

# Investment

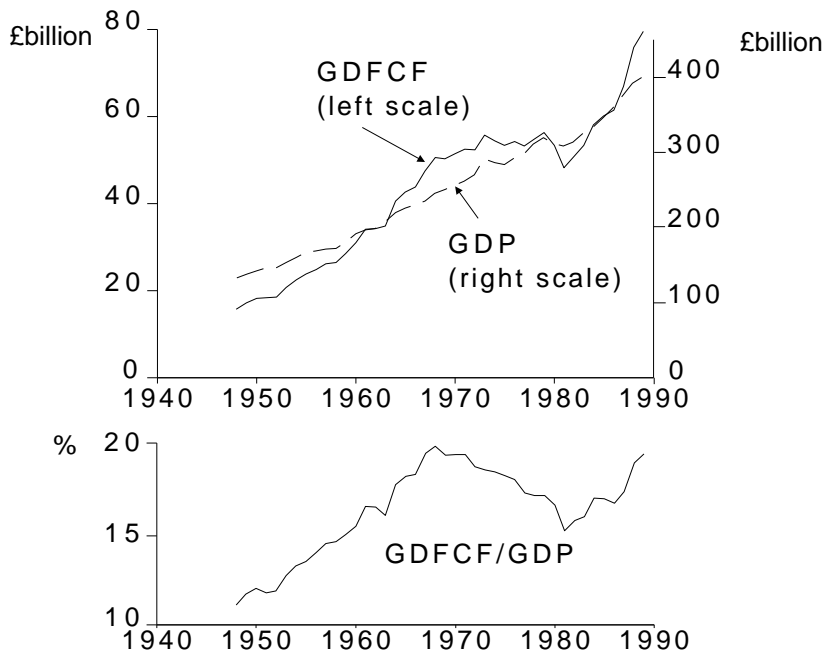
## 3.1 INTRODUCTION

Investment expenditure includes spending on a large variety of assets. The main distinction is between fixed investment, or fixed capital formation (the purchase of durable capital goods) and investment in stocks (inventories). These two categories of investment are in turn divided into three. Fixed investment comprises plant and machinery, buildings and vehicles; investment in stocks includes work in progress, raw materials and finished goods. For much of the time, however, it will be enough to look simply at the two categories of fixed investment and investment in stocks.

### Fixed investment

The simplest definition of fixed investment is *gross* fixed investment, or gross domestic fixed capital formation (GDFCF) which is simply the sum of all spending on new investment goods. The behaviour of gross investment since 1948 is shown in figure 3.1. Three main conclusions can be drawn from these graphs.

- ❑ Investment clearly fluctuates together with output, but it fluctuates more.
- ❑ During the 1970s there was a progressive decline in the proportion of real GDP being devoted to investment.



**Figure 3.1** Gross fixed investment and GDP

Source: *Economic Trends*. Measured in constant (1985) prices.

- From 1979 to 1981 there was a sharp fall in investment, followed by a recovery since 1981.

One reason for being interested in investment is that we are interested in the capital stock. To calculate the capital stock, however, it is not enough to know the level of gross investment (the quantity of new capital being created) — we also need to know how much capital is being 'lost' from the capital stock each year. There are two ways this can be measured: depreciation and scrapping.

- *Depreciation* (or *capital consumption*) is the loss of value of the existing capital stock due to machinery wearing out, becoming obsolete, and so on.
- *Scrapping* is the amount of capital that is scrapped and withdrawn from the capital stock.

These are similar, but are not the same. A machine will depreciate continuously in that its value declines all the time it is in use. Scrapping, on the other hand, occurs only once. Consider an example. A machine costs £100 to purchase, and it wears out gradually over 10 years, after which it is scrapped. Depreciation is £10 per annum. At the end of 10 years it is scrapped. Scrapping is thus zero for the first nine years, and £100 in the tenth year.

Using these two concepts we obtain two different measures of the capital stock.

- *Gross capital stock* includes the value (at replacement cost) of all capital goods that have not been scrapped. A machine thus remains in the gross capital stock valued at its full replacement cost until it is scrapped. Gross capital stock is estimated using the formula:

$$GK(t) = GK(t-1) + GI(t) - S(t),$$

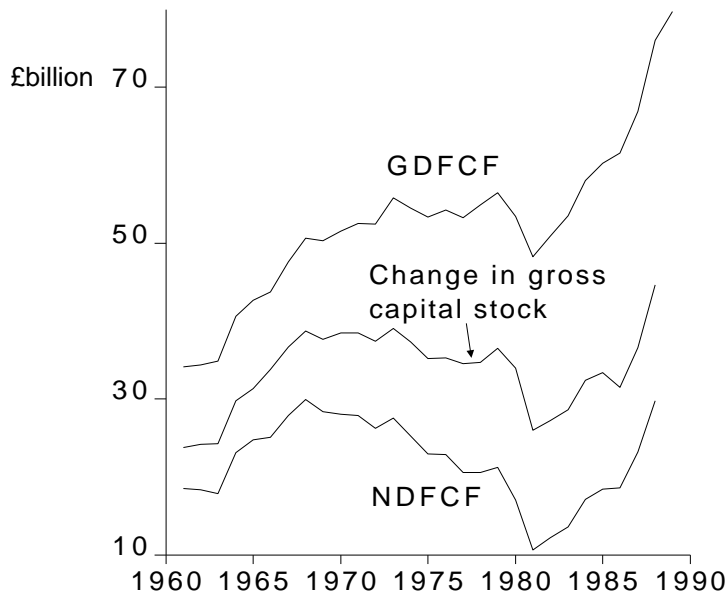
where  $GK(t)$  is the gross capital stock at the end of period  $t$ ,  $GI(t)$  is gross investment during period  $t$  and  $S(t)$  is scrapping in period  $t$ .

- *Net capital stock* includes the value of all capital goods net of depreciation. A machine that is part of the capital stock is valued at a smaller and smaller price as it depreciates. It is calculated according to the formula:

$$NK(t) = NK(t-1) + GI(t) - D(t),$$

where  $NK$  denotes net capital stock and  $D$  denotes depreciation.

Which measure of capital should we use? The answer depends on what we want to use it for. If we are interested in finance, then net capital stock, which measures the *value* of the capital stock, is the right one. If, on the other hand, we are interested in productive capacity, then the gross capital stock is more appropriate. Consider, for example, a car. If we are concerned with the financial aspects of investment, we should value a used car at its value on the second-hand market (i.e. allowing for depreciation): a 2-year old car may thus be worth only half a new car. This is what would appear in the net capital stock. On the other hand, the 'productive capacity' of a 2-year old car is the same as that of a new car. The car should be valued at replacement cost (the price of a new car) until it is scrapped. This is what happens with gross capital stock.



**Figure 3.2** Fixed investment and the change in the capital stock

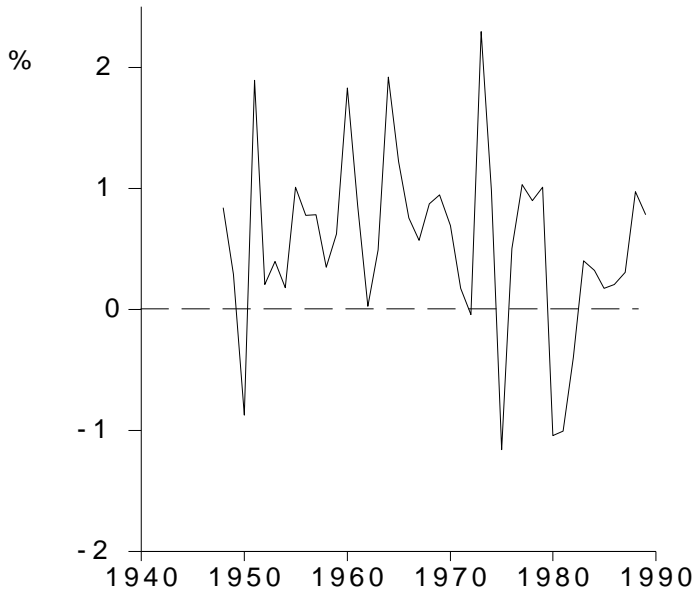
*Source: United Kingdom National Accounts. Measured in constant (1985) prices.*

The relationship between investment and the capital stock depends on which measure of capital we use. Net investment (gross investment minus depreciation) is the change in the net capital stock. The change in the gross capital stock is gross investment minus scrapping. Figures for these two measures of the change in the capital stock are shown in figure 3.2.

The main pattern revealed by figure 3.2 is that investment, according to all three definitions, rose substantially for most of the 1960s, but that after about 1968 net investment fell. From 1968 to 1978 the slight rise in gross investment was insufficient to keep pace with either scrapping or depreciation, both of which obviously increase with the size of the capital stock. The period from 1979 to 1981 was dominated by the fall in gross investment, since when there has been a limited recovery. Note, however, that whereas gross investment is now at its highest ever, net investment still remains low compared with the early 1970s. The implications of this low rate of investment and the resulting fall in the growth rate of the capital stock are considered in chapter 6.

## Investment in stocks

When considering investment in stocks it is important to distinguish between changes in the value of stocks that are the result of inflation (stock appreciation) and the physical change in stocks, for it is only the latter that constitute investment in stocks, or stockbuilding. As shown in figure 3.3, stockbuilding is a fairly small component of GDP. However, it fluctuates far more dramatically than any other category of spending: unlike other categories of spending it is sometimes negative. In the 1974-5 and 1980 recessions, for example, the change in the level of stockbuilding accounted for all of the change in GDP: from 1973 to 1975 GDP fell by £.3b., with stockbuilding falling by £10.3b.; from 1979 to 1981 GDP fell by £9.3b. with stockbuilding falling by £6.5b. (all these are in 1985 prices).

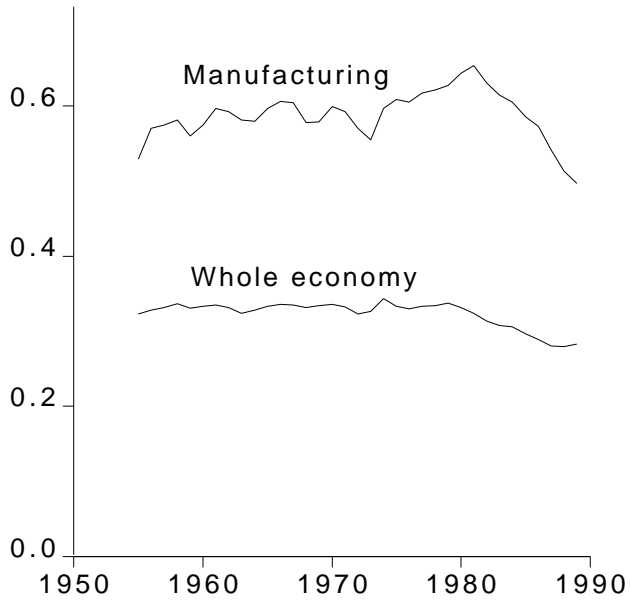


**Figure 3.3** Stockbuilding as a percentage of GDP

*Source: Economic Trends.*

Demand for stocks is clearly related to current output. Figure 3.4 shows the ratio of stocks to output for manufacturing and for the economy as a whole. Before 1979 there was little evidence of any trend, suggesting that firms kept the ratio of stocks to output fairly steady,

though both ratios fluctuated with the cycle. Since 1979, on the other hand, there has been a steady fall in stock ratios, suggesting that after about 1981, when we would have expected stock ratios to increase as the economy recovered from recession, firms changed their behaviour. Though the figures are not sufficient to prove this, they are consistent with firms having become more efficient after 1979, economizing on their holdings of stocks.



**Figure 3.4** Stock ratios

Source: Stock levels calculated from stockbuilding figures in *Economic Trends*.

## 3.2 MANUFACTURING INVESTMENT

### Investment and output

The level of aggregate demand is clearly an important factor underlying firms' investment decisions. To illustrate how this problem can be tackled we consider the case of manufacturing investment. The theory we will use to explain manufacturing investment is the flexible accelerator (see box 3.1), according to which,

$$\Delta K = \alpha v Y - \alpha K.$$

### BOX 3.1 THE ACCELERATOR

The most widely used version of the accelerator is based on two assumptions:

- The capital stock adjustment mechanism. Firms have a desired capital stock,  $K^*$  (which will be explained below) which is not necessarily the same as the capital stock they have actually got,  $K$ . If there is a gap between the desired capital stock and the actual capital stock, firms will plan to get rid of a certain fraction  $\alpha$  of this gap each period. This gives the following equation to determine the change in the capital stock,  $\Delta K$ :

$$\Delta K = \alpha(K^* - K).$$

- The capital-output ratio ( $v$ ). To produce any given level of output there will be an optimal (cost minimizing) level of capital that is required. The optimal ratio of capital to output, which we will call  $v$ , will in general depend on the relative price of labour and capital, but to keep things simple it is often assumed that it is constant. We thus have

$$K^* = vY.$$

Note that the use of actual output,  $Y$ , is another simplification, for we should really use expected output, something we cannot observe.

Putting these two equations together, we have

$$\Delta K = \alpha vY - \alpha K.$$

This is known as the *flexible accelerator*.

The version we will use is the following:

$$\Delta GK_t = \alpha v Y_{t-1} - \alpha GK_{t-1},$$

where  $GK$  is the gross capital stock (discussed above). To obtain total (gross) investment we have to add on replacement investment. In this equation investment in period  $t$  is assumed to depend on  $Y$  and  $GK$  in the previous period. The reason for including  $GK_{t-1}$  is that capital stock statistics refer to the stock at the *end* of the period concerned. The reason for using  $Y_{t-1}$  is that when firms decide how much to invest in period  $t$  they will not know what  $Y_t$  is going to be. They will have to base their decisions on previous levels of output, and the simplest assumption to make is that investment depends on  $Y_{t-1}$ .

If we estimate this equation we get the following:

$$\Delta GK_t = 0.30 Y_{t-1} - 0.076 GK_{t-1}.$$

This suggests that  $\alpha$  is 0.076 and that  $v$  is about 4 (0.3 divided by 0.076). This is consistent with the observed capital output ratio shown in figure 3.5 and implies that if output rises by £100, firms want their capital stock to rise by approximately £400.

If we assume that firms have a desired ratio of stocks to output the flexible accelerator could also be applied to stockbuilding. Such an equation for manufacturing is

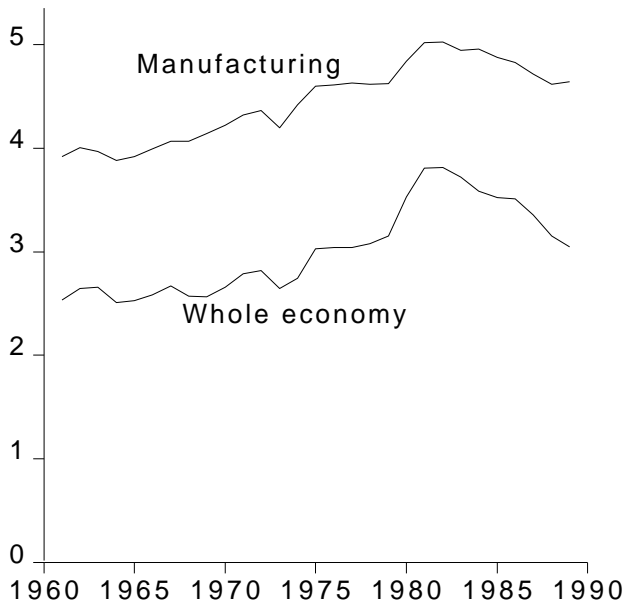
$$\Delta S_t = 0.22 Y_t - 0.36 S_{t-1}$$

where  $S$  denotes stocks and  $\Delta S$  stockbuilding (the value of the physical change in stocks). Notice that we have used current output, not last period's output, on the grounds that firms can vary stock levels relatively quickly in response to changes in demand. Two points are worth noting about this equation:

- The value of  $\alpha$  is 0.36, which is much higher than its value for fixed investment. This is what we would expect: that firms respond much more quickly to differences between desired and actual stock levels than they do to differences between desired and actual levels of fixed capital.



- The equation suggests that firms wish to hold stocks equal in value to about 85 per cent (0.22 divided by 0.36) of current output. This is higher than the observed ratio of stocks to output (see figure 3.4).

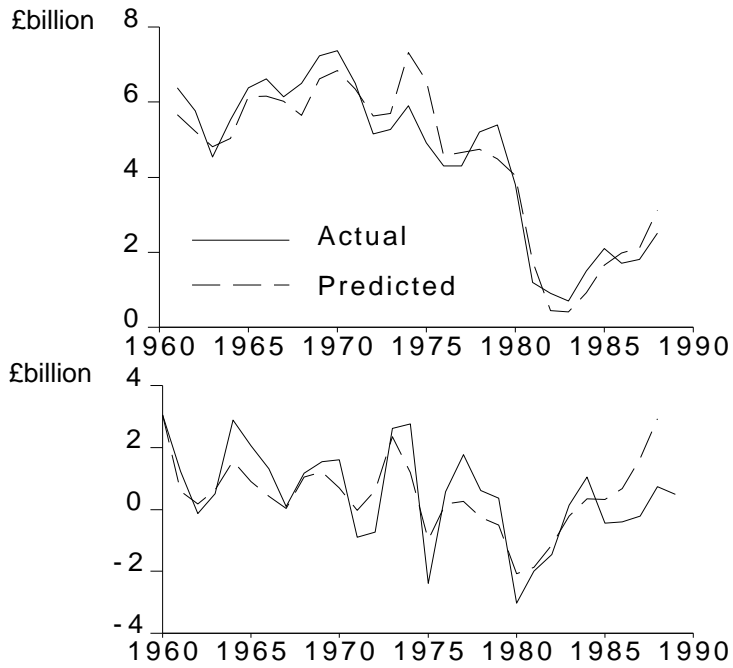


**Figure 3.5** Capital-output ratios

Source: Ratios of gross capital stock to output at factor cost (constant prices), from *United Kingdom National Accounts*.

To see how well these equations explain variations in investment in manufacturing, consider figure 3.6, which shows investment and stockbuilding compared with the values predicted by these equations. It is clear that our accelerator model fits the data for fixed investment much better than for stockbuilding. This is what we would expect: stockbuilding is volatile and depends on many other factors.

- Many changes in stocks will be unplanned: if firms find that they cannot sell their output the result will be a rise in stocks.



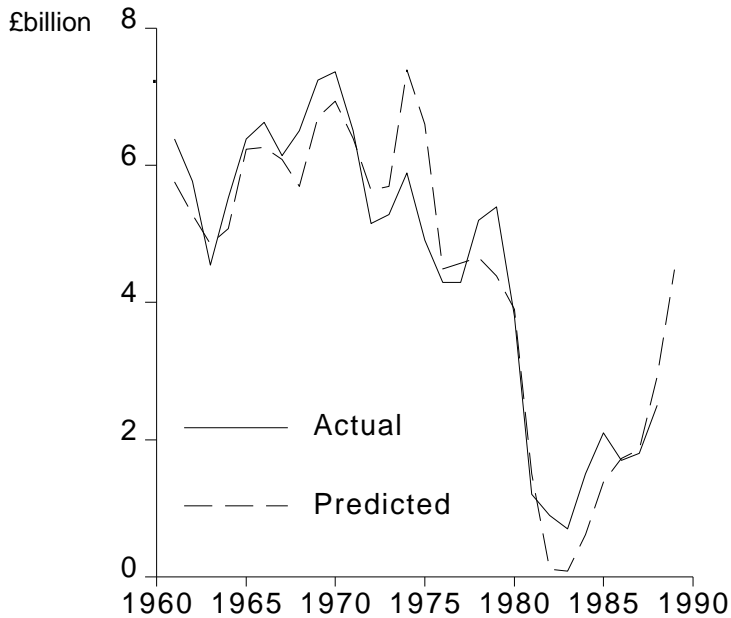
**Figure 3.6** Actual and predicted investment in manufacturing

*Source:* Calculated from equations discussed in the text.

- Because stockbuilding is a short-term decision, easy to change, it ought to be sensitive to fluctuations in costs and expectations about the future. Being a longer-term decision, fixed investment ought to be more stable.

One of the main features of the behaviour of fixed investment is the dramatic fall which took place from 1979 to 1981. Our simple accelerator model captures this fall quite well. The question which arises is whether the equation predicted this fall so well simply because this fall was part of the sample period over which the equation was estimated. To show that this was not the case, consider the version of the equation estimated over the period 1961-79 (i.e. leaving out all data on the 1979-81 fall in investment and the subsequent recovery). The equation we obtain is,

$$\Delta GK_t = 0.31Y_{t-1} - 0.082GK_{t-1}.$$



**Figure 3.7** Predictions of manufacturing investment using pre-1979 data

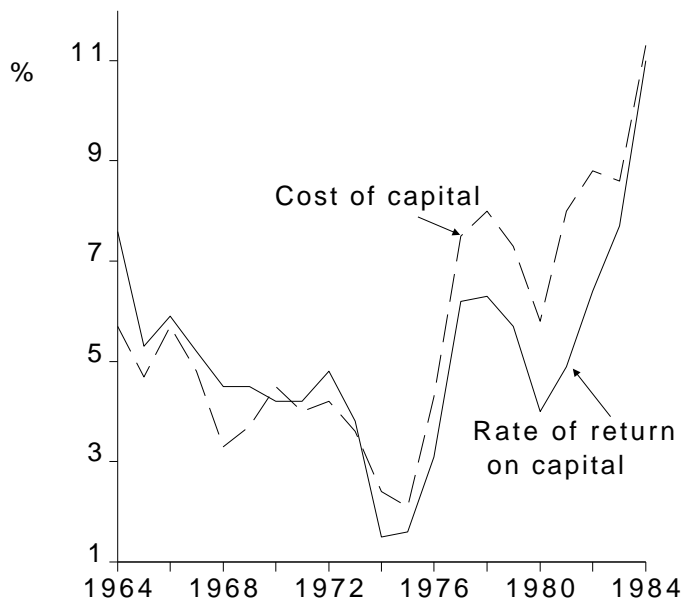
*Source:* Calculated from equation discussed in the text.

The coefficients are, not surprisingly, slightly different from those obtained when estimating the equation over the period 1961-88. The equation, however, still predicts the collapse in investment from 1979 to 1981 successfully, together with the subsequent recovery, as is shown in figure 3.7.

### Investment and profitability

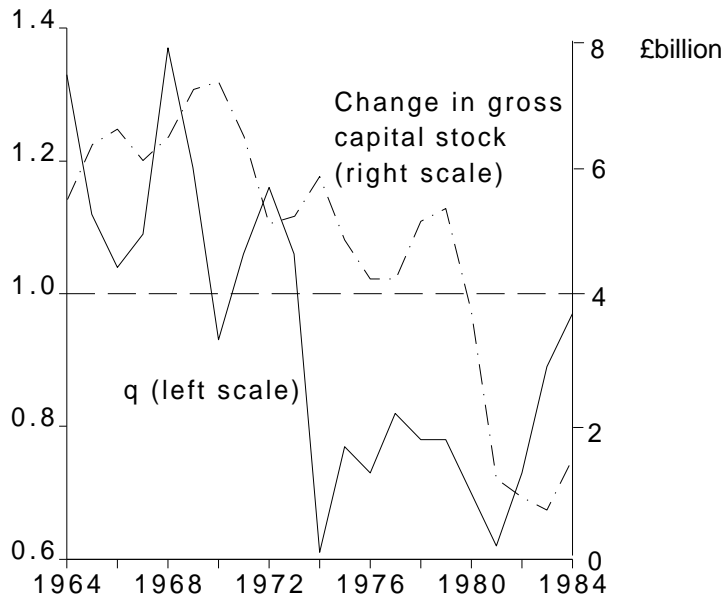
Investment should also depend on profitability. There are two reasons for this. The first is that firms are assumed to maximize profits, and high profitability provides an incentive to invest. The second is that high profits provide firms with the funds they need to carry out investment projects.

The incentive to invest depends on two factors: the profits that firms expect to obtain on new investment, and the cost of obtaining finance. The relationship between these is best described by what is usually known as 'Tobin's  $q$ ', or just ' $q$ ' (see box 3.2). Estimates of the cost of



**Figure 3.8** The rate of profit on capital and the cost of capital

Source: James H. Chan-Lee 'Pure profits and Tobin's  $q$  in nine OECD countries,' *OECD Economic Studies* 7, 1986, pp. 205-32.



**Figure 3.9** Gross investment and  $q$

Source: as figure 3.8 and *United Kingdom National Accounts*.

capital, the rate of return on capital, and the value of  $q$  that results from them are shown in figures 3.8 and 3.9. In figure 3.8 there is a clear relationship between the rate of profit and the cost of capital. On average they move together, but  $q$  has nonetheless changed substantially over the period. The most noticeable change was the decline in  $q$  in the mid-1970s, followed by a partial recovery in the 1980s.

The evidence from figure 3.9 does not suggest a particularly close relationship between  $q$  and investment (measured here by the excess of gross fixed investment over scrapping). These statistics are, however, subject to a number of particularly severe measurement problems. In times of rapid change, such as the 1970s, it becomes particularly difficult to measure the capital stock, because the rates of depreciation and scrapping are liable to increase. Measures of depreciation and scrapping based on conventional lifetimes for different types of capital equipment will thus understate the true extent of depreciation and scrapping. It is thus likely that the capital stock was rising less rapidly than these figures suggest: there may thus have been more of a fall in investment during the mid-1970s than figure 3.9 suggests. In addition, if depreciation is under-estimated, the capital stock will be over-estimated. The result will be that  $q$  will be under-estimated (see box 3.2 for the alternative definition of  $q$ ). It is thus possible that figure 3.9 overstates the fall in  $q$  in the mid-1970s. For these reasons, therefore, it is hard to use evidence such as that contained in figure 3.9 to say whether or not investment is or is not related to  $q$ .

### Profits and the availability of finance

The other way to link profits to investment is to argue that high profits provide the funds that firms need to finance investment. This is an argument that makes sense only if the capital market is imperfect: in a perfect capital market the opportunity cost of finance would be exactly the same whether a project were financed by borrowing or from internal funds. Imperfections may arise in a number of ways: borrowing and lending rates may be different; transaction costs may be associated with borrowing and lending (new share issues, for example, are very expensive); new issues may dilute control of the company; and issuing debt may be regarded by the market as making a company too risky (the problem of gearing). Given problems such as these there may be a preference for financing investment projects out of retained profits rather than from external finance. Historically this has been the case, most investment in the UK being financed out of retained profits (the same is not true in other countries).

**BOX 3.2 TOBIN'S  $q$** 

' $q$ ', often called Tobin's  $q$  after the economist who developed the concept, can be defined in two ways.

- The ratio of the rate of return on capital ( $R$ ) to the cost of capital ( $r_K$ ). The rate of return on capital gives the amount of profit that the firm will make from investing £100 in capital goods. The cost of capital is the percentage return that has to be paid to the people who supply finance to the firm. The cost of capital includes not only interest on debt but also the return to equity shareholders. We thus have  $q = R/r_K$ .
- The second definition is the ratio of the market value of a firm (the value of its equity plus net debt),  $V$ , to the value of its capital stock at replacement cost,  $PK$  (because we have defined  $K$  as the physical stock of capital we have to multiply it by the price level,  $P$ , to obtain its value in current prices):  $q = V/PK$ .

We can easily show that these two definitions are equivalent. The cost of capital is defined by  $r_K = \text{profits}/V$ . The reason for this is that profits ultimately accrue to the suppliers of finance: if profits are not paid out as interest on loans they are either paid as dividends to ordinary shareholders or are retained in the firm, in which case the shareholders should get a return in the form of capital gains. The price of shares, and hence  $V$ , will be determined in the market so that, given the firm's profits,  $\text{profits}/V$ , the return to investing in the firm, equals  $r_K$  the rate of interest at which investors are willing to supply finance to the firm. If  $\text{profits}/V$  is too low, for example, people will be unwilling to hold the firm's shares and so  $V$  will fall.

We can similarly define the rate of profit on capital as  $R = \text{profits}/PK$ . This rate of return is determined by the producti-

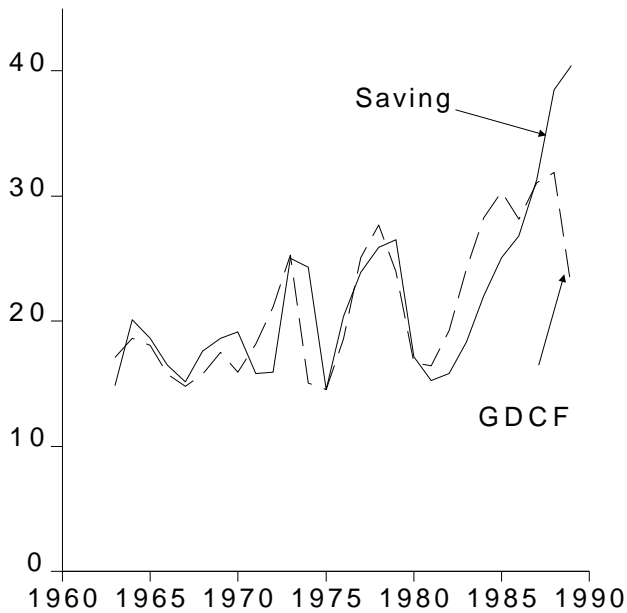
vity of capital (in perfect competition, the marginal product of capital). It follows that

$$q = R/r_K = (\text{profits}/PK)/(\text{profits}/V) = V/PK$$

These two definitions of  $q$  are equivalent.

The value of  $q$  is that it provides a measure of the incentive to invest. In a simple world with no taxation there will be an incentive to invest in new capital goods if  $q$  is greater than 1: if  $q$  is greater than 1 then investing £100 in new capital equipment will increase the value of the firm by more than £100. The difference between  $q$  and 1 measures the profit to be made over and above the cost of capital. Similarly, if  $q$  is less than 1 there will be a disincentive to invest.

In the absence of taxation the equilibrium valuation ratio is 1: if  $q = 1$  firms have no incentive either to increase or to decrease the capital stock. If we allow for taxation, however, the equilibrium valuation ratio may not be equal to 1. Consider the firm's decision about whether to give £1 to shareholders as dividends or to retain it to invest in new capital goods. If firms are run so as to maximize the returns to their shareholders the return to shareholders from an additional £1 invested should be the same as the return from an additional £1 in dividends. If this were not the case then firms would wish to change their dividend policy so as to make shareholders better off. The return to shareholders of an additional £1 in dividends is  $\pounds(1-t)$  where  $t$  is the marginal rate of income tax. The return from an additional investment of £1 is  $\pounds(1-z)q$ , where  $z$  is the marginal rate of capital gains tax. The reason is that £1 worth of new capital raises the value of the firm by  $\pounds v$  and that this gain is subject to capital gains tax. If the firm's dividend policy is to be optimal, therefore, we must have  $1-t = (1-z)q$ , or  $q = (1-t)/(1-z)$ . If income and capital gains tax rates are different, therefore, the equilibrium valuation ratio will be different from 1.



**Figure 3.10** Saving and investment by industrial and commercial companies

*Source: Economic Trends.*

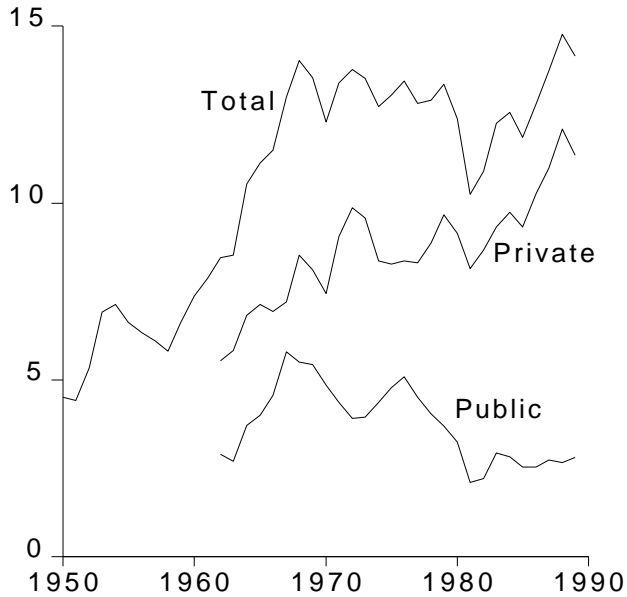
Evidence on this is given in figure 3.10 which shows saving by industrial and commercial companies (roughly retained profits) together with investment. It is clear that there is a close connection between the two. Causation, however, could run in either direction. It could be that the availability of finance influences investment. Alternatively, it is possible that the need to finance investment determines the level of profits that companies choose to retain.

### 3.3 INVESTMENT IN HOUSING

Investment in housing is shown in figure 3.11. Total investment in housing is divided between private and public-sector investment. Before 1968 these were both increasing, but since then public-sector investment in housing has been falling, whilst private-sector investment has been rising. Because changes in public-sector housebuilding are determined by government policy, dominated in this period by pressure to reduce government spending, the rest of this section will be concerned only with private-sector investment in housing.



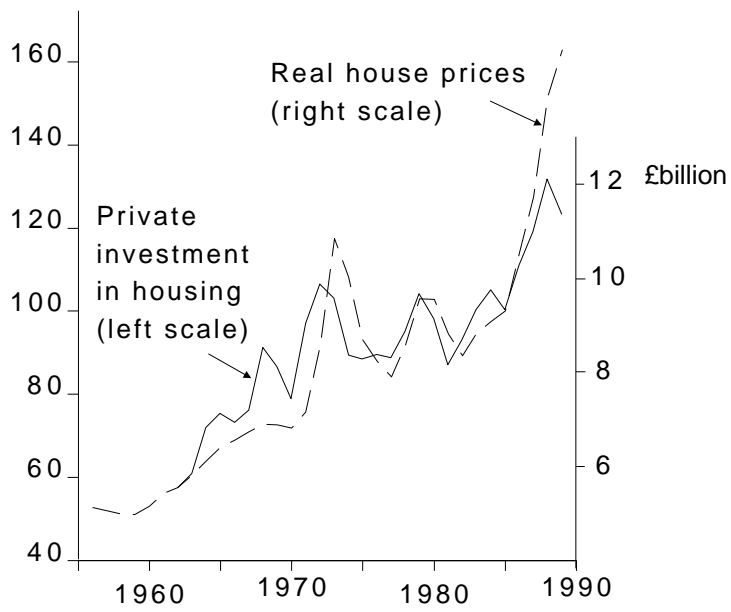
Private-sector investment in housing can be explained using a theory very similar to Tobin's  $q$ . The theory is that the market price of housing depends on supply and demand for the *stock* of housing, with demand depending on factors such as household incomes and the cost of mortgages. Because second-hand houses are bought and sold so frequently the market price of housing is easily observed. The level of investment in housing (the number of new houses built) depends on the price of housing relative to the cost of building new housing: if this ratio is high, there will be a great incentive to build houses, and if it is low few houses will be built. Eventually new housing will increase the stock of housing and thus affect price, but because the existing stock is



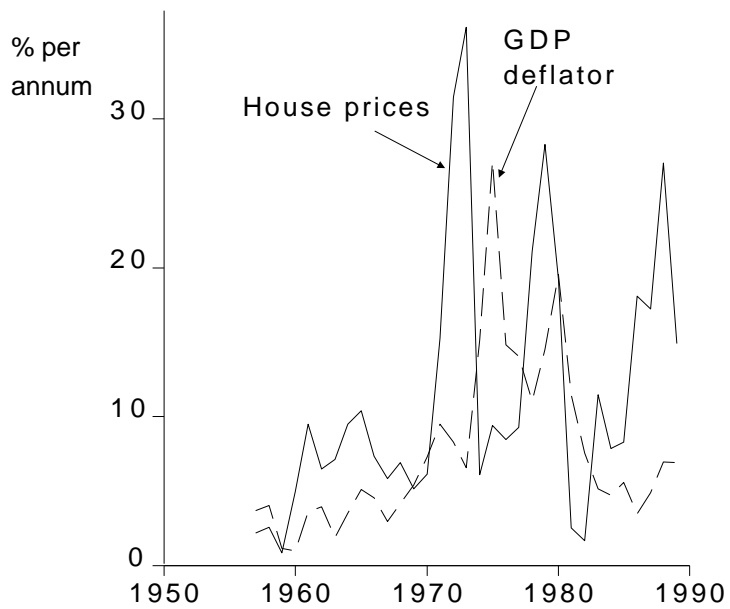
**Figure 3.11** Investment in housing

*Source: Economic Trends.*

so large relative to the amount of new housing this process will take a long time. Although the gap between the price of housing and its replacement cost measures the incentive to build, however, we would not expect the two to be equal. The reason is that building new housing requires land, and the supply of land, combined with planning restrictions, limits the amount of new construction that can take place.



**Figure 3.12** Investment in housing and the price of housing  
*Source: Economic Trends, Housing and Construction Statistics, Datastream.*



**Figure 3.13** House price inflation and the GDP deflator  
*Source: as figure 3.12.*

In practice, however, it is difficult to find a measure of the cost of housing which is different from the price at which houses are sold. There is the further problem that houses are not all the same: new housing is physically different from older housing and thus commands a different price. In figure 3.12, therefore, we use a measure of the real price of housing calculated by dividing the average price of new housing by the GDP deflator. The GDP deflator is used as a broad measure of costs: a measure of replacement cost (comprising labour, materials and normal profits) would be preferable, but is not available.

Figure 3.13 shows changes in the two variables that make up the real price of housing. Since the 1970s there have been three periods when house prices were rising rapidly: 1972-3, 1979-80 and 1983-7. In all three periods house prices rose much faster than the general price level and the real price of housing rose. The real price of housing fell during 1974-5 and 1980, when house prices failed to keep pace with the general price level.

Figure 3.12 strongly suggests that there is a close connection between the real price of housing and investment in housing by the private sector (we would expect public-sector investment to be less responsive to prices). The real price of housing and private-sector investment both move with the business cycle: there was a housing boom, associated with high prices, in 1973, followed by falls in both in 1974-5. There was a further boom in 1978-9, followed by a sharp recession in 1980 since when there has been another boom. There is, of course the possibility that there is no direct link, both being determined by some common cause, but a causal link from the real price of housing to the level of private-sector investment seems likely.

The price of housing depends on demand (in the short run the stock of housing changes little) and demand should depend on income and interest rates. Figure 3.13 also shows real personal disposable income alongside the real price of housing. The relationship is much what we would expect. In the boom of 1978-9 the rise in the price of housing was associated with rising real incomes and a low real interest rate. The sharp fall in the price of housing relative to costs in 1980-1 was the result of a fall in real income and a sharp rise in the real interest rate. The boom since 1981 has been caused primarily by rising real incomes, for real interest rates have, by the standards of the 1970s, remained very high.

### 3.4 CONCLUSIONS

Investment is one of the most difficult components of aggregate demand to explain, for it depends, to an even greater extent than do other categories of demand, on expectations. Many investment projects yield returns over long periods of time, so firms may have to form expectations concerning events even 20 or 30 years away. Such long-term expectations are unlikely to be directly related to current conditions, and to the variables economists can observe. With investment in stocks, the problems are different, for stockbuilding will reflect not only the planned changes in firms' inventories, but also unplanned changes. Such mistakes are, by their nature, hard to predict.

Notwithstanding these problems, the theories of investment discussed in this chapter appear to have some value as explanations of investment: the simple accelerator model performs better than might be expected in predicting manufacturing investment. Real house prices seem very closely connected to private investment in housing. Investment is thus not completely unpredictable.

### FURTHER READING

K. F. Wallis *et al.* 'Econometric analysis of models of investment and stockbuilding', in *Models of the UK Economy: a Fourth Review by the ESRC Macroeconomic Modelling Bureau* (Oxford: Oxford University Press, 1987) provides a short, clear account of the theory of investment and an appraisal of the investment functions used in the main macroeconomic forecasting models. Colin Mayer 'The assessment: financial systems and corporate investment', *Oxford Review of Economic Policy*, 3(4), pp. i-xvi, examines the way UK investment is financed and discusses the implications of financial market liberalization for investment. The housing market is investigated in John Ermisch (ed.) *Housing and the National Economy* (Aldershot and Brookfield, VT: Avebury, 1990), a book which covers much more than simply investment in housing. Investment is discussed in the context of capital accumulation and changing productive capacity in chapter 6.