit*

IV. THE FINDINGS OF THE SURVEY

To obtain a comprehensive knowledge of the problems involved, questions were asked about many aspects of the treatment of fixed assets. In all specific questions were asked under each of twelve main headings.

Replacement Cost Valuations

All firms contacted were completely familiar with the concept of replacement cost valuation of fixed assets. Of the fifteen firms in the survey thirteen had replacement cost valuations for all or part of their fixed assets. One of the thirteen had a valuation for buildings but none for plant and machinery but it felt that it could readily estimate one if obliged to do so. Both firms who had no replacement cost valuations had full details of original costs of existing assets and their dates of purchase so that had they been provided with index numbers they could make adequate estimates. One of the thirteen had an up-to-date valuation through the coincidence that its factory premises and machinery were all purchased new in that year. It did not intend to make any revaluations in the forseeable future.

Table 1 shows details of the firms' replacement cost valuations. Four firms had employed the services of a professional valuer for all or part of their assets while revaluations were attempted internally by nine firms. Internal valuations were made by applying index numbers to original cost and by comparing with the costs of new assets. Four firms used index numbers. Two used the same U.K. commercial[25] index mentioned earlier, another used the U.K. general goods wholesale price index. Firm 5, owned by an international parent company, purchases all its assets from an associate firm. All firms in the group are circulated with annual price adjustments from the parent company which has an organisation responsible for producing specific information for individual firms. This firm uses replacement cost in its balance sheet and in all calculations involving a measure of capital or depreciation.

While the index number approach is often carried out by an accountant or his department, cost comparison is invariably done by the engineering department or the engineering buyer. Prices of new machines can be had from suppliers or catalogues but some adjustments are required if there have been changes or improvements in the new machinery. For buildings, prices for unit area are known by auctioneers, architects and estate agents and this provides an easily applied method. Normally, cost comparison is used when revaluations are infrequent or when an initial revaluation is being made. Annual revisions are made more readily with index numbers. In the Table 1 all firms which make annual revaluations either use index numbers or employ a professional valuer.

[25]This is the index produced by the Economist Intelligence Unit.

It is clearly important to check the accuracy of the estimates. To do this the firms were asked to provide a list of original costs of their fixed assets and their dates of purchase. The request usually had to be modified to, in some cases, a branch factory or a building and its contents or a group of large representative assets. Index numbers[26] were then applied to these lists of assets and replacement costs calculated. Each firm's own valuation was then expressed as a percentage of that calculated. Discrepancies in the comparable figures may of course be due to inaccuracy in the writer's index numbers or perhaps the fact that general capital goods indices are being applied to equipment of a type specific to a firm or trade. However, the pattern of variation should show any firms which are seriously out of line and the average of the results as a whole should check the index numbers used in the test. In Table 1 the firms' estimates of plant and machinery are almost all above the test estimates between 10 and 20 per cent or average. These figures suggest that contrary to what one might expect, the writer's index numbers of plant and machinery are probably on the low side. It may also be that there is a substantial amount of improvement incorporated in repairs and maintenance. Buildings exhibit no such obvious pattern, with considerable variation in both directions. Firm 3 with an estimate 20 per cent below the test value is an interesting case. The test estimate is based on original expenditures together with a valuation in 1947, while the firm's valuation was made by an architect. Further investigation revealed that much of the expenditure in acquiring extra floor area was inefficient in that the firm had expanded in its existing site by buying out premises around it. The present square footage of its buildings could be provided in a new building on the same site at much smaller cost than acquiring the additional area piecemeal. Firm 4 has a particularly low R.C. valuation for its buildings. These buildings are not of traditional materials and are actually built around the machines by the firm's employees. No precise reason could be given for the discrepancy but since the valuations were calculated for insurance purposes and these buildings are virtually fireproof the company may have been satisfied with a low R.C. value for insurance purposes. It is also worth noting that the commercial indices used by this firm and by firm 2 give higher valuations for plant and machinery and lower values for buildings.

All the firms who had replacement costs used them for insurance purposes. Most of the firms who used their valuations for insurance only had revalued for the first time within the past few years. Had this survey been carried out in 1964 instead of 1968 less than half these firms would have possessed R.C. valuations. The introduction of the "average clause" in the early sixties is largely responsible for this. However, there is also an increasing awareness of

[26]The index numbers were obtained as follows:—
Building Prices Index: 1936–1953 calculated from indices of building costs supplied by the Central Statistics Office, 1953–1967, taken from *Irish Trade Journal and Statistical Bulletin*, March 1968, December 1960. Plant and Machinery Prices Index: *Irish Trade Journal and Statistical Bulletin, Statistical Abstract of Ireland*. The basis of calculation of the published indices is due for revision by CSO so they cannot be regarded completely accurate.

the inadequacy of balance sheet valuations for planning and costing purposes.

Annual adjustments to R.C. valuations to account for price changes and additions and disposals are made in about half the firms. Unfortunately not all firms adjusted or intended to adjust with reasonable frequency. Firm 11, with its new factory and equipment, did not intend to revalue in the foreseeable future and it had never revalued its fixed assets in its previous factory, partly because the premises and some of its equipment were rented.

Fire Insurance

Every firm had insured all or part of its fixed assets against fire. All but one had insured on a reinstatement basis and they mostly had estimates of R.C. for this purpose. Two firms insured for reinstatement on the basis of fairly recent original costs. The only firm to use an indemnity policy had internally calculated replacement costs and written down these values to obtain an approximate indemnity valuation. This was Firm 7[27] which had a lot of old equipment. Its main reason for insuring for indemnity is that the firm may cease to operate in the foreseeable future.

Two firms stated that they deliberately over-insured. One of these insured some assets for as much as 30 per cent more than the R.C. value. This firm had, in the past, fallen foul of the average clause and suffered a considerable loss as a result. It now considered the extra premium worthwhile for the additional margin of safety on high risk equipment. On the face of it, a more rational approach would be to insure on an accurately assessed, annually revised replacement cost figure. The second firm which makes annual adjustments sets its insurance at 3 per cent higher than its replacement cost valuations in order to allow for additions during the coming year. It also insures some unusual items such as roadways and foundations in order "to provide an extra cushion on our cover".

One firm insured its buildings for reinstatement at 12½ per cent below the valuer's estimate of replacement cost because it builds all its own buildings at an estimated 12½ per cent cheaper than market rates.

Assets of an indestructible nature were omitted from fire insurance by most firms, these include such items as kilns, silos, locomotives, foundations, land, roadways and various types of heavy machinery not subject to much fire risk. Assets well spread out such as railway track or power lines are relatively free from fire hazards and these are omitted. The extent of uninsured assets varied considerably from one firm to another. The firm with most assets not insured was the one mentioned above which greatly over-insured its few insured assets.

Balance Sheet Valuations and Depreciation

In the balance-sheet, companies are free to show fixed assets at cost less

[27]Firm 7 had no details of original cost for most of its older assets. It had employed cost comparison to estimate R.C. valuations.

depreciation or at valuation less depreciation. In either case the amount written off for depreciation must be shown separately.

Firm 5 used replacement cost valuations in the balance sheet. This firm, which used such ideal methods of estimation, could see no sense in publishing "quite meaningless figures based on original cost". In the balance sheet for 1967 firm 6 used valuations for 1966 and expressed its valuation as "Valuation or Cost". This firm intended to revalue at regular intervals in the future and would alter its balance sheet valuation accordingly. All other firms used original cost or original cost and valuation.

For the preparation of their annual balance sheet valuations of fixed assets each firm had plant records of one form or another. The records contained information on original cost, date of purchase, supplier's name, accumulated depreciation, and sometimes insurance valuation, details of repairs and maintenance, and location in the factory. The records were kept in different systems ranging from ledgers to computers.

Firms calculated their depreciation in widely different ways. The only thing which they appeared to have in common was that they write off their assets in a most conservative fashion. Depreciation calculated in the balance sheet bears little relation to the expected length of life of the asset or to wear and tear. It seems more appropriate to regard it as a process of amortisation. That is a purely financial procedure for recouping original cost. One firm has assets with an expected life of 50 years which were written off on a straight line basis over ten years. Another had portable machinery with an estimated 7–10 year life which was written off in one year. These were exceptional, in most cases plant and machinery was written off over a period of one half to two thirds of the expected lives. A comparison of the amount of annual depreciation calculated this way compared with that calculated from replacement costs using realistic lengths of life can be seen in Table 3 colums 2 and 5 in the next section. In several cases depreciation calculated for the firms' balance sheets is higher, and where it is not the difference is small. Thus businessmen appear to arrive at an appropriate deduction for depreciation by this roundabout method; a case of two wrongs making a right.

Actual lengths of life of plant and machinery vary considerably according to the type of asset ranging from 5 to 50 years. In the balance sheet most plant and equipment is depreciated over a period of 10 to 20 years. Both straight line and reducing balance methods are used. Strictly speaking a reducing balance method can imply an infinite life but from a practical point of view most of the value of the asset is written off over a finite number of years. One of the two public corporations depreciated its fixed assets at an amount equal to its total annual repayments on capital advances. Another firm had adopted the practice of writing off an amount of equipment equal to the average annual capital expenditure over the past ten years. Another depreciated certain assets according to the amount of production of that asset. It expressed the year's production as a fraction of the total expected lifetime production and continued to

calculate depreciation in this manner even though cumulative output may have exceeded the expected lifetime output. Thus an asset may be written down by more than 100 per cent.

Firms also differed in their treatment of buildings. One firm did not write down its buildings in its balance sheet. Since its buildings were of modern design and construction it considered that, with adequate repairs and maintenance, they would last for the next 200 years. It regarded this time period as beyond its possible planning time horizon. Most firms, however, write off buildings over 40 or 50 years, usually on a straight line basis.

Vehicles are treated differently according to whether they are cars or commercial vehicles. Cars are usually retained for only 1 or 2 years and are written down at rates between 25 and 30 per cent per annum. Commercial vehicles are usually retained for 4 to 5 years and written down between 12½ and 20 per cent per annum.

The amounts written off as depreciation and retained out of current profits are not set aside as depreciation reserves for the purpose of replacing specific assets. In all the firms they were treated simply as a cash flow used generally in their operations. Capital expenditure is financed mainly from current cash flow comprising depreciation changes and retained profits. When a cash surplus does arise it may be placed on short term deposit with financial institutions or put to reducing a bank overdraft. If additional capital is required, recourse may be made to the banks or the capital market. One firm adjusted its depreciation figures around years when large prices of capital expenditure were taking place. By doing this it was better able to offset the additional expenditure in any one year and to maintain a fairly stable rate of dividend for its shareholders. It regarded this stabilising function as particularly important since much of its additional finance came from public share issues.

Obsolescence

Obsolescence occurs in existing plant and equipment when new assets are produced which, for the same real cost, can earn a greater net return. Thus, if a new machine can produce the same quantity of output as an old one of the same real cost, but requires fewer operators or causes less waste of materials, then the old machine will be experiencing obsolescence. The more obvious example is where the physical output of the new machine is greater than an old one with the same cost and operating expenses.

For all practical purposes obsolescence is important only to plant and machinery; not to buildings or vehicles. Modern buildings, both factory and office, are designed and built in a functional manner with increasing life expectancies. Changes in building design and materials come slowly and existing buildings can be altered to take account of any new ideas. Most of the repairs done to a building are likely to incorporate improvements in building techniques but the main purpose of a building, which is to provide cover from

the elements, will not be altered much by the peripheral changes in building techniques. Real building costs have shown no sign of declining over the years; if anything the reverse is true. One can of course cite examples of obsolescence in old buildings, but in general it is a long term gradual effect which for all practical purposes can be ignored. Vehicles are fairly free from the problem of obsolescence since they are retained for only a short period during which time vehicle design will change little. Vehicle design changes are usually qualitative in that they increase passenger comfort, technical efficiency or appearance. While changes in technical efficiency can reduce running costs and so increase the net income potential of a vehicle, the effects of these changes will generally be so small as to be negligible.

Only two firms felt that obsolescence was important or was becoming important. Firm 15 in the plastics group regarded obsolescence as a significant factor to be considered when purchasing new equipment. Its machinery was highly complex and specialised and in comparatively early stages of development.

Two other forms of obsolescence were experienced by firms. In three firms the need for increased capacity to meet growing demand had produced obsolescence. Small machines were sold off and replaced by larger more automatic ones. Basically this is a problem of an indivisibilities in capital assets. Changes in fashion also cause a form of obsolescence. Pattern plates had to be replaced by those of a newer design to keep pace with fashion changes.

In those instances where obsolescence was an important influence, firms reacted to expected future changes by writing-down their assets at a faster rate. The firms in the old established industries maintained that there had been little change in machine design over the past years. Such changes that had occurred had been mainly to ancillary equipment. Apart from the two firms mentioned above, the apparent absence of obsolescence in basic machine design in so many trades was surprising.

Scrapping

Reselling assets occurs most frequently with vehicles, especially cars. Apart from prestige and technical reasons there exists a highly organised second-hand market where vehicles can be easily sold. Buildings are long lived and in a thriving firm are seldom disposed of unless the entire firm is sold. Plant and machinery lies somewhere between the two. While usually of fairly long life it will fall due for replacement in a foreseeable period. What criteria does a firm adopt in deciding when a piece of equipment should be replaced? The main reasons given were (*a*) the operation of the machine was uneconomic in that repairs had become excessive, (*b*) the inability of the machine to meet increased demand, (*c*) changes in the form or quality of the final product and (*d*) new inventions providing potentially more profitable machines i.e., obsolescence. The most important of these reasons was clearly the first. Several firms stated that they carried out evaluations before deciding whether a machine

TABLE 1: *Details of Replacement Cost Valuations*

Firm Number	*Trade*	*Assets for which replacement cost valuations have been obtained by the firm*	*Where was the replacement cost valuation calculated*	*Methods used in internal calculations of replacement cost*	*Firms R.C. valuations expressed as a percentage of the values calculated from original costs*		*Reasons for obtaining replacement cost valuations*	*Frequency of Adjustment*	COMMENTS
					Plant and Machinery	*Buildings*			
1	Food, Drink and Tobacco	All fixed assets*	Internal	Index numbers†	112	112	Costing, Insurance	Annual	*Including vehicles and site value of land. †U.K. wholesale price indices used.
2	Food, Drink and Tobacco	Buildings and Plant and Machinery	Internal	Index numbers*	122	92	Insurance, Measuring rate of return Depreciation	Annual from 1966	*U.K. Indices provided by a commercial firm.
3	Food, Drink and Tobacco	Buildings and Plant and Machinery	Architect, Internal	Cost comparisons	99	80*	Insurance	Occasional, one recent revaluation	For an explanation of this difference, see Text.
4	Food, Drink and Tobacco	Buildings and Plant and Machinery	Professional Valuer	—	107	105	Insurance	Annual	
5	Engineering	Buildings and Plant and Machinery	Internal	Cost per unit floor area, Index numbers	—	—	Planning, Costing, Insurance	Annual	Index numbers specific to plant and equipment are supplied to this firm by the parent company. Original cost valuations are not used at all in this firm.
6	Engineering	Buildings and Plant and Machinery	Professional Valuer, Internal	Cost comparisons	117	100	Insurance, Costing	2–3 years, first valuation in 1966	
7	Transport Equipment	Buildings and Plant and Machinery	Internal	Cost per unit floor area, Cost comparison	—	—	Insurance	Occasional	No original cost information exists for a large part of the older assets in this firm.
8	Transport Equipment	Buildings and Plant and Machinery	Auctioneer, Internal	Cost comparison	—	—	Insurance	2–3 years	The internal valuations were admitted to be rough estimates.
9	Clothing	None	—	—	—	—	—	—	Full details of original costs were available. The firm was established in 1961.
10	Footwear	Buildings	Professional Valuer	—	—	101	Insurance	Occasional, one revaluation to date (1967)	The firm could produce a R. C. valuation for p. & m. if obliged to do so.
11	Furniture	All fixed assets	Factory and all assets acquired new in 1967	—	100	100	Coincidence, no replacement cost valuations were made on the previous factory or equipment		This small firm did not intend to revalue in the foreseeable future.
12	Non-Metallic Mineral Products	All assets at one location only	Internal	Cost comparison	105	106	Costing, Insurance	One revaluation to date (1967)	There are several other locations in this company for which no revaluations have been attempted to date. It is expected that all locations will eventually be revalued.
13	Non-Metallic Mineral Products	None	—	—	—	—	—	—	Full details of original costs of assets available.
14	Non-Metallic Mineral Products	Buildings and Plant and Machinery	Internal	Index numbers†	126	73	Insurance	Annual from 1966	Buildings are special purpose constructions built round the machinery and of non-traditional materials. †Same indices as firm No. 2.
15	Plastics	Buildings and Plant and Machinery	Internal	Cost per unit floor area, Cost comparison	112	135	Insurance, Planning	One recent valuation but every 3 years from now on	

should be replaced. One firm offered an interesting criterion for replacement; the marginal cost of retaining the existing asset is compared with the average annual cost, including depreciation and interest on capital, of a new one over its expected life. If the marginal cost is greater the machine is replaced.

Machines can be disposed of as scrap or sold in the second-hand market. Several firms mentioned dealers in second-hand assets to whom they sold unwanted equipment which was in working order. These dealers in turn notified prospective purchasing firms when suitable assets came on the market.

Repairs and Maintenance

The distinction between expenditure on repairs and maintenance and capital expenditure is often blurred within firms. Income tax principles state that where a new asset is purchased or an improvement made to an existing asset, the expenditure should be treated as capital. In all other cases expenditure should be treated as maintenance and charged to current account. In practice, however, the maintenance of plant often requires extensive replacement of parts and this may improve its operating efficiency. This improvement is often difficult to specify and there is a definite incentive for treating all this expenditure as maintenance whenever possible. Tax allowances for capital expenditure are spread over a number of years, whereas expenditure on maintenance is treated as a current cost, i.e. the full allowance is given in the year of expenditure. This liquidity consideration was considered to be important by most firms and many tended to lump as much expenditure as possible under the maintenance heading. A few firms treated all acquisitions of small pieces of equipment as current maintenance costs.

The above classification does not mention the size of expenditure. Thus replacing a worn out engine costing £20,000 in a large piece of plant would be treated as maintenance while the purchase of a new typewriter costing £100 to replace an existing one should be treated as capital expenditure. In practice many firms would treat both as maintenance. Replacing parts of a machine can greatly alter its length of life. It is extensive repairs and replacement which account for the life expectancy of 50 years for the machines in firm 14. This firm put the situation succinctly by saying that "in some cases all that remains of the original unit is the plant number and the machine drawings".

Some firms could distinguish a pattern of expenditure on repairs and maintenance over time. During the initial settling-in period teething troubles kept maintenance at a fairly high level. The next several years of the machine's life would see low charges for repairs and maintenance while towards the end of its life repairs expenditure would become high. When these high repair charges appeared replacement would follow soon after. A large piece of repair expenditure may occur on a once-and-for-all basis when a machine gets a large new part, say an engine, in the middle of its life. Other firms expressed the opinion that by and large repairs tended to increase with age.

While the evidence may be conflicting in some cases it does appear that the productive capacity of a machine does not reduce steadily over the years due to increasing repairs and maintenance. It may even be the reverse; that the improvements embodied in the repairs actually increase a machine's capacity and only in the last few years of its working life does it tend to fall off. This improvement element may be responsible for the higher replacement cost values mentioned earlier and if it is, it has not serious implications for the gross capital stock measure of capital.

Rented Assets

Only one firm rented plant and machinery on a substantial scale. Most firms tended to rent specialist one-off pieces of equipment such as computers, internal telephone systems, time clocks or loudspeaker systems. All these require regular expert maintenance and in most cases this was the reason for renting.

Firm 10, in the footwear industry, rented more than one third of its machinery This was modern, high cost, light weight machinery with an expected length of life of 15 years. The annual rental, which was about one sixth of the original cost of the machines, includes free service and under the terms of the lease they can be returned without fee after 5 years usage. Obviously the renting firm are charging a higher rental than the normal interest, depreciation and service costs which would arise if the hirer had bought the asset outright. However the firm felt that "taking into account such items as retention of capital, free service and the rapid development in the design of these machines . . . leasing was advantageous for the style of machinery."

Asset rentals are treated in the accounts as current costs. Contracts for rented assets required the individual firms to insure the assets against fire. All were insured for reinstatement but at original cost.

New Plant and Machinery

All plant and machinery owned by the firms in the survey had been imported from abroad, most of it being bought from producers in the U.K. and West Germany but Denmark and Switzerland were also named as suppliers of specialist machinery.

Second-Hand Assets

Only two firms bought second-hand assets regularly. One of these regarded second-hand assets as an alternative to new assets, comparing new and second-hand prices with the expected lives and returns on comparable assets. The other firm purchased second-hand assets for a specific purpose. When entering a new area of production where market demand may require building up, the use of smaller second-hand machinery has proved to be prudent and beneficial in the past. Less risk is attached to the smaller capital outlay and as the market

expands the small second-hand machine can be replaced with a larger new one. The technical expertise gained in the operation of the old machine can be a valuable guide in buying and operating its successor. Both firms were kept regularly informed by second-hand dealers of any second-hand assets in which they might be interested.

Capital Utilisation

Shift working was carried on in only two of the firms and in both cases for technical reasons. In firm 1 a process required several days for completion and so shift work was an essential characteristic of that part of the firm's operations. In firm 14 production continued without stopping for several months at a stretch, the reason being that the cost of stopping and restarting the operation is much higher than the additional labour costs incurred in shift work. The other firms did not operate shift work usually because in their industries (in some cases very labour intensive compared with those two mentioned above) the extra costs of labour outweighed the benefits of the intensive utilisation of capital.

Some firms felt that it caused greater wear and tear on plant and machinery. The two firms employing shift work agreed that over time the wear and tear was greater but they both pointed out that per unit of output it was probably reduced.

V. SOME MEASURES INVOLVING VALUATIONS OF FIXED ASSETS

The information collected on the inquiry has strengthened the proposition that the capacity of fixed assets is well-represented by replacement cost. The writer would also argue that while written-down replacement cost may overstate the value of an asset if sold singly, it is an appropriate valuation of assets if the firm were sold as a going concern. Having said this the problem of using a measure of capital is not over. One must know for what purpose it is to be used in order to know which measure is appropriate. Capital per employee, rate of return on capital and value added per unit of capital are commonly used statistics, but which measures of capital should be used in them?

A government department might be interested in two different measures of capital per employee. The development planners may attempt to combat heavy unemployment by providing state-owned industry or attracting private firms to establish there. The total amount of investment needed to provide a

given employment must be estimated in advance. It may try to attract foreign firms by offering grants toward capital expenditure on fixed assets. Perhaps it has to import all its plant and equipment and it must bear in mind its payments position. In the former case it will be interested in total permanent capital assets per employee while in the latter it is fixed assets per employee and this information must be estimated from existing firms in various industries and trade groups. The only meaningful measures of capital are those based on replacement cost. Replacement cost new is the appropriate valuation of fixed assets when one is interested in the cost of setting up new factories with their plant and equipment. But as well as fixed assets, working capital will be needed to get the firms into production. Working capital is regarded by accountants as part of the necessary permanent capital in a firm. While not unanimous, many regard working capital as represented by net current assets, i.e. current assets less current liabilities. Current assets include stocks and work in progress, trade and other debtors, prepaid expenses, marketable securities and cash in hand and at the bank. Current liabilities include creditors, bank overdrafts, provision for taxation and dividends. In manufacturing firms, debtors normally account for the largest part of current assets and creditors for the largest part of current liabilities. A bank overdraft which continues over a substantial period might reasonably be regarded as permanent capital so that usually it would be added back into net current assets. Some firms might regard "provision for taxation and dividends" as capital employed for certain purposes until quite close to actual payment. However, the criterion to be used is whether it forms a "permanent" part of the firm's capital.

Long term investments in and loans to associated companies, common items in balance sheets, will be omitted for the above purpose since these assets are not directly employed in the conduct of the firm's activities. Intangible assets such as goodwill will also be omitted. The replacement value of all rented assets should be included, though they will not appear on the balance sheet, for they form part of the quantity of fixed assets which is combined with labour in the operation.

If our interest is in knowing the amount of fixed assets only as in the latter case above, clearly replacement cost new of fixed assets per employee is the appropriate measure.

When one refers to the capital intensity of an industry it is the technical relationship between the quantity of labour and the quantity of capital to which one refers. If the process is unchanged the measure of capital intensity should remain constant. It is unthinkable that capital intensity should vary from year to year as the resale value of the machine moves or that one machine older than another will give rise to different values of capital intensity. Clearly capital intensity should be described as a relationship between replacement cost new, representing the quantity of fixed assets, and the quantity of labour. Table 2 shows fixed assets for employee and total net capital per employee for a group of firms.

TABLE 2 : *Capital per Employee*

Firm	*Trade*	*R.C. Valuation of Fixed Assets*	*Total Net Capital**	*Number of Employees*	*Fixed Assets per Employee*	*Total Net Capital per Employee*
						(£000's)
1	Food, Drink and Tobacco	2,780	3,620	410	6·7	8·7
2	,,	7,120	7,900	1,710	4·2	4·6
3	,,	4,170	4,940	1,780	2·3	2·8
4	,,	1,930	2,270	640	3·0	3·5
6	Engineering	3,800	5,310	1,560	2·4	3·4
7	Transport ‡ Equipment	3,820	—	2,410	1·4	—
10	Footwear†	3,400	4,520	2,910	1·2	1·6
12	Non-Metallic Mineral Products	5,450	6,340	2,050	2·7	3·1
13	,,	3,080	—	490	6·3	—
14	,,	1,930	2,080	130	15·0	16·0
15	Plastics	3,690	5,350	750	4·9	7·1

*Total net capital is taken as: Fixed assets+net current assets+bank overdrafts.

†In order to prevent disclosure of the identity of some firms in the survey it was decided to reduce some capital and employment figures to $\frac{1}{10}$th and multiply others by 10.

‡The replacement cost of rented assets has been included in this firm's fixed assets.

The success of a business is measured by its profitability, where profitability is related to the firm's assets. Management and shareholders use rate of return on capital to assess the efficiency of the firm in comparison with other firms or other forms of investment. Rate of return on capital is of interest to the economist since it indicates the directions in which resources should be flowing. In a capitalist economy a high rate of return attracts resources from industries where they are earning a low return.

Many different definitions of return and capital are used in practice.[28] Each firm in the survey was asked to define precisely the variables "capital" and "profit" used in their measure of the rate of return on capital. Most calculated rate of return on capital in more than one way. Of the fifteen firms only two used the replacement cost of fixed assets as part of their capital, the rest used the balance sheet (written-down original cost) valuations. All included working

[28]For a discussion of some of the different meaningful measures of rate of return on capital see J. Batty, Management Accounting, Ch. 15 and M. Greener, Between the Lines of a Balance Sheet, Ch. 4.

capital in their valuations. Some calculated rate of return on fixed assets as well as on net capital. Some used gross values of fixed assets and written-down values as well. A few firms used it as method of comparison for individual departments or locations, or for assessing the performance of a specific piece of plant but most tended to treat it as a rough guide to the company's overall annual performance, comparing one year with previous or with other companies (often erroneously). In some of these latter firms the precise meaning of rate of return on capital based on particular definitions had clearly not been thought out.

Balance sheets and profit and loss statements show a bewildering number of items which are included in computing total assets and earnings. Which of these items should be included in the rate of return measure and which should be excluded? Which valuations of fixed assets and which current assets should be included? What should be included in the profit figure? The answers to these questions depend on which aspect of the firm's activities one wishes to investigate.

Comparisons between firms or industries are only possible if fixed assets are measured in replacement cost or written-down replacement cost. Thus firms who used only balance sheet valuations of fixed assets can make no sensible comparison with other firms, though several of the survey firms made these comparisons. On a year by year basis within a firm it can provide a usable yard-stick. Rate of return on capital is calculated in this manner below and it is interesting to see how it compares with the more meaningful measures.

Rate of return on capital might be used by a board of directors to measure the efficiency of the management's use of the assets at its disposal. All that has been said before indicates that fixed assets must be included at replacement cost. While rate of return on individual fixed assets may be of interest to the businessman, such a measure for all fixed assets is limited in its application. Rate of return on the firm's permanent capital is of more interest, where permanent capital is taken to be fixed assets and working capital. In other words what is the percentage return on the capital necessary to establish and operate the firm. Firstly replacement cost new will be the measure of fixed assets and working capital can be taken as before, i.e. current assets less current liabilities with continuing bank loans or overdrafts added. The assets side of the balance sheet will include loans to and investments in other companies. However, management has no control over external investments so they should be excluded from "capital". Accordingly the return on external loans and investments will be omitted from the returns side of the ratio. It is absolutely essential to match the measure of return with the measure of capital.

The profit figure should show the economic facts of the year's trading. Only current expenditure and revenue should be included. Exceptional gains or losses such as from the sale of fixed assets or from foreign exchange transactions should be excluded. Profit on trading after charging working and administration expenses is the figure from which directors' fees, auditors' fees, pension contributions and depreciation will be deducted. Depreciation should be

calculated from replacement cost of fixed assets using realistic lengths of life.

Rented fixed assets require special treatment here. They are not included in fixed assets in the balance sheet. The rental is treated as a current cost and deducted as a working expense. However, since one is attempting to assess the use of assets at management's disposal, the replacement cost of rented assets should normally be added to fixed assets. The rental should be added back into the profit figure and from it a figure for depreciation on the rented assets should be deducted.

Rate of return on capital calculated in this fashion is shown in Table 3 as number I. The economist or the businessman intending to set up a new firm will be interested in this rate of return on the permanent capital employed directly in the industry.

The third measure of rate of return shown in Table 3 is a similar measure to I but it is based on original cost valuations of fixed assets. Permanent capital and profit are calculated in the same way; the depreciation deducted in the calculation of profit being based on that used in the actual balance sheet.

No particular pattern emerges from comparison of these two sets of figures except that the ranking in each is much the same. The reason for its lack of

TABLE 3 : *Rate of Return on Capital*

Firm	*Depreciation based on Replacement Cost with actual length of life* (£000)	*Rate of Return on Capital Per Cent* (I)*	*Rate of Return on Capital Per Cent* (II)†	*Depreciation as calculated for the Balance Sheet* (£000)	*Rate of Return on Capital Per Cent* (III)*	*Rate of Return on Capital Per Cent* (IV)†
1	81	11·3	15·5	155	12·2	17·7
2	207	8·2	9·7	303	8·0	10·5
3	76	9·6	12·9	121	8·4	13·6
4	43	1·6	2·3	27	4·9	6·1
6	137	4·1	5·1	150	3·9	5·0
10	(*a*) 85 (*b*) 64	7·9	12·5	(*a*) 80 (*b*) 60	9·9	13·8
12	364	3·9	5·9	294	6·3	9·2
14	39	9·0	11·2	90	8·9	12·9
15	280	13·9	16·7	240	16·4	22·6

(*a*) Depreciation calculated on fixed assets with rented assets included.
(*b*) Rented assets are excluded from capital.

*These two measures of rate of return on capital are based on the undepreciated or gross concept of fixed assets as discussed in the text (I) using replacement cost and (III) using original cost.

†Both measures are based on the written down or net concept of fixed assets as discussed in the text (II) using written-down replacement cost and (IV) using written-down original cost.

pattern comes from the fact that profit is calculated after depreciation and depreciation based on replacement cost with actual lengths of life may be higher or lower than depreciation based on original costs with conservative lengths of life. This can be seen in Table 3 where in several instances balance sheet depreciation is higher than that based on replacement cost. Firm 4 shows a very meagre rate of return of 1·6 per cent when calculated in the meaningful way I. This result is masked if original cost valuation is used as in III.

Rate of return on capital might also be used by shareholders or investors to assess the efficiency of the board of directors in their use of company assets. Both internal and external assets would be included. One approach is to consider the earnings on the existing assets and compare these with the return which could be obtained if all the tangible assets in the firm were sold off, and the proceeds invested in a different manner.

The appropriate measure of capital would again be based on replacement cost but this time it will be written down replacement cost as a proxy for second-hand market value. Working capital is included as are external investments at market value. It follows of course that income from external investments should be included with the profit figure. Rented assets are no longer included in the figure for capital since their value cannot be realised. Depreciation is calculated on the firm's own assets and ignores rented assets; the rental is treated simply as a current expense to be deducted from profits.

In Table 3 rate of return on capital is calculated this way. The figures of capital used in the calculations are rough estimates of written-down replacement cost. They had to be estimated from a rough knowledge of the firm's capital expenditures over past years. Number IV was calculated in a similar manner only using balance sheet valuations of fixed assets. As one would expect all values of II and IV are greater than the corresponding calculations in I and III with fixed assets valued new.

Only measures I and II, which are based on up to date valuation of fixed assets, can be used to compare different firms. While III and IV may be used internally to compare one year with another they can give a misleading impression of the performance of the firm.

Value added per unit of capital is an important measure used by government economist and development planning to estimate the expected primary increase in national income as a result of investment. As with capital per employee the interest may be in the return to all permanent capital or solely fixed assets. Fixed assets will once again be valued at replacement cost new and total permanent assets will be fixed plus working capital as defined before. Value added is taken as the sum of net profit and payments to labour. Loans and investments in other companies are excluded from capital and the income therefore excluded from the profit figure.

Table 4 shows a high inverse correlation between value added per unit of capital and the amount of capital per employee in Table 2. Other things being equal, it seems reasonable that development policy should attempt to attract

TABLE 4 : *Value Added per Unit of Capital*

Firm	*Trade*	*Value added per unit of fixed assets*	*Value added per unit of capital*
1	Food, Drink and Tobacco	·314	·241
2	,,	·266	·259
3	,,	·382	·323
4	,,	·227	·195
6	Engineering	·411	·294
10	Footwear	·582	·437
12	Non-Metallic Mineral Products	·362	·311
14	,,	·158	·148
15	Plastics	·371	·258

firms in trades which will produce a high value added per unit of capital or per unit of public expenditure on capital grants. If, however, profits are likely to be expatriated to a parent company abroad then wage bill per unit of capital may be a better guide to policy.

VI. RECOMMENDATIONS

The present study has indicated that replacement cost is a familiar concept to industry and those institutions associated with it. Furthermore the fact that all but two of the firms in the survey have replacement cost valuations while those two exceptions possessed basic data on original costs, suggests that a high proportion of firms, especially the larger ones, have or could obtain estimates of the replacement cost of their fixed assets. Industry has become aware of the importance of up-to-date valuations, mostly for insurance purposes, but more efficient firms have realised the necessity of adequate valuations for planning, costing and assessing efficiency.

The writer is firmly convinced of the practicability of the Central Statistics Office conducting a census of capital assets for the industries covered by the Census of Industrial Production. A Census, properly conducted, should produce good estimates of the replacement costs of fixed assets. Ten or even five years ago such a census would have been much more difficult. Since that time many firms have obtained replacement valuations for themselves often because they have become aware of the dangers of underinsurance.

The census will provide an estimate of capital stock at a particular date and annual adjustments will be needed to keep replacement cost up to date. Marginal adjustments are never perfect but if the information on additions, disposals and price changes is adequate, the figure for the stock of capital can be adjusted for several years without much risk of serious error. Producing estimates of replacement cost will involve some firms in an amount of expense and effort and it would be unreasonable to suggest that the census should be annual. A five yearly census would provide an adequate frame on which intercensal adjustments could be made. The statutory authority under which the Census of Industrial Production is carried out is from the Statistics Acts, 1926 and 1946. An Order by the Minister could provide the necessary authority for conducting a census of capital. The capital census should be linked closely with the Census of Industrial Production in execution and administration. The capital inquiry could be treated as a quinquennial addition to the usual annual CIP inquiry. The necessary administrative machinery is already at CSO and the firms are familiar with the CIP procedure. Further, the CIP already obtains information which can be used to obtain intercensal estimates, namely annual expenditure on fixed assets and a figure for disposals. However, a gap exists in the information on capital expenditure at present obtained. The first census form which a company returns covers the first financial year in which production occurs. Capital expenditure incurred before the financial year in which production starts is omitted. This may be a serious omission which should be corrected. Unfortunately, little can be done to remedy the series of figures on capital expenditure to date.

The present figure obtained for disposals has little meaning. It is simply the total of the scrap and second-hand prices obtained from the sale of assets; it bears little relation to the reduction in the value of fixed assets and no relation whatever to the reduction in capacity. One could obtain replacement cost valuations of the disposals from a schedule of original costs and dates of purchase of the assets being disposed of. I strongly recommend that those two modifications to the existing CIP procedure on capital assets should be implemented without delay.

For intercensal adjustment existing fixed assets could be revalued using index numbers for the appropriate categories. To this will be added the additions, and disposals at replacement cost will be deducted.

Thus:

Replacement cost of fixed assets at 1 Jan. 1968 = R.C. of Fixed Assets at 1 Jan. 1967
+ Expenditure on Fixed Assets during 1967
— Disposals during 1967 (all at 1 Jan. 1968 prices new).

The information requested in the capital inquiry will require more effort to produce than the questions asked in the CIP. The response is likely to be best with larger firms, many of whom will already have up-to-date valuations. They are also likely to be more conscientious in returning accurate valuations. The many smaller firms will present greater problems and probably return less reliable figures. It is a pity that this survey did not include some very small firms. Evidence of their practices would be most useful. Rather than attempting to cover all firms in the capital inquiry the most practical approach is to obtain figures for a large sample of firms and gross up the figure for all firms. Grossing up can be by trade group and category of assets. Figures of employment are readily available from the CIP and could be used to calculate ratios for the sample firms which could be applied to all. The sample should be stratified and weighted heavily towards the larger firms. Classifying size of firms on employment a sample pattern might be:

Size of Firms by Employment	Percentage of Firms in Sample
10 and under 25	10
25 ,, ,, 50	25
50 ,, ,, 1,000	70
1,000 and over	100

Many of the practical problems could be gauged in advance by a pilot survey. Fifty firms varying in size and occupation should be sufficient to reveal most of the snags. Giving early notice of the intention to conduct the capital census might also help to smooth out difficulties.

Fixed assets are usually classified into three main categories: plant and machinery, vehicles, buildings and land. National income accounts usually group the latter two together but at the survey stage it is better to treat them separately. Buildings are in some cases valued with the site value included, in others without, so it will be important to distinguish them separately. Valuation of land is an everyday task to auctioneers and valuers but their resale valuation bears little relation to the contribution of land to the production process. The economic rent element in its price is so large that an urban site may cost many times as much as a more efficient rural site. It is not practical for CSO to attempt to provide firms with a general index of land prices to apply to the site cost and it would be unjust to compel firms to provide valuations which would necessarily involve them in the cost of employing outside valuers. A possible approach would be to ask for details of site area and location together with the site valuation where possible. CSO could obtain approximate indices of area land prices partly from those returns which have up-to-date valuations and use these on the area figures for approximate site valuations. In most manufacturing industries land forms a small part of the value of total assets, so that those approximations will not much affect the estimates of total assets.

Clearly the first information to be given in the inquiry would be a definition of replacement cost. A general definition might be: the cost of replacing an asset with a new one having the same capacity. For buildings it would be taken as the cost of replacing new the same floor area and facilities, for vehicles, the cost of replacing new the horsepower and haulage capacity, and for plant and machinery, the cost of replacing new the equipment to produce the same net income. For simplicity the definition of the capacity of plant and machinery might have to be altered to "the ability to produce the same net output".

Questions and information given in the capital census form must be designed for those who already have their own replacement cost valuations or of those who must start from scratch. Questions directed to firms with their own replacement cost valuations should inquire how they were obtained and for what purpose. And instructions should be given on how to treat assets which have been excluded from their valuations, e.g. indestructible assets excluded from fire insurance valuations. There is considerable danger that these assets may be omitted unless direct reference is made to them. For those assets or for firms without replacement cost valuations, detailed instructions should be given on how to obtain replacement costs. Price indices for different categories of assets must be provided and instructions on how to apply them to original costs. Examples of cost comparison for assets for which there are no original costs must also be suggested. There should be no insistence on using the index numbers provided by CSO for they will be general indices for broad categories of assets, and in many cases firms will be able to produce better estimates using their own sources. Indices specific to their equipment or cost comparison are this type of refinement.

There will be problem firms and problem assets where no valuations are available. Figures of area for land, floor area for buildings and cost comparison for plant and machinery should offer a reasonable basis for estimation. One would normally expect vehicles to present few unsolvable problems.

Rented assets are part of an industry's productive fixed assets and should be covered in the inquiry. Their replacement costs and rentals are worthwhile information which should be obtained.

The inquiry has revealed some rather disquieting information about the gross capital stock measure calculated from the perpetual inventory method. Firstly, the sum of a set of annual expenditures at constant prices may not necessarily give a reasonable estimate of the whole. This was evidenced by the firm which acquired its additional floor area by buying out its neighbours. Capital expenditure is defined for the Census of Industrial Production as the actual cost of the asset either new or second-hand and no account is taken of the fact that the purchase price may be grossly inflated by market conditions. This is likely to be a problem with buildings only. The improvement element embodied in repairs discussed earlier will be missed by the perpetual inventory method. This may be a serious omission and it may partly account for apparent increases in productivity. It may explain why the replacement cost estimates in

the United Kingdom are higher than the gross capital stock estimates. There is need for a detailed inquiry into the extent of improvements and acquisitions included under repairs and maintenance.

VII. SUMMARY

The aim of this survey was to find a method of getting an adequate measurement of fixed assets in manufacturing industry. This meant inquiring into many aspects of the valuation and treatment of capital assets in the sample firms. It was firstly necessary to sort out what the different concepts of capital are and how they could be measured, and then to find out if a sufficient number of firms possessed the necessary details.

Capital is a heterogeneous collection of assets so that in order to measure the quantity of capital it is necessary to work in money terms. Changing prices or changing technology make it imperative to base the different measures on replacement cost, where replacement cost is defined as the cost of replacing the existing net income earning potential with new assets. *A priori*, replacement cost new should represent quantity or capacity; written-down replacement cost should represent value. One of the purposes of the survey was to determine how well these measures represent the concepts.

Replacement cost proved to be a familiar concept to all the manufacturing firms and those providing ancillary services. Of the fifteen manufacturing firms, thirteen had replacement cost valuations for all or part of their assets and the remaining two had the necessary original cost details from which it could be calculated. Some had employed the services of a professional valuer, others had used cost comparison or index numbers applied to original costs. While admitting imperfections in measurement the three approaches should give adequate estimates of replacement cost. The concepts being measured by these methods are close to our theoretical concepts.

Such evidence as could be collected, substantiated the use of replacement cost to represent capacity. Rather than decline throughout the life of a machine, capacity may well increase due to an improvement element in repairs. Firms stated that not till near the end of a machine's life does the output of a machine tend to fall off through excessive repairs and maintenance; when this happens the machine is scrapped. Changing technology, the most difficult aspect of capital of which to take account, appears to be less important in many industries than was originally supposed. It is virtually true to say that obsolescence through changing technology applied only to plant and machinery, not to modern buildings or vehicles. Most firms stated that there had been little change

in their basic production machinery over the past twenty years. Only three firms considered obsolescence an important factor in the design of their equipment and they reacted by accelerating depreciation.

In practice the resale value of an individual piece of equipment is less than its value to the firm. However, the written-down replacement cost of all fixed assets should give a good representation of their resale value if sold as a going concern. In practice, firms tend to write down assets at conservative rates; adequate valuation should be based on actual expected lengths of life.

Most of the firms who had replacement cost valuations used them for insurance purposes. Fire insurance is universal and the adequacy of cover has been improved tremendously over the past few years. The introduction of the "average clause" must receive much of the applause for forcing so many firms to revalue their assets, though there has been lately a general awareness of the inadequacy of balance sheet data for costing and planning purposes. Insurance valuations can be used in a supporting role in any inquiry into the replacement cost valuations of fixed assets.

Balance sheet valuation is, in general, completely inadequate for any serious study of the firm or industry. Any measure which involves fixed capital must use replacement cost. Whether replacement cost new or written-down, with all or some of the non-fixed current assets included, will depend on what one is endeavouring to explore.

The most satisfying part of this survey has been the realisation that many firms possess data on replacement and original costs and this should make the conduct of an official census of capital a practical proposition. A census, conducted on statutory authority by the Central Statistical Office, on a quinquennial basis, should enable the compilation of usable statistics on capital in the manufacturing sector. Annual adjustments would of course be required and these could easily be obtained if the capital census is operated in conjunction with the existing Census of Industrial Production. The existing questions in the CIP on acquisitions and disposals of fixed assets would have to be amended somewhat to make them more comprehensive and meaningful. Once the administrative machinery is established a reasonably small section in the Central Statistical Office could provide annual information on capital which is vital for Irish planners and economists.

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