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Investment, output and the stock market

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Interpreting Economic Data

Investment, Output and the Stock Market

Paul Turner
Department of Economics
University of Sheffield

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Correspondence Address

Dr P.M. Turner
Department of Economics
University of Sheffield
9 Mappin Street
Sheffield
S1 4DT
UNITED KINGDOM

Tel: 0114 2223404
e-mail: p.turner@sheffield.ac.uk

Introduction

An understanding of investment is essential if we are to explain the behaviour of the economy in both the long and the short run. In the short run we observe that business cycle movements in Gross Domestic Product (GDP) are closely related to those of aggregate investment spending. In the long run it is investment in physical capital which determines the productive capacity of the economy and therefore its long term growth prospects. This article will look at some of the approaches which have been taken to the explanation of investment behaviour. In particular, we will concentrate on the approach known as the ‘Tobin’s q ’ model. Using American data we will examine the extent to which this is consistent with observed investment behaviour and how it can be used to predict both the level of investment and the cyclical behaviour of aggregate output.

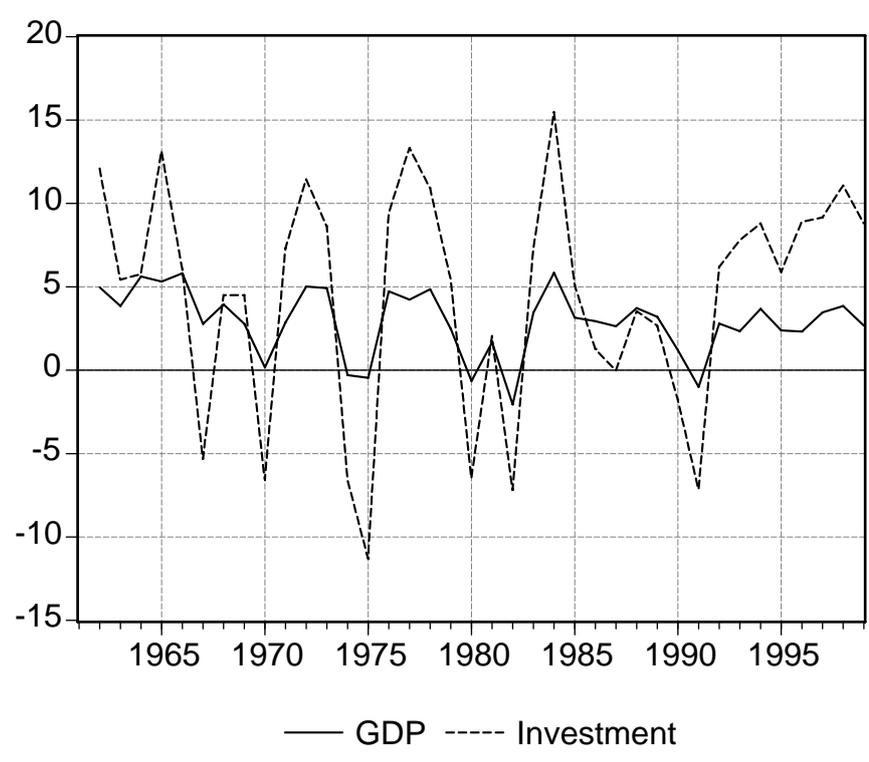
The relationship between investment and GDP

For most economies there is a close relationship between movements in investment spending and aggregate output. For example, consider the data for the US economy shown in Figure 1. It is clear that the peaks and troughs of the investment cycle match those of GDP very closely. This in itself however, does not tell us whether it is the cycle in investment which is causing the cycle in GDP or whether it is the expansion and contraction of aggregate output which is pulling investment along in its wake.

For many years the popular *accelerator* model hypothesised a fairly mechanical relationship in which changes in output required the capital stock to adjust which in turn caused investment to rise. Thus this model has the direction of causation running from output to investment. However, the accelerator model is arguably over simplistic. It assumes a very rigid relationship between capital and output and has nothing to say about the role of expectations and future profitability. In contrast, the neo-classical approach allows some degree of substitutability between labour and

capital in the production process. This means that in the short run output can rise without there necessarily being a simultaneous increase in the capital stock. Once this is the case then investment decisions become more concerned with long run profitability than with the short run response to changing output. In this case it becomes more accurate to think in terms of changes in investment causing changes in GDP rather than vice-versa.

Figure 1: Annual % growth rates for GDP and investment



When the direction of causation runs from investment to GDP, then our model effectively becomes the Keynesian multiplier model. In this framework investment is regarded as exogenous (Keynes attributed it to the ‘animal spirits’ of entrepreneurs) and acts as an injection into the circular flow of income. The equilibrium level of output is then determined by a multiplier process. The multiplier tells us by how much output rises when there is a unit increase in GDP.

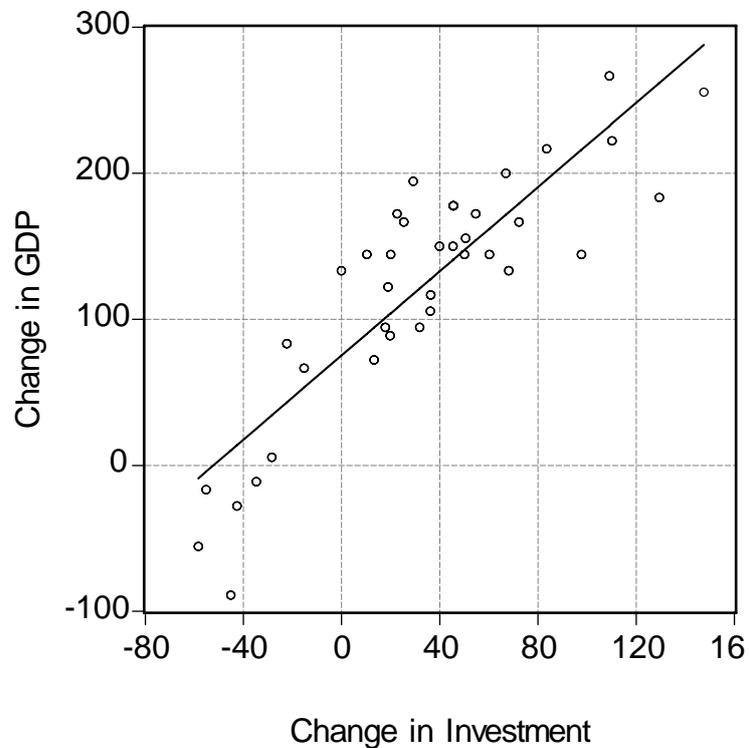
How big is the effect of investment on GDP for the US economy? To answer this question we need to make use of a scatter diagram approach coupled with a line of

best fit. For example, in Figure 2, we show the scatter for the percentage change in investment against the percentage change in GDP. We can see from the close grouping of the observations around the best fit line that there is a fairly close relationship between these two variables. Calculation of the best fit line gives the following results.

$$\text{Change in GDP} = 75.2 + 1.44 \times \text{Change in Investment}$$

The best fit line above indicates a strong multiplier effect of investment on output. A \$1 increase in investment produces an increase in GDP of \$1.44. This may seem modest by the standards of simple textbook Keynesian models but is quite large when we take into account the numerous leakages from the circular flow of income (taxation, imports etc) which are often neglected by such models.

Figure 2: Scatter diagram for change in GDP and Investment



The relationship between investment and Tobin's q

Since we have argued that the simple accelerator model is probably not the best approach to the determination of investment, we need to consider alternatives. One such is provided by the q theory of investment which was first put forward by the American economist James Tobin. The main novelty of this approach is the influence of the stock market on investment expenditures. Tobin, who won the Nobel prize for his work on the integration of the real and financial sectors of the economy, defined q to be the ratio of the market value of capital to its replacement cost:

$$q = \frac{\text{Market Value of Capital}}{\text{Replacement Cost of Capital}}$$

The main advantage of the q variable is that it acts as a proxy for market expectations. The market value of capital is determined by expectations of future profits. When this is high relative to the replacement cost of capital, then there is an incentive to invest. The model therefore predicts a positive relationship between q and investment. In doing so, the model also provides a valuable framework within which we can discuss the effects of recent movements of the stock market. From the East Asian crisis of 1997 until last year, stock markets in industrial economies rose steadily. However, we have recently seen sharp reverses in many countries. On this basis the q model predicts that the investment will slow down in response during the immediate future leading, in turn, to a slowdown of world output growth.

We will now proceed to investigate if our theoretical propositions are supported by the data. The first stage of our investigation is to obtain a measure of q . First we note that we can express q as a ratio of the price of equity to the price of new capital goods. This can be shown as follows: the market value of existing capital is equal to $p_E K$ where p_E is the market price of a unit of existing capital and K is the number of units of capital outstanding. The replacement cost of capital can be written $p_K K$ where p_K is the price of new capital goods. Taking the ratio of these two expressions and

cancelling K which occurs on both the numerator and the denominator gives $q = \frac{p_E}{p_K}$.

This simplifies the measurement of q considerably.

Table 1 contains the basic data necessary to calculate a measure of q for the US economy. Our measure of the price of equity is the Standard and Poors composite index of 500 shares while our measure of the price of new capital goods is the deflator for gross private sector investment expenditures.

Table 1: Calculation of q for the US economy

Date	$p_E =$ Equity Price Index	$p_K =$ Price Deflator for Investment	$q = \frac{p_E}{p_K}$
1990	334.6	100.0	3.3
1991	376.2	101.5	3.7
1992	415.7	101.5	4.1
1993	451.4	103.0	4.4
1994	460.4	104.4	4.4
1995	541.7	105.7	5.1
1996	670.5	105.6	6.3
1997	873.4	105.5	8.3
1998	1085.5	104.8	10.4
1999	1327.3	104.6	12.7

Source: Business Statistics of the United States Economy

The calculations in Table 1 show a value of q which increases steadily throughout the 1990s from a value of 3.3 in 1990 to 12.7 in 1999. We should note at this stage that what is important here is not the absolute value of our calculated value of q but its change over time. Our calculations here are based on the ratio of two variables expressed in index form. It follows that the absolute value of the ratio depends on the base years used for each of the index numbers. We could arbitrarily change the scale of the values of q calculated by, for example, taking a different base year to express the investment price deflator. This does not mean to say that our calculations are useless – they can still tell us the direction in which investment ought to move when q changes.

Next we need to test the hypothesis that the investment has a positive relationship with q . Table 2 contains data for investment in the US economy (Gross Private Investment \$bn at 1990 prices). In order to provide a relevant scale for investment Table 2 also gives data for total output (Gross Domestic Product \$bn at 1990 prices). If the q model is correct then we should observe a positive relationship between the share of investment in GDP and the value of q .

Table 2: Investment and GDP data for the US economy (\$bn at 1990 Prices)

	$I =$ Investment	$Y =$ Gross Domestic Product	Percentage share of investment in GDP = $100 \times \frac{I}{Y}$
1990	847.2	5554.1	15.3
1991	788.7	5498.6	14.3
1992	839.2	5654.1	14.8
1993	907.2	5787.4	15.7
1994	990.7	6004.0	16.5
1995	1050.8	6148.4	17.1
1996	1148.4	6292.8	18.2
1997	1258.6	6515.0	19.3
1998	1406.1	6770.5	20.8
1999	1535.5	6953.7	22.1

Source: Business Statistics of the United States Economy

The calculations in Table 2 indicate that investment in new capital increased substantially as a share of GDP from 15.3% in 1990 to 22.1% in 1999. This is consistent with the predictions of the q model since the value of q also rose significantly during the same period. However, conclusions based on a short period of data – even one as long as a decade – should be treated with some suspicion. With this in mind we now turn to graphical examination of a much longer sample period. Figure 3 shows the values of q and the share of investment over the period 1961-1999.

Figure 3: Investment as % of GDP and q

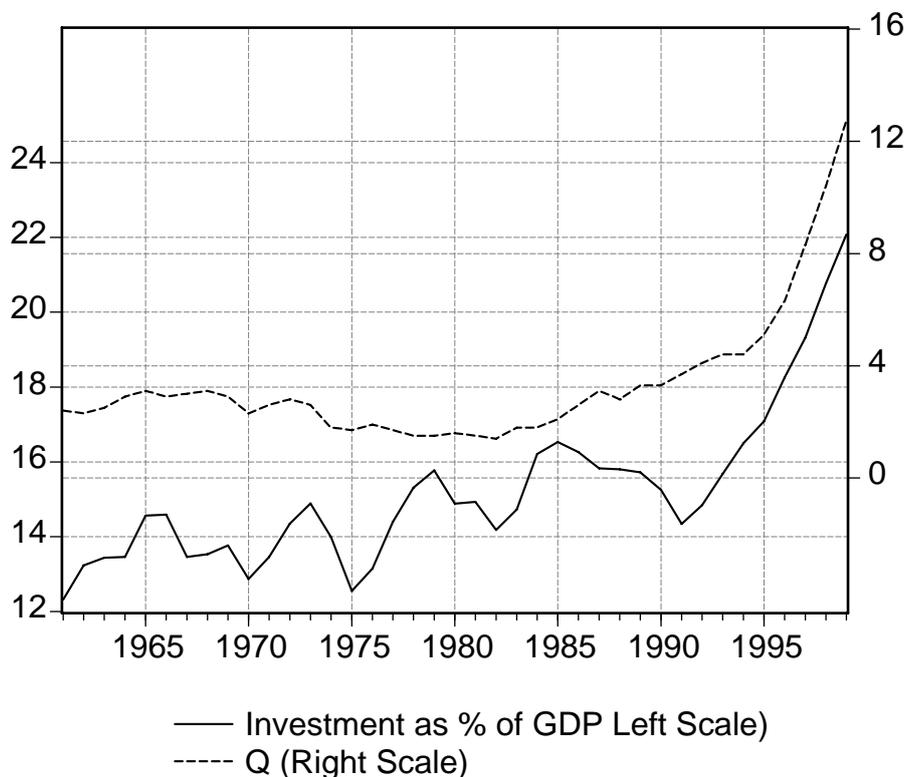
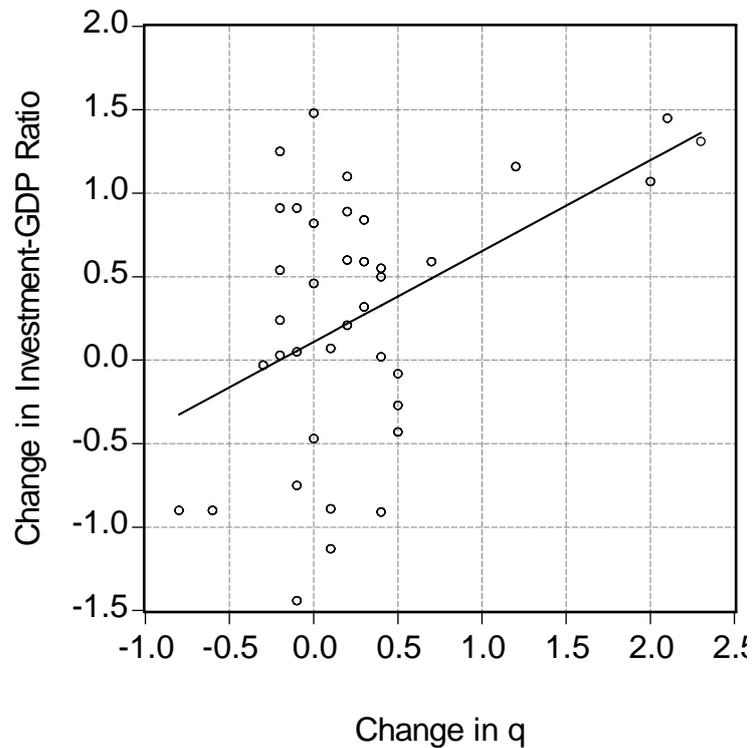


Figure 1 is certainly indicative of some form of relationship between investment and q . The positive relationship between the variables which we have identified for the 1990s is clearly visible in the diagram as well as in the Tables. Despite this however, the overall relationship is less clearcut than would be suggested by either the theory or the data for the 1990s. For example, during the period 1985-1990, q increased but there was a sharp fall in the ratio of investment to GDP. More supportive evidence can be found in the fact that troughs in investment coincided with downturns in q in both 1970 and 1975.

So far we have simply examined how each series has evolved over time and looked for common patterns in their behaviour. While this is a useful first stage it does not give us any quantitative information on either the size or the importance of the relationship. An alternative approach is to look at a scatter diagram relating investment and q . Such a diagram is present in Figure 4 which plots the change in the investment-GDP ratio against the change in q . This provides a much tougher test for

the presence of a relationship between the two variables for several reasons. The first is that it becomes easier to focus on the spread of observations as a whole rather than concentrating on one or two years of data. The second reason why this provides a tougher test is that, by taking differences of the data, we have eliminated any possible common trends in the series which would lead us to infer a relationship even when none was present. Even given these adjustments, it is clear from Figure 4 that there is a positive relationship between the series. This is confirmed by the positive slope of the line of best fit shown in the diagram. However, it should also be noted that the spread of observations around the best fit line is not particularly close. This implies that, even though a relationship is present, it is not a particularly strong one.

Figure 4: Investment and q



The scatter diagram approach also enables us to quantify the relationship between the variables more accurately. We can determine the line of best fit as:

$$\Delta \frac{I}{Y} = 0.11 + 0.54 \Delta q$$

This indicates that a rise of 1 percentage point in q will result in a rise in the investment-GDP ratio by 0.54%.

Conclusions

In this article we have looked at the determinants of investment expenditures for the US economy. Although there is a strong relationship between changes in investment and changes in GDP we have argued that this reflects the multiplier effects of investment on GDP rather than the accelerator effects of GDP on investment. This is because investment is likely to be more influenced by long term profits than short run movements in output. Tobin's q provides an alternative theory in which profitability influences investment through its effects on the stock market. Evidence from the US economy indicates a positive effect of q on investment but there are clearly other factors which we have not taken into account. What the q theory does indicate is some cause for concern over recent movements in stock prices. If the theory above is correct then recent falls in share prices should produce a fall in investment and this in turn is likely to lead to downturn in GDP growth and possible recession.

Questions for thought and further discussion

1. Suppose the value of the stock market increases by 5% while the replacement cost of capital increases by 7%. What are the implications for the value of q and what is likely to happen to investment as a result?
2. Download data for investment and GDP for the UK economy from my website www.shef.ac.uk/~ptn/downloads/download.htm . Use this data to create a graph similar to Figure 1 and assess the differences and similarities between the behaviour of investment in the UK and the USA.
3. Both the accelerator model of investment and the multiplier model of output predict a positive relationship between investment and output. However, these two theories make very different assumptions about the direction of causality. Set out the differences between the theories and consider which you believe to be most relevant for the practical analysis of the economy.