Long-run equilibrium ratios of business investment to output in the United Kingdom

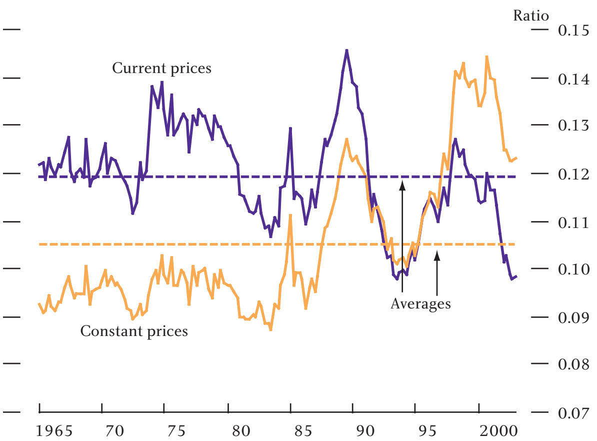
By Colin Ellis and Charlotta Groth of the Bank's Structural Economic Analysis Division.

Over the past 20 years, the constant-price and current-price ratios of business investment to total output have behaved very differently. In this article we use a simple framework to examine how these two ratios should behave in long-run equilibrium. We investigate the conditions in which each ratio will be constant and, more generally, consider how each might evolve over time.

Background

Over the past 20 years, the ratio of business investment to output measured at constant prices has been rising while the ratio measured in current prices has been falling (see Chart 1).(1) In the most recent data, the current-price ratio is close to the lowest on record, while the constant-price ratio is significantly above its long-run average. The different patterns in these two ratios have been discussed by Bloom and Bond (2001) and in the February 2003 *Inflation Report* (Bank of England (2003a)). Furthermore, as noted in the minutes of the Monetary Policy Committee (MPC) meeting in December 2002, '...it [is] unclear whether the nominal share or the constant price share [offers] the best guide to the sustainable level of investment' (Bank of England (2003b)).

Chart 1
Business investment to output ratios



Past work at the Bank of England has focused on explaining UK business investment using econometric methods, eg Bakhshi and Thompson (2002). In this article we examine how the two ratios of business investment to output should in theory behave in long-run equilibrium. We discuss what determines the long-run behaviour and which ratio is easier to interpret. As such, our work complements the previous work by Bakhshi and Thompson (2002), in addressing the same question from a different perspective.

What determines long-run business investment to output ratios?

In this section, we explore the determinants of the behaviour of the two investment to output ratios. Throughout the article we use the following definitions:

I	constant-price investment
Y	constant-price aggregate output
H	the price of investment (capital) goods
P	the price of aggregate output

It follows that the constant-price investment to output ratio is I/Y, and the current-price ratio is HI/PY. It is shown in the appendix that the long-run equilibrium paths of the constant-price and current-price investment to output ratios, $(i - y)^{kp}$ and $(i - y)^{cp}$ respectively, are given by the following relationships:

$$(i - y)^{kp} + \sigma(h - p) = \psi \qquad (1)$$

$$(i - y)^{cp} + \sigma(h - p) - (h - p) = \psi \qquad (2)$$

where lower-case letters denote natural logarithms.

These relationships indicate that the first of the two key elements that determine the long-run equilibrium path of the investment to output ratios is $h - p$, or the price of investment goods relative to the price of aggregate

(1) The two ratios cross in 1995 as this is currently the year in which the constant-price data are 'benchmarked' against the current-price data.

output. We will refer to this as the relative price of investment. The second key element, σ, is the elasticity of substitution between capital and labour. This parameter determines the extent to which the investment to output ratios respond to changes in the relative price of investment goods. The long-run equilibrium path also depends on ψ, which is a function of structural parameters and variables.

Intuitively, we can think of the long-run equilibrium investment to output ratios as reflecting a 'demand' effect and a 'price' effect. If σ is high, there is a strong 'demand' effect on the investment to output ratios: firms' demand for investment goods increases rapidly when the relative price of investment falls. For the current-price ratio, there is also an offsetting 'price' effect to take into account: as the relative price of investment goods falls, nominal spending on investment falls in relation to nominal output, for any given quantity of investment.(1)

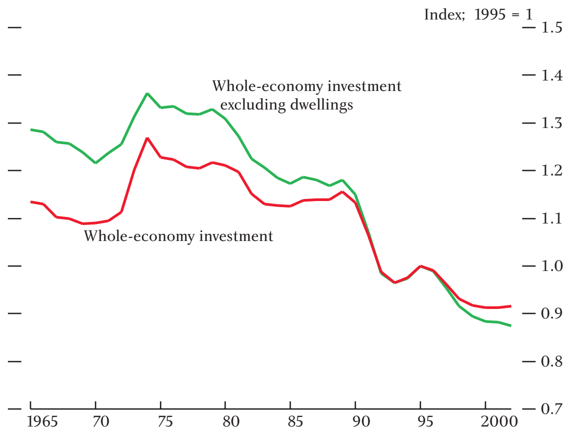
In the rest of this article we discuss each of these three elements in the long-run equilibrium relationships, starting with the relative price of investment goods. We then discuss the elasticity of substitution, and finally the structural parameters and variables represented by ψ. Having discussed these three elements, we then construct some simple long-run equilibrium ratios for the current-price and constant-price investment to output ratios.

The relative price of investment

There has been a marked fall in the relative price of business investment over the past 20 years: as Chart 2 shows, it has fallen by almost 40% since 1980 Q1.(2) To analyse the downward trend in the relative price, it is useful to look at asset-level data. These are only available for whole-economy investment and not for business investment;(3) at current prices, business investment accounted for 79% of whole-economy investment (excluding dwellings) in 2002, with the difference between these two series mainly consisting of government investment. Like the relative price of business investment, the relative price of whole-economy investment (excluding dwellings) has also been falling over the past 20 years (see Chart 3), and the correlation between movements in the two series is high.(4) So we could reasonably expect the findings regarding the whole-economy investment (excluding dwellings) deflator to apply to the business sector as well.

Chart 2
The relative price of business investment

Chart 3
The relative price of whole-economy investment



For an asset breakdown of whole-economy investment (excluding dwellings) we use the data constructed by Bakhshi, Oulton and Thompson (2003). These encompass five different asset categories: vehicles, buildings, intangibles, computers and other plant and machinery.

Chart 4 shows that the relative price of computer investment has fallen much faster than the relative price of whole-economy investment, excluding computers and dwellings. However, it is interesting that the trend in the relative price of investment *excluding computers* is similar to the relative price including computers until the last five years of the sample. Chart 5 shows the

(1) The demand effect is identified by the term $\sigma(h - p)$ in both relationships, while the price effect is identified by $-(h - p)$ in the current-price investment to output relationship.
(2) Technically, the charts in this article show the investment deflators relative to the GDP deflator. Deflators may differ from true prices if there are compositional changes within the aggregates.
(3) Whole-economy investment is referred to as 'Gross fixed capital formation' in the National Accounts.
(4) The correlation between quarterly movements in the two series since 1980 is 0.5.

Chart 4
Relative price of computer investment

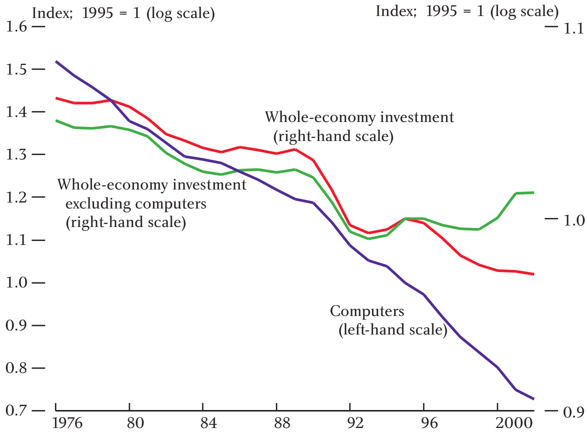
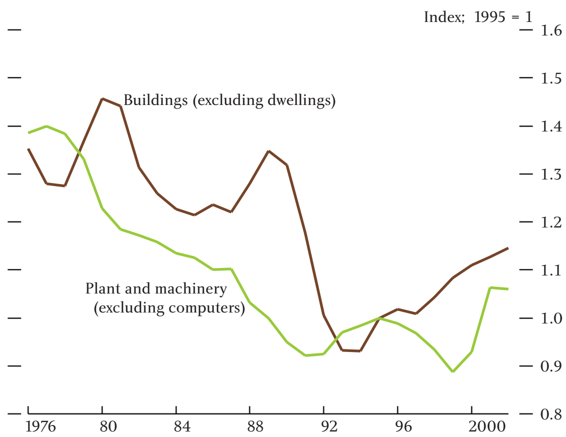


Chart 5
Relative price of investment asset types



relative price of two other asset categories, buildings (excluding dwellings) and plant and machinery (excluding computers). The relative price of plant and machinery fell during the 1980s, and there was a sharp fall in the relative price of buildings in the early 1990s. This fall does not represent falling land prices, since the price of land does not affect the buildings deflator. Instead, it partly reflects a large fall in real wages in the construction sector between 1990 and 1994.

The contribution of each asset to the fall in the relative price of whole-economy investment includes both price effects and quantity effects: changes in both the relative price of an individual asset and in its share of total investment will affect the asset's contribution to the fall in the relative price. The total contribution of each asset is shown in Table A, which breaks our sample into five subperiods.

In the early periods, the contribution of computers to the fall in the relative price of whole-economy

Table A
Contributions to the change in the relative price of whole-economy investment excluding dwellings[(a)]

Percentage points

	Buildings	Vehicles	Computers	Plant and machinery	Intangibles	**Total**
1976–79	2.4	-0.1	0.2	-4.4	-0.1	**-2.1**
1980–84	-6.5	-0.1	2.2	-3.7	-0.4	**-8.6**
1985–89	4.5	1.0	0.9	-7.2	0.1	**-0.7**
1990–94	-11.5	0.4	-2.8	3.2	0.0	**-10.7**
1995–present	5.5	-1.4	-15.9	1.4	0.1	**-10.4**
Whole sample: 1976–present	-5.7	-0.2	-15.5	-10.8	-0.4	**-32.5**

(a) Components may not sum to total due to rounding.

investment excluding dwellings was small, even though the relative price of computer investment was falling, as the share of computers in investment expenditures was small. In contrast, computers contributed strongly to the fall in the relative price of investment in recent periods. Other plant and machinery contributed strongly to the fall in the relative price during the 1980s, and buildings made a notable contribution in the early 1990s.

Another way of examining the fall in the relative price of investment goods is to consider imported and domestically produced investment goods separately. The relative price of investment has probably been affected by the exchange rate, as the import share of investment is significantly higher than that of consumption (see Table B). We might expect a negative correlation between the exchange rate and the relative price of investment: as sterling appreciates, imports of investment goods become cheaper. Chart 6, however, exhibits no simple long-run relationship between the relative price of whole-economy investment and the nominal exchange rate.

Table B
The import content of consumption and investment[(a)]

Per cent

	Consumption	Investment
1984	21.9	33.7
1990	20.3	31.8
1995	20.3	35.9

(a) Data from the ONS input-output tables. The investment data refer to whole-economy investment *including* dwellings, and the import content of business investment (which excludes dwellings) is likely to be higher.

Chart 7 shows the relative prices of imported capital and consumption goods (excluding cars) over the past 15 years, together with the effective exchange rate index.[(1)] Following the appreciation of sterling since 1996, the relative price of imported capital goods has

(1) The relative price of imported capital goods is measured as the deflator of imported capital goods (only available from 1988) divided by the GDP deflator, and the relative price of imported consumption goods is measured in the same way.

Chart 6
Sterling and the relative price of investment

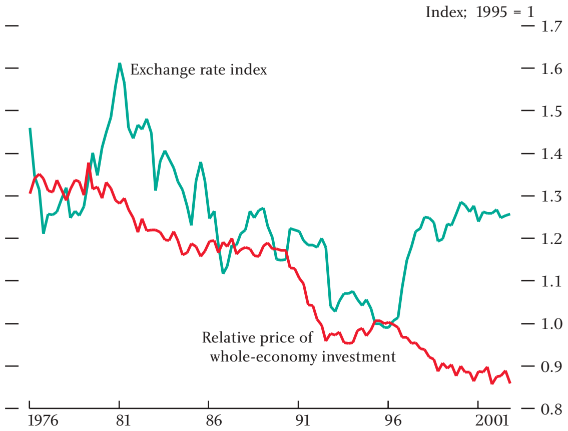
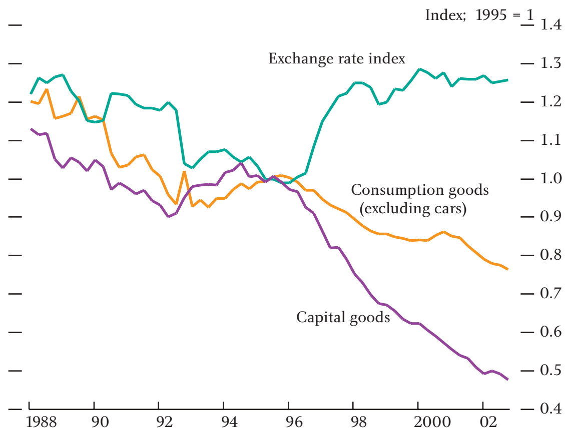


Chart 7
The relative price of imported consumption and capital goods



fallen much more sharply than that of imported consumption goods. Also, the relative price of capital goods rose between 1992 and 1994, when sterling depreciated. This suggests that the relative price of imported capital goods may have been more sensitive to movements in the exchange rate than that of imported consumption goods over the past few years, although there may also have been other factors at work.

To evaluate the extent to which the fall in the relative price of investment reflects a fall in the price of imported capital goods, Table C shows the contributions of imported and domestically produced capital goods to the fall in the relative price of whole-economy investment (excluding dwellings). The contributions are calculated in the same way as those for asset-level investment in Table A, under the simplifying assumption that all imported capital goods are investment goods. The relative price of imported capital goods is available only from 1988, and we break our sample into two separate periods.

Table C
Contributions to the change in the relative price of whole-economy investment excluding dwellings(a)

Percentage points

	Imported capital goods	Domestic capital goods	**Total**
1988–94	-1.3	-16.0	**-17.3**
1995–present	-23.1	15.0	**-8.1**
Whole sample: 1988–present	-24.5	-1.0	**-25.4**

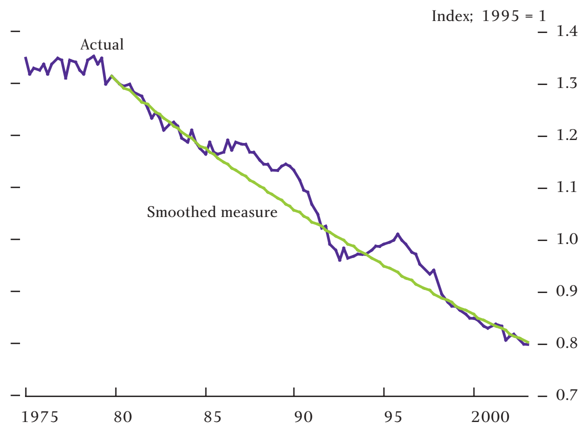
(a) Components may not sum to total due to rounding.

The table suggests a very strong pattern in the contributions: in the earlier period, falling relative prices of domestically produced capital goods led to a fall in the relative price of whole-economy investment excluding dwellings, while the contribution of imported capital goods was negligible. This was because the relative price of domestically produced capital goods fell at a fast rate, when the share of domestic goods in investment was high (around 80%). In contrast, imported capital goods have driven the fall in the relative price of investment since 1995, due to a fast fall in their relative price (see Chart 7) and an increasing share in overall investment expenditure. Since 1995, the relative price of domestically produced capital goods has actually risen. This could partly explain the increasing share of imported capital goods in total investment.

To sum up, a fall in the relative price of plant and machinery investment was the main contributor to the fall in the relative price of whole-economy investment during the 1980s. During the 1990s, computer investment prices accounted for further reductions in the relative price of aggregate investment, and there was also a sizable effect from a sharp fall in the price of buildings in the first half of the 1990s. The import content of investment is high, and changes in the price of imported capital goods, which are partly driven by exchange rate movements, have contributed strongly to the fall in the relative price of investment since 1995.

Returning to our two long-run equilibrium relationships, we know that the current-price and constant-price investment to output ratios depend crucially on the relative price of investment. As discussed, the relative price has been falling since 1980, although this aggregate picture masks different relative price trends for different types of capital goods, and for imported versus domestically produced capital goods. For simplicity we will use a smoothed measure of the relative price, one which falls at its average rate of 0.5% a quarter since 1980 (see Chart 8), to calculate our

Chart 8
Smoothed relative price of investment



estimates of the long-run equilibrium ratios. By smoothing, we hope to exclude the impact of temporary or cyclical changes in relative prices.

If we wanted to project forward the long-run equilibrium investment to output ratios, we would also need to project a path for the relative price. In particular, whether or not the relative price continues to fall and at what rate would be crucial.

The elasticity of substitution in production

The second of our determinants of the long-run investment to output ratios is the elasticity of substitution between capital and labour. Economic models are of course simplifications of the real world. Production functions, which describe how firms use inputs to make output, are no exception. One common approach is to assume that firms produce output using just two inputs to production: labour; and capital, including machinery in factories (and factories themselves), but also photocopiers, computers and other office equipment. In the short run, firms may be unable to change the amount of labour or capital they use. But it is common to assume that, in the long run, firms can vary the amount of both capital and labour used in the production process.

One assumption that we make here is that firms face constant returns to scale (CRS) in the production process. This means that when firms double the amount of capital and labour used in production, the amount of output produced also doubles exactly.(1) Another key factor is the elasticity of substitution between capital and labour in production: this measures how easy it is to change the mix of capital and labour while producing the *same* amount of total output.

As noted earlier, this elasticity of substitution (σ) determines the extent to which the investment to output ratios respond to changes in the relative price of investment goods. In other words, it determines how sensitive the two ratios are to the 'demand' effect from a change in the relative price, discussed earlier. If capital and labour are easy to substitute, σ is high and the demand effect will be high—firms will substitute capital for labour as the relative price of capital (investment) falls. But if firms cannot substitute between capital and labour at all (σ equal to zero), there will be no demand effect: a fall in the relative price of investment will not make firms buy more capital, as the extra capital cannot be used instead of labour.

Different degrees of substitutability will thus imply different paths for the investment to output ratios. A common simplifying assumption is that the elasticity of substitution does not change over time: this is referred to as constant elasticity of substitution (CES) technology. But although the elasticity may be fixed, the degree of substitutability may take a range of values.

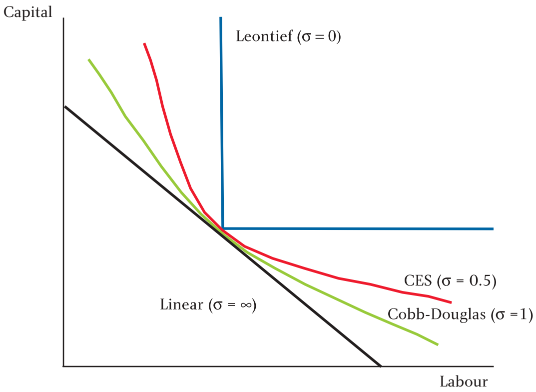
As mentioned above, one assumption is that it is not possible to substitute between capital and labour *at all* in the production process. This means that if firms use some extra labour in production but not any extra capital (or *vice versa*), total output produced is unchanged. This is called Leontief technology.

One way to represent the CES assumption about production technology is to plot the different combinations of capital and labour that result in the *same* level of total output. These lines are called isoquants. For Leontief technology, the isoquants are L-shaped, as extra capital or labour does not increase total production, as represented by the blue line in Chart 9.

Leontief technology is an extreme assumption and implies an elasticity of substitution of zero, as capital and labour cannot be substituted. The other extreme is that capital and labour are perfectly substitutable in the production process. This is called linear production technology, and has an infinite elasticity of substitution: the firm can change to using relatively more capital than

(1) If firms faced increasing returns to scale, output would more than double, but faced with decreasing returns to scale output would increase by less than double when firms doubled all inputs to production.

Chart 9
Isoquants for different production technologies



labour (or *vice versa*) with no loss of output. The isoquants are straight lines, as capital and labour are completely interchangeable.

A common alternative to these two extremes is Cobb-Douglas technology, where the elasticity of substitution is equal to one. This means that a 1% decrease in the *price* of capital relative to labour is matched by a 1% increase in the *amount* of capital used in production relative to labour (and *vice versa*).(1) As a result, Cobb-Douglas isoquants are convex curves—between the straight-line isoquants of linear technology and the L-shaped isoquants of Leontief technology. The green line in Chart 9 is an illustrative example of a Cobb-Douglas isoquant.

Research suggests that the elasticity of substitution may not in practice be unity for the United Kingdom. For example, Barrell and Pain (1997) report an estimate of 0.48 for the UK private sector, and Hubert and Pain (2001) report well-determined estimates of around 0.5 for a panel of manufacturing industries. Recent work by Ellis and Price (2003) at the Bank of England estimated a slightly lower elasticity of 0.44.(2) These estimates suggest that capital and labour are *less* substitutable than under Cobb-Douglas technology. An example of an isoquant when the elasticity of substitution is less than one is shown as the red line in Chart 9: note that the isoquant is more L-shaped than with Cobb-Douglas technology.

In the analysis of the long-run equilibrium investment to output ratios, we will examine the impact of three different assumptions about the elasticity of substitution: CES with an elasticity of substitution of a half; Leontief technology, as an example for less substitutability; and Cobb-Douglas, which implies more.

Other parameters and variables

The variable ψ in our two long-run equilibrium relationships is a function of structural parameters and variables. These include the depreciation rate of capital, the discount rate, the price elasticity of demand for the firm's output, a parameter that determines the distribution of income between capital and labour, and the long-run growth rates of both the capital stock and the price of investment goods. It also depends on tax rates and allowances.

Some components of the variable ψ are analysed in more detail by Bakhshi and Thompson (2002). For simplicity, we will assume here that it is constant over time. In a true long-run equilibrium, we would by construction expect ψ to be constant. However, this may not be true over our sample, for example in the case of the discount rate. But from experimenting with alternatives we think the effect of this assumption is small.

In the analysis of the long-run equilibrium path for the investment to output ratios, we consider two different methods for obtaining a value for ψ. Given that the relative price of investment has been falling since around 1980 (see Chart 2), one possible assumption is arbitrarily to assume that the investment to output ratios were in long-run equilibrium at that point. This means that, for given initial values for the investment to output ratios and the relative price of investment, and given an assumed value for the elasticity of substitution, we can calculate the value of ψ from **(1)** and **(2)**. As an alternative method, we choose a best-fitting value of ψ over the sample period by simple regression techniques: this will be the value of ψ that minimises the gap between the observed ratios and our estimated equilibria.

Estimating equilibrium paths of the business investment to output ratios

The long-run equilibrium paths for the business investment to output ratios, using the smoothed relative price series (see Chart 8) and different assumptions about production technology, are shown for constant-price (KP) data in Chart 10 and for

(1) Or, analogously, the expenditure shares on capital and labour are constant.
(2) These estimates are all obtained from demand equations for the inputs to production (capital and labour): the elasticity of substitution is one of the estimated parameters.

current-price (CP) data in Chart 11. The structural variable ψ has been calculated using the initial values (observed in 1980 Q1) for the investment to output ratios and the relative price of investment.

Charts 10 and 11 illustrate the key role of the technology assumption in judging whether either investment to output ratio is above or below equilibrium. With Leontief technology, we would expect the equilibrium constant-price ratio to be constant: in this case, a simple measure of equilibrium would be a long-run average.

Chart 10
Constant-price business investment to output ratios

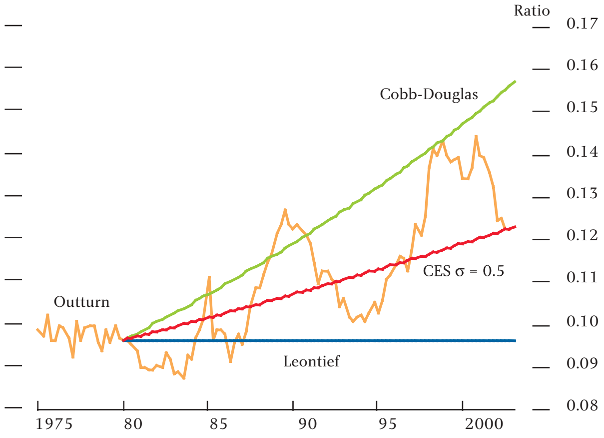
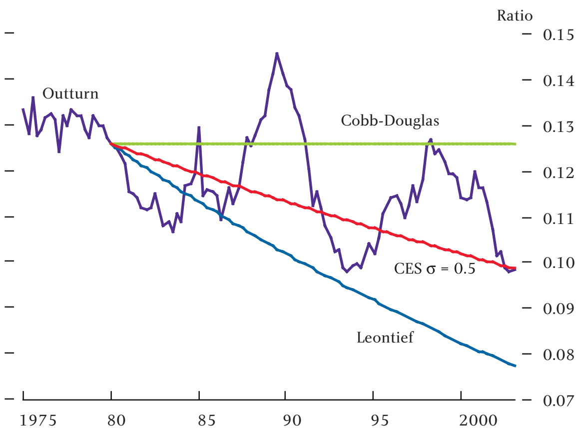


Chart 11
Current-price business investment to output ratios



But with Cobb-Douglas technology, we would expect the equilibrium current-price ratio, rather than the constant-price ratio, to be constant. In this case, a measure of how far away we are from equilibrium would be to compare the current-price ratio with a long-run average.

Between these two cases, the long-run equilibrium behaviour cannot be characterised by an average of either ratio: given the falling relative price, neither the constant-price nor the current-price ratio would be constant in equilbrium.

Our baseline case, CES with an elasticity of substitution of a half, is of this type. And Charts 10 and 11 could also be taken to confirm that it is the most plausible, as it appears to be the one on which the data converge. This could be misleading, of course, as it could reflect our choice to fix the constant ψ by starting the equilibrium from 1980.

An alternative way is to choose a best-fitting constant by simple regression techniques, as mentioned in the previous section. The resulting equilibria from this method are shown in Charts 12 and 13. Based on these charts, it is less obvious that the Cobb-Douglas assumption is wrong, as the green equilibrium lines seem to fit the data more closely than in Charts 10 and 11.

Chart 12
Constant-price business investment to output ratios

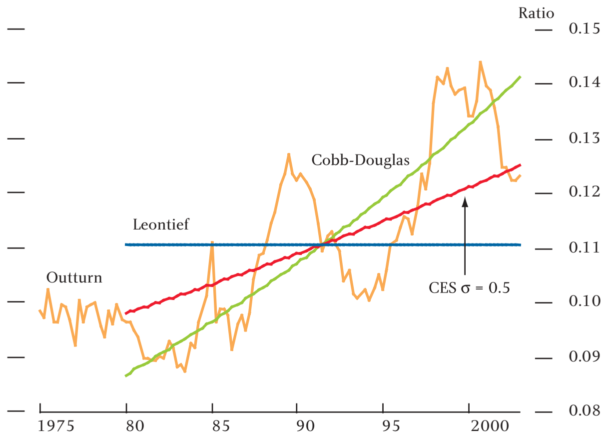
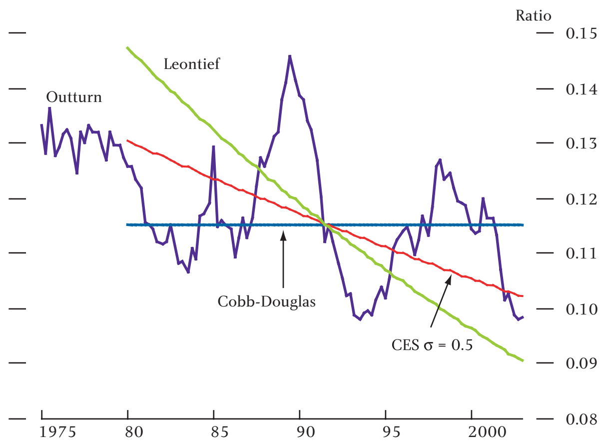


Chart 13
Current-price business investment to output ratios



The different assumptions about technology also have implications for where the investment to output ratios stand relative to equilibrium at the moment. Under Cobb-Douglas technology, both ratios are significantly below equilibrium in the latest data. In contrast, under Leontief technology both ratios are above it. In our baseline case, with an elasticity of substitution of a half, both ratios are slightly below equilibrium, but not as much as under Cobb-Douglas technology.

The equilibrium lines in Charts 10 to 13 are based on simple assumptions and methods, but they are useful examples of how we would expect the equilibrium to evolve over time. Looking forward, the outlook for both equilibrium investment to output ratios depends on whether the relative price of investment continues to fall or not. If the relative price continues to fall, we would expect the equilibrium constant-price investment to output ratio to continue to rise, although the above charts illustrate that the deviations around this equilibrium can be large and long-lived. The mirror image of this is that the equilibrium current-price investment to output ratio would continue to fall. But if the relative price were to stop falling, both the constant and current-price equilibrium ratios would then stop rising and falling, respectively. On the other hand, if the relative price were to start rising, the trends in the equilibrium constant and current-price ratios would reverse.

Conclusion

Over the past 20 years, the constant-price and current-price investment to output ratios have behaved very differently. In this article we have set out how the ratios behave in long-run equilibrium, using a simple framework. The long-run equilibrium paths depend on the relative price of investment, which has been falling over the past 20 years, and the elasticity of substitution between capital and labour in the production process. In our baseline case, with an elasticity of substitution of 0.5, neither ratio is obviously more informative than the other, and both ratios were slightly below our baseline long-run equilibrium measures in the recent past.

Appendix

This appendix derives the two long-run relationships described on page 177. The expressions are derived from a simple model with a single capital good and a constant returns to scale (CRS), constant elasticity of substitution (CES) production function. In addition to the variables listed on page 177, we define K as the capital stock, W as labour cost and N as labour input. As before, lower-case variables denote natural logarithms. The CES production function may be written:

$$Y^s = \left[\alpha K^{-\theta} + (1-\alpha)\left(Ne^{at}\right)^{-\theta}\right]^{-\frac{1}{\theta}}$$

and firms face a constant-elasticity demand curve

$$Y^D = P^{-\varepsilon}$$

Firms are assumed to maximise the infinite stream of future profits subject to the capital accumulation identity, so the Lagrangean is:

$$L = \sum_{t=0}^{\infty}\left(\frac{1}{1+\beta}\right)^t \left[P_t Y_t - H_t I_t - W_t N_t - \lambda_t\left(K_{t+1} - (1-\delta)K_t - I_t\right)\right]$$

where δ is depreciation, $1/(1+\beta)$ is the nominal discount rate and $t = 0$ is the current time period. The first-order conditions with respect to investment and capital yield:

$$\left(1-\frac{1}{\varepsilon}\right)P_t Y_{K,t} = (1+\beta)H_{t-1} - (1-\delta)H_t$$

where Y_K denotes the first-order derivative of the production function with respect to capital, given by:

$$Y_K = \alpha\left(\frac{Y}{K}\right)^{1+\theta}$$

After substituting and re-arranging we have:

$$\alpha\left(1-\frac{1}{\varepsilon}\right)\left(\frac{Y_t}{K_t}\right)^{1+\theta} P_t = \frac{H_t}{1+g_t^H}\left[\beta + \delta - (1-\delta)g_t^H\right]$$

where g^H is the rate of increase of investment prices. We can rewrite the capital accumulation identity as:

$$K_t = \frac{I_t}{\delta + g_t^K}$$

where g^K is the growth rate of capital. Using this to substitute out for capital, and taking natural logarithms, we find:

$$i_t - y_t = -\sigma(h_t - p_t) - \sigma\, ln\left\{\frac{1}{\alpha}\frac{\varepsilon}{\varepsilon - 1}\right\} - \sigma\, ln\left\{\frac{1}{1+g_t^H}\left[\beta + \delta - (1-\delta)g_t^H\right]\right\} + ln\left(g_t^K + \delta\right)$$

where σ is the elasticity of substitution, equal to $1/(1 + \theta)$.

To simplify, we assume that the structural parameters (α, β, δ and ε) are fixed in long-run equilibrium: technically this is a behavioural assumption. In addition, if we assume that the growth rates of capital and the price of investment are also fixed in long-run equilibrium, we can put most of the right-hand side of the expression into a constant term. This simplification allows us to focus on the relative price and elasticity of substitution. Bakhshi and Thompson (2002) examine some of the components that we assume are fixed, eg depreciation, in more depth: we deliberately do not replicate their analysis here.

Dropping time subscripts, our assumptions about long-run equilibrium allow us to rewrite the equation as:

$$\left(i-y\right)+\sigma\left(h-p\right)=\psi$$

where ψ is a constant. The first term in brackets in this expression is the constant-price investment to output ratio, written as $(i - y)^{kp}$ on page 177. The current-price investment to output ratio, $(i - y)^{cp}$, is given by:

$$\left(i-y\right)^{cp}=\left(i-y\right)+\left(h-p\right)$$

so we can also express this as:

$$\left(i-y\right)^{cp}+\left(\sigma-1\right)\left(h-p\right)=\psi$$

These are the two long-run equilibrium relationships.

References

Bakhshi, H, Oulton, N and Thompson, J (2003), 'Modelling investment when relative prices are trending: theory and evidence for the United Kingdom', *Bank of England Working Paper no. 189*.

Bakhshi, H and Thompson, J (2002), 'Explaining trends in UK business investment', *Bank of England Quarterly Bulletin*, Spring, pages 33–41.

Bank of England (2003a), *Inflation Report*, February.

Bank of England (2003b), *Monetary Policy Committee Minutes and Press Notices*, February.

Barrell, R and Pain, N (1997), 'Foreign direct investment, technological change, and economic growth within Europe', *Economic Journal*, November.

Bloom, N and Bond, S (2001), 'UK investment: high, low, rising, falling?', *Institute for Fiscal Studies Briefing Note*, No. 18.

Ellis, C and Price, S (2003), 'UK business investment: long-run elasticities and short-run dynamics', *Bank of England Working Paper*, forthcoming.

Hubert, F and Pain, N (2001), 'Inward investment and technical progress in the United Kingdom manufacturing sector', *Scottish Journal of Political Economy*, Vol. 48.