# Explaining trends in UK business investment

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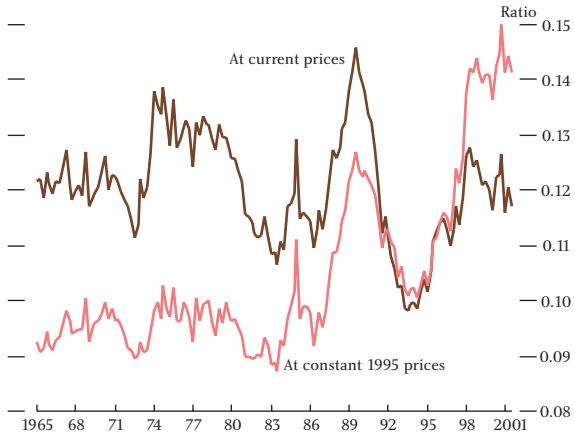
*The ratio of business investment to GDP at constant prices has been trending upwards over the past two decades, picking up sharply in the second half of the 1990s. This article investigates possible explanations. We argue that the rise largely reflects a sustained fall in the relative price of investment goods, given that there is little discernible trend in the current-price ratio. This is consistent with a significant role for rapid technological progress in the investment goods sector and, given the importance of imported investment goods, for exchange rate developments in explaining trends in UK firms' investment behaviour. But other factors, such as falls in the cost of finance and increases in replacement investment, may also have been important. This view is supported by an illustrative model-based analysis.*

## Introduction

UK firms' investment behaviour can be characterised by some key stylised facts:

- The business investment to GDP ratio at constant prices has been trending upwards over the past two decades, rising particularly sharply in the second half of the 1990s (see Chart 1).(1)

**Chart 1**
**Business investment to GDP ratios**




Note: Real GDP at market prices is used to calculate real business investment to GDP ratios in charts throughout this article.

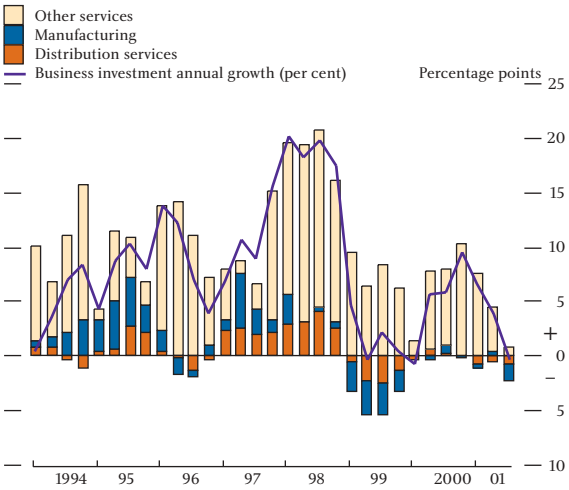
- There is little discernible trend in the business investment to GDP ratio at current prices.
- The corollary is that over the past two decades the price of investment goods has fallen sharply relative to other goods in the economy—and that decline was particularly marked in the latter half of the 1990s (see Chart 2).

**Chart 2**
**Ratio of business investment deflator to GDP deflator**


- By sector, the rapid constant-price growth in business investment in the latter half of the 1990s was largely accounted for by services (see Chart 3).

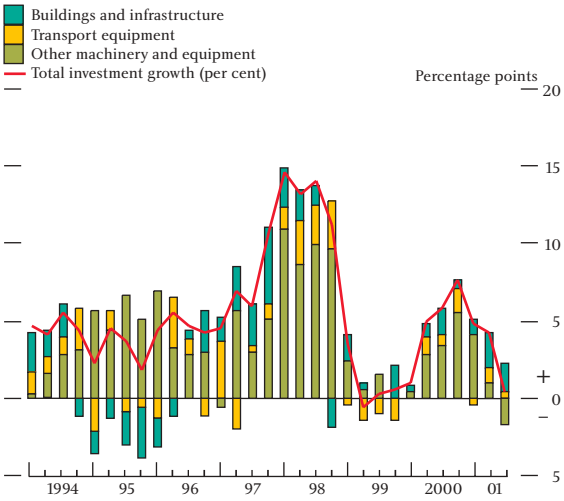
(1) Note that ONS aggregate series for the United Kingdom are calculated on a 'fixed-weight' basis—that is, the components of aggregate series (such as business investment or GDP) are weighted together using weights that are only changed at five-year intervals. This means that in recent years, assets (such as computers) that have experienced declines in relative prices have been given more weight than in alternative aggregation systems that update weights more regularly. The ONS is planning to introduce a 'chain-linked' system for the United Kingdom with the publication of the 2003 *Blue Book*. The wedge between growth rates of investment and GDP in recent years is likely to be less pronounced in this system, where weights are adjusted annually. And non-additivity issues render interpretation of ratios under this system problematic. See Tuke and Reed (2001) and Whelan (2000) for further details.

### Chart 3
### Contributions to annual business investment growth



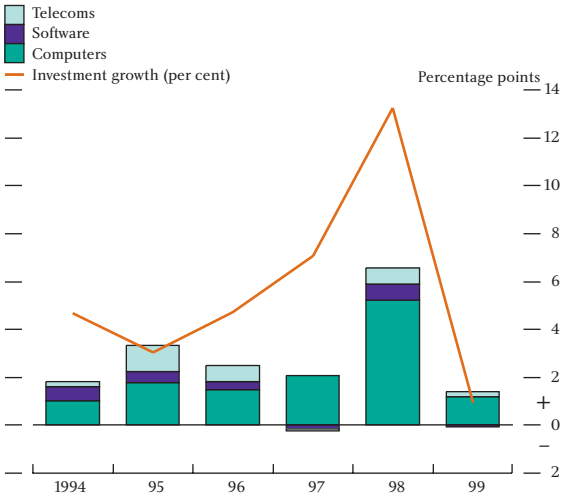

- By asset, investment was particularly strong in 'other machinery and equipment'—that is, investment in goods other than buildings and transport equipment (see Chart 4).(1) And it was the price of these investment goods that fell most markedly during the 1990s.(2)

### Chart 4
### Contributions to annual whole-economy investment growth by asset




- Within 'other machinery and equipment', the contribution of investment in information and communications technology (ICT) was particularly important (see Chart 5).(3)

### Chart 5
### Contribution of ICT to annual whole-economy investment growth




The rest of this article investigates the factors that might explain these stylised facts about UK firms' recent investment behaviour.

## Investment and firms' desired capital stocks

Theory suggests that the level of firms' desired capital stocks is determined by their planned production levels and the 'real user cost of capital'. And investment decisions are made to bring current capital stocks to their desired levels. Below we consider why firms' desired capital stocks may have changed.

### General economic activity

#### Cyclical movements in investment

Investment is highly variable. Between 1970 and 2001, the standard deviation of growth in quarterly business investment was some three and a half times greater than for GDP. And investment is typically strongly procyclical. But, importantly, while GDP growth tends to revert over time to its average rate, Chart 1 shows that the constant-price business investment to GDP ratio has trended up over time. In other words, the rise in the ratio—and the associated fall in relative investment prices—is unlikely to be purely cyclical.

(1) This asset breakdown is of whole-economy investment. The ONS does not publish an asset breakdown of business investment.
(2) As discussed in the November 2001 *Inflation Report*, page 18.
(3) 'Software' in Chart 5 represents total software investment—that is, both the software investment that the ONS allocates to 'other machinery and equipment' and the software investment that is allocated to 'intangible fixed assets'. Current-price estimates of investment in computers, software and telecommunications are derived from supply and use tables for 1992–99 consistent with the 2001 *Blue Book*. These data are then deflated by the relevant ONS deflator series in order to be consistent with the National Accounts. See Oulton (2001).

### Increases in trend growth

An increase in the underlying trend growth rate of the economy would cause firms to revise upwards the expected marginal return on their investments. That would lead to a rise in the constant-price investment to GDP ratio. It is sometimes argued that this accords with the experience of the United States in the latter half of the 1990s. But it is difficult to reconcile with research suggesting that total factor productivity (TFP) growth in the United Kingdom has actually been weaker than its historical average for most of the 1990s.(1)

## Reductions in the real user cost of capital

Survey evidence points to a sustained fall in the cost of capital in the second half of the 1990s. In particular, the CBI survey of manufacturers' investment appraisal techniques conducted in June 2001 finds that where financial hurdle rates are used, real rates may have fallen by around 5 percentage points since 1994.(2)

Theory suggests that there are several key components of the real user cost of capital. When deciding whether or not to invest, a firm first faces an acquisition cost, the relative price of capital. As the relative price of capital declines (rises), profit-maximising firms will substitute towards using proportionately more (less) capital in the production process. The firm then faces additional costs when actually holding the unit of capital: any fall in the price of the capital; the interest foregone by not selling the capital and saving the proceeds; taxes on income from this capital, less investment allowances; and depreciation of the capital.(3) We examine each of these components in turn.

### Relative price of investment goods

- *Technological progress specific to the production of investment goods*

One explanation for the fall in relative investment prices is that the rate of technological progress in the production of investment goods has outstripped that in other sectors. Brayton and Reifschneider (2001) assert that this may have accounted for some of the strength of US investment in the second half of the 1990s.

Bank research argues that investment-specific technological progress has been particularly marked in the production of ICT goods.(4) Firms have responded to the marked fall in ICT investment prices over time by substituting into ICT investment. As shown in Chart 5, the contribution of ICT to whole-economy investment growth was important in the late 1990s.

- *Technological progress and sterling*

Technological progress specific to the production of investment goods may arguably have been stronger in the United Kingdom than in some countries. Although the relationship between productivity and exchange rates is complex, this might conceivably explain some of sterling's appreciation since 1996. It is interesting that sterling has not appreciated over this period against the US dollar, where technological progress in the investment goods sector in the 1990s is perceived to have been, if anything, even more marked.(5)

But even if sterling's appreciation since 1996 had nothing to do with relative rates of technological progress, there could still have been important implications for the actual and relative price of investment goods.

The appreciation would have had two key effects on the price of investment goods: the direct effect of cheaper imports of investment goods; and the indirect effect of cheaper imported raw materials used in the domestic production of investment goods. Import content estimates attempt to capture both of these effects. As Table A shows, the import content of investment expenditure is rather higher than for other expenditure components of final demand in the United Kingdom.(6) As a result, the appreciation of sterling since 1996 probably contributed to the marked fall in the price of

(1) See Oulton (2001). This appears to be a robust conclusion: Oulton reports similar results when ONS data are adjusted for possible ICT mismeasurement.
(2) CBI (2001).
(3) Depreciation here is measured as the difference between the prices of a new and, say, a one-year old asset at a point in time, rather than the total change in the price of an asset between two periods.
(4) See Bakhshi and Larsen (2001) for a macroeconomic analysis of investment-specific technological progress in the United Kingdom. There is some evidence that productivity growth in the ICT sector has been rapid in the United Kingdom, as well as in the United States. See IMF (2001).
(5) Bailey, Millard and Wells (2001) argue that the appreciation of the US dollar in recent years might reflect a productivity shock concentrated in highly traded goods, such as ICT.
(6) These current-price estimates are taken from the 1990 ONS input-output tables for the United Kingdom. More timely input-output data are not available, but the share of imported final investment goods in whole-economy investment captures the direct effect discussed above. This share has risen strongly (at both current and constant prices) since 1990.

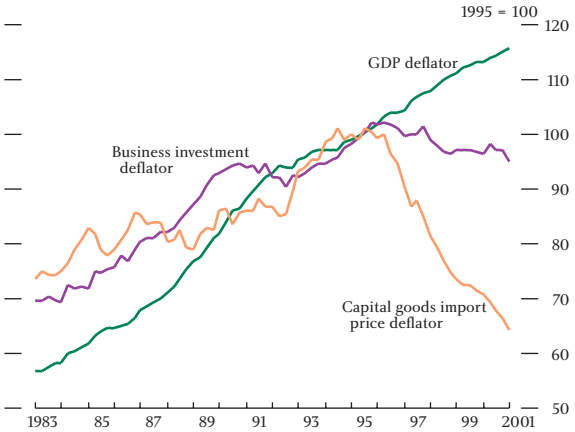
investment goods relative to other goods in the economy (see Chart 6).[1]

**Table A**
**Import content estimates for the United Kingdom**

Per cent

| Final demand expenditure components | Import content |
|---|---|
| Consumption | 20.0 |
| Investment | 31.8 |
| Government | 13.2 |
| Domestic demand | 20.0 |
| Exports | 22.4 |
| Total final demand | 21.0 |

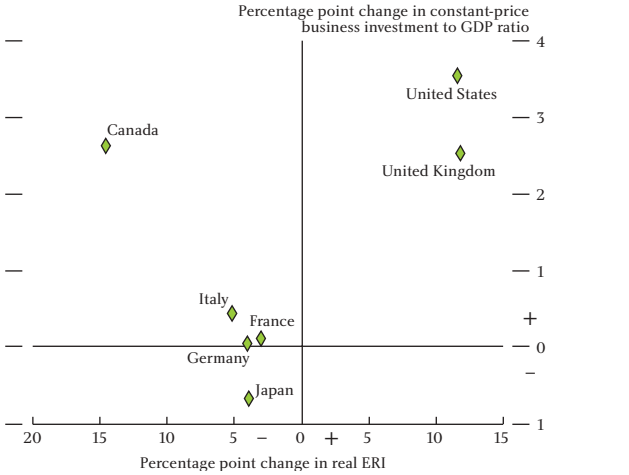
**Chart 6**
**GDP, business investment and capital goods import prices**




This could also imply rather different investment behaviour in the tradable and non-tradable goods sectors. Although sterling's appreciation is likely to have depressed the price of capital goods faced by firms in both sectors, exporters have also had to lower the sterling price of their output to remain competitive. We might therefore expect a greater fall in the price of capital relative to firms' own output price—and a greater rise in desired capital stocks—in sectors that can choose to import their capital inputs from abroad but are more sheltered from international competition in the goods market. That is consistent with the markedly different investment behaviour of manufacturing and service sector companies in the mid to late 1990s.

If the exchange rate explanation could account for the strength of the constant-price business investment to GDP ratio in the United Kingdom in the second half of the 1990s, then we might expect similar developments in other countries whose currencies have appreciated strongly over that period. Chart 7 shows that as in the United Kingdom, the sharp appreciation of the US dollar in the latter half of the 1990s was accompanied by a rise in the constant-price business investment to GDP ratio. Interestingly, there was little or no rise in the ratio for the G7 countries that experienced exchange rate depreciation, with the notable exception of Canada.

**Chart 7**
**G7 real exchange rates and business investment to GDP ratio at constant prices (1996–2000 v 1991–95)**[a]




(a) Data for Italy are 'private investment' rather than 'business investment'.

### Expected change in relative price of investment goods

It is probable that firms' expectations in the second half of the 1990s were that the relative price deflation in the investment goods sector discussed earlier would continue, on the back of continued technological improvements in that sector. But if firms had expected the future rate of relative price deflation to be even *more* rapid than in the past, these expected capital losses would have encouraged firms to reduce their demand for capital. And this would tend to counteract the effect on investment of the actual relative price falls. Firms' expectations are not directly observable, though, so it is difficult to establish the quantitative importance of this factor.

### Cost of finance

Another key component of the real user cost of capital faced by firms is the cost of finance. This might have fallen for several reasons:

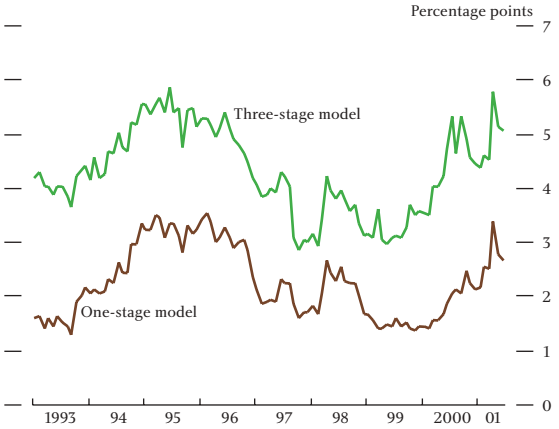
- *Adjustment to lower-inflation environment*

The lower-inflation environment in the 1990s may conceivably have led to a fall in the cost of finance. First, the decline of inflation and a more certain macroeconomic environment may have led to a fall in

(1) Correspondingly, the post-ERM depreciation of sterling was associated with a rise in the relative price of investment goods. This might help to explain some of the weakness of investment in the early to mid-1990s.

the equity risk premium. As Chart 8 shows, some estimates suggest that the equity risk premium fell sharply in the mid to late 1990s, reducing the cost of equity finance for firms, before rising markedly more recently.(1) Second, the shift in inflation environment may have been accompanied by falls in the inflation risk premium on the cost of longer-term corporate debt.(2)

**Chart 8**
**Equity risk premium estimates**




Other things being equal, falls in the equity risk premium and inflation risk premium would have lowered the cost of finance, which might have led firms to revise upwards their desired capital stocks.

- *Credit market imperfections and financial liberalisation*

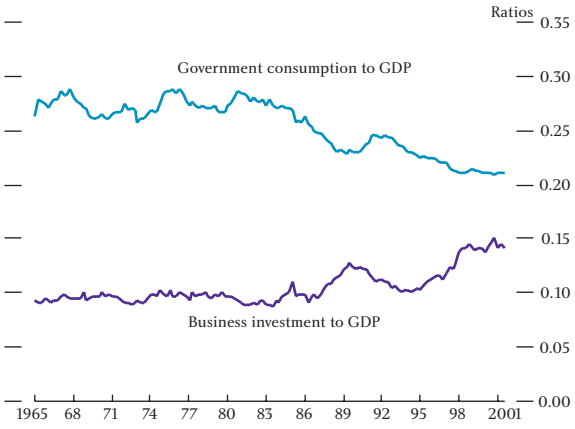
Financial liberalisation may also have had important implications for firms' behaviour. Greater competition between lenders should have lowered the cost of finance for many firms. And if financial liberalisation improved the operation of the financial system and reduced the costs faced by banks in monitoring borrowers' performance, theory suggests that this too should have lowered the cost of finance.(3)

Access to funds may also have increased, as the UK corporate bond market has become more liquid. But some have argued that greatly increased access to credit for consumers, which has perhaps been a more striking feature of financial liberalisation in the United Kingdom, could actually have reduced the net supply of savings for investment.

- *'Crowding out'*

Some researchers claim to have established a link between government consumption and private investment in industrialised economies.(4) These might be related if increases in government expenditure and borrowing 'crowd out' private sector activity by bidding up long-term real interest rates through increased competition for available funds. And conversely, periods of fiscal retrenchment might, other things being equal, be associated with lower real rates of interest and a lower cost of finance for firms.(5) Some estimates suggest that real rates did fall in the United Kingdom and other G7 countries in the latter half of the 1990s.(6) And Chart 9 does show an inverse correlation between business investment and government consumption (both expressed as constant-price shares of GDP) in the United Kingdom, although that does not of course establish causality.

**Chart 9**
**Business investment to GDP and government consumption to GDP at constant prices**




## Taxation

Government behaviour might affect business investment not only via the 'crowding out' channel discussed above, but also through taxation. Governments might finance their consumption through distortionary taxes, which are harmful for private investment. But it is not obvious that changes in government consumption are

(1) These estimates are discussed in more detail in the article by Panigirtzoglou and Scammell on pages 59–66 of this *Bulletin*.
(2) As discussed in the article by Scholtes on pages 67–77 of this *Bulletin*.
(3) See Hall (2001).
(4) See, for example, Barro (1991). Barro found no negative link between private investment and government investment, though, which may cast some doubt on a simple taxation argument.
(5) For further discussion of the relationship between fiscal consolidation and real interest rates, see Jenkinson (1996).
(6) For example, estimates derived from government bond yields and inflation forecasts from Consensus Economics, or those derived from index-linked gilt yields.

necessarily associated with changes in distortionary taxation.(1)

### Depreciation rate

A further component of the real user cost of capital is the depreciation rate. In principle, a reduction in the average depreciation rate might have contributed to a fall in the real user cost of capital faced by firms. But the average depreciation rate should have risen as short-lived ICT assets have become more important in the capital stock. That would serve to raise the cost of capital.

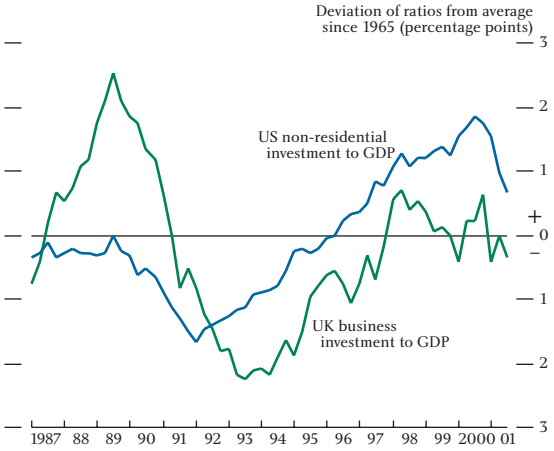
## Other factors

### 'Over-investment'

Some commentators have suggested that part of the strength of investment in the United States in the second half of the 1990s reflected 'over-investment'. Specifically some firms might have invested on the back of unrealistic expectations of their marginal returns, particularly on ICT. And then, as firms later revised down their expected returns, investment growth weakened.

One diagnostic when evaluating the over-investment hypothesis is the current-price share of business investment in GDP. This tells us what proportion of all the money spent in the economy is allocated to purchasing investment goods. It is constrained by the resources of the economy, and large movements in the share may be unsustainable. Chart 10 shows that the current-price ratio has been close to its historical average in recent years (unlike in the United States).(2) This does not, by itself, lend weight to the over-investment hypothesis for the United Kingdom. In the next section, we evaluate over-investment and other hypotheses for the United Kingdom using an econometric model.

**Chart 10**
**UK and US current-price investment to GDP ratios**




### Replacement investment

Given that depreciation rates on ICT assets are typically high (partly because firms replace their assets to keep up to date with more modern products), the increasing importance of these assets should have been accompanied by an increase in the level of replacement investment. Other things being equal, that implies that firms need to undertake higher levels of gross investment to achieve any desired net capital stock. In contrast with the effect of a rising depreciation rate on firms' cost of capital, the replacement investment effect might help to explain some of the rise in the constant-price business investment to GDP ratio.

Temporary factors may also have affected firms' replacement investment decisions, though. Ahead of the millennium date change, firms may have brought forward replacement investments in ICT. And ICT-related investments do appear to have made a significant contribution to the rise in the investment to GDP ratio (see Chart 5). But it is difficult to identify how much of this was related to Y2K.(3) One might speculate that Y2K factors are plausible explanations for a relatively short period of strong investment growth in the very late 1990s and subsequent weakness.

## Decomposing the rise in the constant-price business investment to GDP ratio

This section decomposes the rise in the constant-price business investment to GDP ratio using a simple econometric model. An important note of caution is that it is notoriously difficult to model firms' investment

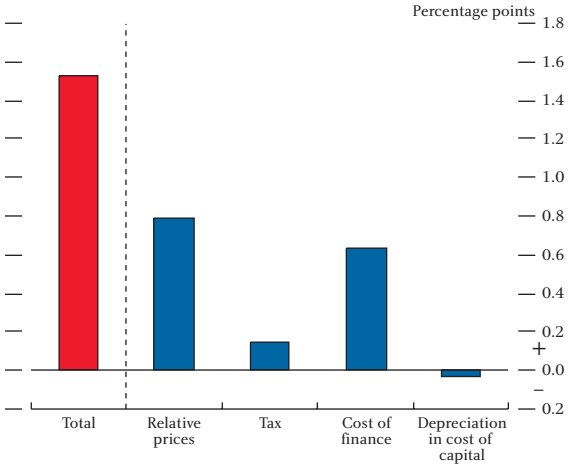
(1) Government policy could also have important though less obvious implications for business investment. Investment projects undertaken through schemes such as the Private Finance Initiative and public private partnerships are mostly included in 'business investment' in the National Accounts. Such activity was too small to be able to account for much of the strength of business investment in the latter half of the 1990s, however.
(2) From a longer-term perspective, over-investment cannot explain the persistent decline in the relative price of investment goods discussed earlier. But Wadhwani (2001) points out how previous waves of technological innovation have often been associated with initial elements of 'over-investment', which were not a *long-run* precursor of a reversion to lower historical investment rates before the innovation.
(3) The Bank's regional Agents found in March 2000 that only a small minority of companies were planning much lower IT investment over the next two years than in the previous two years. That might suggest that other factors were rather more important in explaining the strength of IT investment in the latter half of the 1990s.

decisions at the aggregate level, and our attempt is no exception. But the model may usefully illustrate the relative importance of the factors discussed above.

The single-equation model is derived in a theoretical framework that allows explicitly for long-term falls in the relative price of investment goods. It also contains the other components of the real user cost of capital(1) and a dynamic term to capture the higher replacement investment associated with increases in the average depreciation rate. Further details on the equation specification are provided in the appendix on page 40.

Chart 11 uses the model to decompose the rise in the constant-price business investment to GDP ratio since 1995 into its 'long-term' or fundamental determinants. Between 1995 and 2001 Q2, the ratio rose by more than 4 percentage points. According to the equation, around 1.5 percentage points of this rise reflected 'long-term' factors. And among these, most important is the fall in the relative price of investment goods, followed by falls in the cost of finance.

**Chart 11**
**Contributions to long-term rise in constant-price business investment to GDP ratio since 1995**




Some of the residual rise in the ratio is explained by increased replacement investment and 'cyclical' considerations, both of which are captured by the model dynamics. And some represents a return of the ratio to 'equilibrium', following pronounced weakness in the first half of the 1990s. Some might also be explained by 'over-investment', although the absence of any systematic under-estimation of investment growth over this period does not obviously support this.

## Conclusions

This article sets out a number of possible explanations for UK firms' investment behaviour over the past two decades. This has been a period when business investment, expressed as a constant-price share of the economy's output, has trended upwards. And this trend was particularly marked in the second half of the 1990s, a period also characterised by strong investment by the service sector and in high-tech goods such as ICT.

The rise largely reflects a sustained fall in the relative price of investment goods, given that there is little discernible trend in the current-price measure of the ratio. But our illustrative model-based analysis supports the idea that other factors have also been relevant. Firms are likely to have undertaken higher levels of replacement investment in the United Kingdom as ICT and other high-depreciation rate assets have become more important. And falls in the cost of finance and marginal tax rates may have been important.

The simple econometric model suggests that of all these factors, the fall in the relative price of investment goods has been quantitatively most significant. This is consistent with simple economic theory: as the relative price of capital declines, firms substitute towards using proportionately more capital in the production process. It suggests an important role for investment-specific technological progress and, given the importance of imported investment goods, for exchange rate developments in explaining trends in UK firms' investment behaviour.

(1) With the exception of the unobservable expected change in the rate of relative price deflation term. Investment equations are typically quite sensitive to how we attempt to measure this term, although alternative equations using actual and smoothed price inflation produced a similar ranking to that shown in Chart 11.

## Appendix

The equation described on page 39 is characterised by a simple long-term relationship between the constant-price business investment to GDP ratio and the real user cost of capital. We follow Bean (1981) in exploiting the steady-state relationship between investment and capital to substitute out the capital stock from the long-run condition relating the capital stock to output and the real user cost. That has the advantage of allowing us to decompose long-term movements in the investment to output ratio without recourse to capital stock data, a notoriously difficult series to measure. The Bean specification for the long run of the investment equation is also convenient in our context, as the dependent variable is the business investment to GDP ratio. Bean shows that a constant depreciation rate and growth rate in steady state implies a simple relationship between the constant-price investment to output ratio and the real user cost.(1)

The model assumes that past investment behaviour affects current investment, and so the dynamics of the equation contain lagged business investment growth. The dynamics also contain a depreciation rate term and a survey-based measure of capacity utilisation.(2) The capacity utilisation variable plays the role of an 'integral correction mechanism', reflecting cumulated past equation errors that affect the level of the capital stock and so have implications for investment.

Each variable is expressed in logs, apart from the capacity utilisation measure, and t-statistics are given in brackets. The model is estimated for the period 1972 Q2 to 2001 Q2.

$$\begin{aligned}\Delta ibus_t = {} & -0.335 + 0.148\Delta ibus_{t-3} + 0.195\Delta ibus_{t-4} \\ & \textit{(-3.789)} \quad \textit{(1.769)} \qquad\quad \textit{(2.368)} \\ & -2.912\Delta beta_{t-2} - 3.754\,\Delta beta_{t-4} \\ & \textit{(-1.767)} \qquad\quad \textit{(-2.265)} \\ & +0.001CU_{t-1} - 0.112\,(ibus_{t-1} - gdp_{t-1}) \\ & \textit{(3.834)} \qquad\quad \textit{(-4.000)} \\ & -0.039rcc_{t-1} \\ & \textit{(-2.969)} \\ & + \; dummy + dummy_{t+1}\end{aligned}$$

where:
*dummy* = 1985 Q2
*ibus* = real business investment
*beta* = one minus the average implied depreciation rate
*CU* = survey-based capacity utilisation measure
*gdp* = real GDP
*rcc* = real cost of capital

(1) Specifically, Bean (1981) worked with the steady-state relationship between investment, capital and output in a one-sector growth model. In a two-sector model, such as Bakhshi and Larsen (2001), where technological progress in the investment goods sector *persistently* outstrips that of other sectors, the steady-state relationship is much more complicated. Current Bank research is investigating potential implications for aggregate modelling in this framework.
(2) The capacity utilisation variable is based on CBI Industrial Trends survey responses until 1989 and a GDP-weighted BCC measure thereafter.

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