Using surveys of investment intentions

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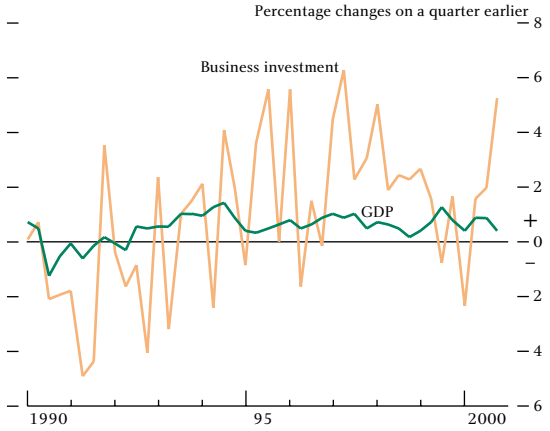
Business investment is an important component of aggregate demand in the UK economy. But it is volatile and difficult to predict. Surveys of investment intentions provide a timely and useful source of information on future investment plans, and can be used to forecast changes in business investment. This article describes a model that uses surveys of investment intentions to forecast business investment, and compares its forecast performance with the business investment equation in the Bank of England's macroeconometric model.

Introduction

'Business investment' is an important component of aggregate demand, accounting for around 14% of GDP in 2000. But as Chart 1 indicates, business investment is volatile; and it is difficult to predict its quarterly growth path. So any extra evidence that can be brought to bear is potentially valuable. Surveys, which provide a direct and timely indication of firms' investment intentions, are one potential source of such evidence.

Chart 1
Growth in business investment and GDP



This article examines the information that surveys of investment intentions can provide about the future growth of business investment in the UK economy. The first section looks at the components of business investment in detail. The second section outlines the main economic determinants of investment growth. The third section explores surveys of investment intentions, and describes a model of investment that uses these surveys. The fourth section examines the forecast performance of this survey model, and finds that the model provides a useful source of additional information about future business investment.

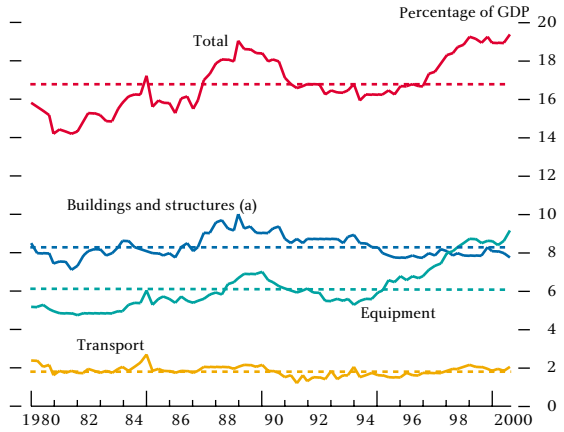
Components of business investment

'Business investment' accounted for 75% of 'whole-economy investment' in 2000, with the other main components being private dwellings investment (14%) and government investment (7%). Business investment comprises spending by firms on different assets. The three main asset categories are machinery and equipment (denoted in Chart 2 as equipment), buildings and structures, and transport equipment. But an asset breakdown of investment is available only for whole-economy investment. Chart 2 shows the ratio of whole-economy investment to GDP by asset; as the chart illustrates, the share of equipment investment in the total has increased steadily over much of the past decade.

Chart 3 shows the breakdown of business investment by sector.(1) Service sector investment is the largest component of business investment, and has been growing in importance, reflecting the growth in the share of activity accounted for by the service sector. Manufacturing investment as a proportion of GDP has declined slightly since 1994. The importance within

(1) Some of the increase in the ratio of business investment to GDP since 1994 will reflect a shift of investment expenditure from the government to the private sector via the Private Finance Initiative (PFI). Non-dwelling investment by public corporations is also included in business investment.

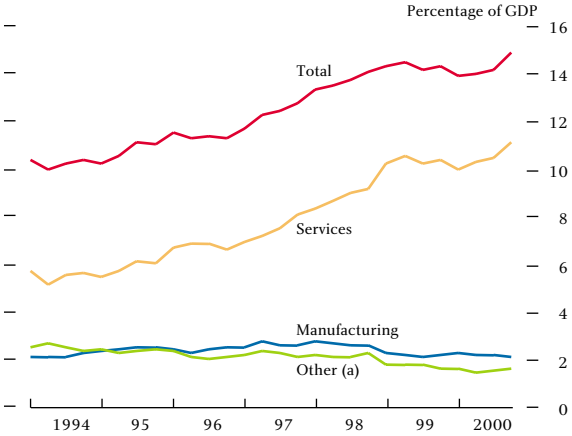
Chart 2
Whole-economy investment/GDP by asset (at constant prices)



Note: Dashed lines show the mean for the period.

(a) Includes private dwellings investment.

Chart 3
Business investment/GDP by sector (at constant prices)



(a) Other includes investment by construction companies, 'other production', and non-manufacturing public corporations. 'Other production' includes agriculture, mining and utilities.

business investment of 'other sectors', which include construction companies, mining and utilities, has declined since 1994.

Modelling business investment

The outlook for business investment is an important element of the relative balance between demand and supply pressures in the economy and hence the outlook for inflation. One approach to forecasting the outlook for business investment is to model the behaviour of firms in the economy. The Bank of England's macroeconometric model (MM), for example, can be used to analyse how firms' investment will respond to changes in the economic environment. The model assumes that firms invest to achieve their desired stock of capital.(1) The flow of gross investment depends on how rapidly existing capital needs to be replaced, ie the rate of depreciation, as well as how much additional capital, if any, firms wish to acquire. The demand for new capital is assumed to depend, in turn, on the productivity of capital and the cost of purchasing the new capital. How quickly firms will invest to reach their desired capital stock will depend on adjustment costs.

A model of investment based only on evidence of firms' past adjustment to an estimate of their desired capital stock is often an inadequate description of future investment behaviour. There are several reasons for this. One reason is that the simple characterisation in the MM is an incomplete description of the investment decisions that firms make in practice. Investment decisions are forward-looking and hence are subject to uncertainty about the future productivity of capital. Many investment decisions are also costly to reverse or are irreversible. There can be sunk costs of installing a new piece of capital equipment, and it may not be possible to resell the equipment in secondary markets.

One modelling strategy is to try to incorporate uncertainty and the irreversibility of investment decisions into a model of firm behaviour, but the cost of doing so is greater complexity. And more complex models may still fail to capture investment behaviour adequately. An alternative is to use a simple model based on the behaviour of firms and then to exploit information from other sources, such as surveys of investment intentions, to improve the model's performance. Surveys of investment intentions have the advantage that they are, by their nature, forward-looking.

Surveys of investment intentions

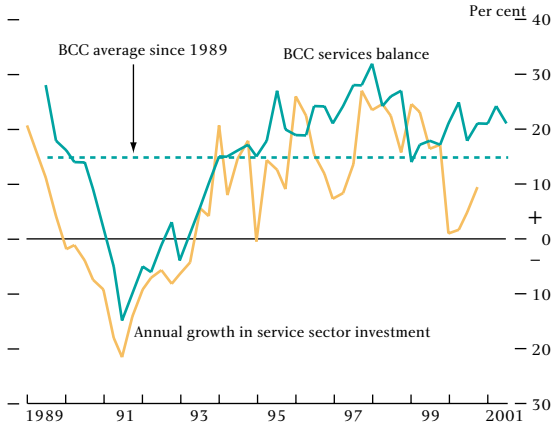
Unlike a model of business investment, surveys of investment intentions provide direct information on firms' plans for future investment. There are numerous surveys that ask firms about their investment intentions. These surveys are a useful and timely source of information.(2) Here we analyse two surveys: the British Chambers of Commerce (BCC) *Quarterly Economic Survey*, and the Confederation of British Industry (CBI) quarterly *Industrial Trends Survey*.(3)

(1) For further details of the business investment equation, see *Economic models at the Bank of England: September 2000 update*, available at www.bankofengland.co.uk/modcoupdate.htm
(2) See Britton, E, Cutler, J and Wardlow, A (1999) for a summary of how the Bank uses surveys to inform the MPC's economic assessment.
(3) There are other surveys that include questions on investment intentions, but we focus on these two surveys as they have large samples and have been conducted over a long time period. The BCC survey covers approximately 7,000 firms and the CBI's around 900 firms.

With regard to investment intentions, the CBI survey asks manufacturers: 'Do you expect to authorise more or less capital expenditure in the next twelve months than you authorised in the past twelve months?' The options presented to the firms are more, less, or the same. And the BCC's survey asks manufacturers and service companies separately: 'Over the past three months, which changes have you made in your investment plans for plant and machinery?' The possible responses are revised upwards, revised downwards or no change.

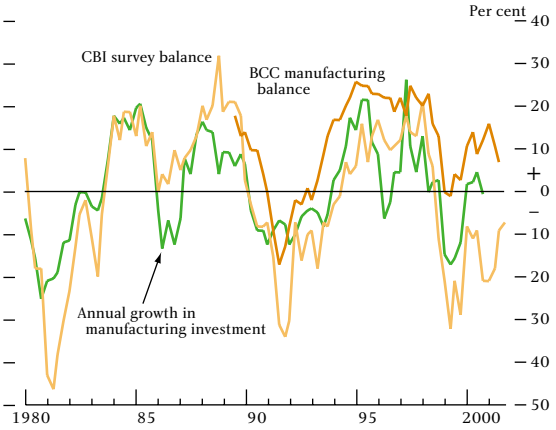
How do the qualitative answers to these questions relate to actual investment? The surveys are asking firms qualitative questions about their investment plans. A simple way of quantifying this information is to use the balance statistic—the difference between the percentage of companies reporting an increase and the percentage of companies reporting a decrease.(1) This balance can then be related to investment growth: a more positive balance suggests higher intended investment growth. Since the surveys relate to investment plans, lagged survey balances tend to have a higher correlation with current investment growth than do current survey balances. Charts 4 and 5 plot survey investment intentions for plant and machinery lagged by two quarters along with annual growth in sectoral services and manufacturing investment.

Chart 4
Services investment intentions



The BCC services balance statistic lagged by two quarters and the annual growth in service sector investment are highly correlated, though there are times when the relationship has diverged: notably in 1996 and in 2000. The annual growth in manufacturing

Chart 5
Manufacturing investment intentions



investment is also reasonably well correlated with both the CBI and the BCC manufacturing balance statistics. In terms of total business investment, the BCC services balance is more informative as service sector investment is the dominant component.

Building a survey-based model for business investment

The balance statistic can be made more directly comparable with actual investment by regressing investment for the relevant sector on the balance statistic. A similar approach is used at the Bank of England for quantifying other qualitative surveys, such as some inflation expectations surveys. But this simple approach does not fully exploit the informational content of the surveys. For business investment, we have developed a more complex model that generates projections for business investment growth over the next four quarters. It uses three sources of information: the BCC's *Quarterly Economic Survey*, the CBI's quarterly *Industrial Trends Survey*, and the 'construction new orders' series published by the Department of the Environment, Transport and the Regions. We match these three sources with investment data as follows. Manufacturing investment in 'other machinery and equipment' is matched with the CBI survey. For service sector investment, we match the BCC services survey with whole-economy investment in 'other machinery and equipment' minus manufacturing investment in 'other machinery and equipment'. This is because an asset breakdown of service sector investment alone is not available.(2) In addition to business investment in machinery and equipment, the other main asset

(1) See Cunningham, A (1997), which provides a detailed account of how qualitative surveys can be used to produce quantitative estimates for data series.
(2) This means that investment by government in plant and machinery will be included in this proxy for service sector investment.

category of investment is buildings and structures.(1) To obtain a projection for this component of business investment we use construction new orders. Construction new orders are the total number of future contracts signed by construction companies. So lagged construction new orders are related to construction output, and also to firms' expenditure on buildings and structures. We add together these three projections (one for the service sector, one for manufacturing, and one for buildings and structures investment) to produce a proxy for business investment.(2)

Modelling firm behaviour and creating a projection

We also make assumptions about the way in which firms form their investment plans.(3) Since the CBI question asks explicitly about plans over the next year, we lag it by four quarters when interpreting current investment trends. The BCC survey is also lagged by four quarters since it asks about plans, which, for the purposes of the model, we interpret as having a one-year horizon. For simplicity, we also lag construction new orders by four quarters. We then assume that firms' expressed investment intentions are accurate reflections of their investment plans. Firms report these plans as their investment intentions, and we make assumptions in order to relate the aggregate statistics reported by the BCC and CBI to plans made at the firm level. These assumptions can be used to estimate a model that generates a projection for investment four quarters ahead.(4)

But we also want to generate projections at shorter horizons—and at these shorter horizons, more information will be available. For example, assume that firms form plans at t–4 for investment in the period from t–4 to t. At time t–3, firms will have undertaken some of that investment and formed a new plan for investment up until t+1. This new plan may include revisions to planned investment for the remaining three quarters up to t. The new plan will be reported in the survey of investment intentions at t–3. We can use the relationship between the survey at t–3 and actual investment in t–4 to improve our forecast.(5) We formulate and estimate similar models for updating the investment projection for time t, using information from quarters t–2 and t–1, ending up with four empirically based models for projections of investment at one to four-quarter horizons.

Assessing the forecast performance

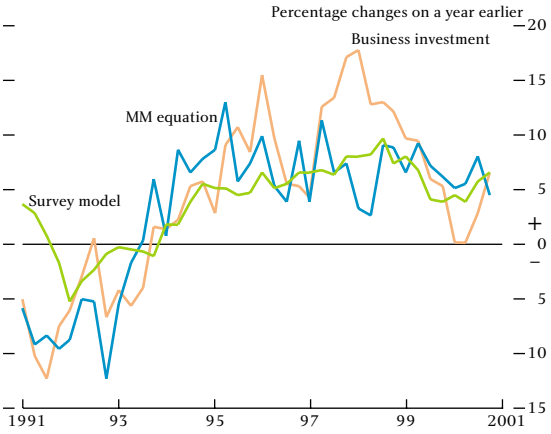
To assess the forecast performance of the survey model, we compare its projections at the one to four-quarter ahead horizons with the Bank's macroeconometric model (MM) equation for business investment.(6) Such a comparison is not straightforward however. The MM equation uses lagged values of GDP growth and the cost of capital to model firms' investment behaviour. Ideally, we should use the values of GDP and the cost of capital that were available at the time preceding each forecast. Also, for periods more than one quarter ahead, we should use predicted rather than actual values for these exogenous variables over the forecast period. For simplicity, however, we use the most current data for these variables. This gives the MM equation an informational advantage over the survey model.

Chart 6 compares the four-quarter ahead forecasts from the survey model and the MM equation with actual growth in business investment. We can see that both models perform reasonably well on average but both fail to capture the volatility of business investment growth. It is hard, however, to draw further conclusions on the relative forecast performance of the survey model and MM equation on the basis of the chart alone. It is helpful to look at some summary statistics of forecast performance.

In the table below we report the root mean square errors (RMSEs) of the model forecasts.(7) We find that the survey model does not outperform the MM equation at the one-quarter horizon (3.57 compared with 2.29), but it does so at the four-quarter horizon (4.03 compared with 4.46). The relative forecast performance of the

(1) For simplicity, we have not included investment by the business sector in vehicles in our model. This data series is available only for manufacturing and its weight is small; approximately 4% of total manufacturing investment. There is also no equivalent survey question on vehicle expenditure.
(2) This series is only a proxy for business investment; we have added together three components from the asset breakdown in order to proxy a component of the sectoral breakdown. But the proxy is highly correlated with business investment both in level and in annual and quarterly growth rates (correlation coefficients of 0.99, 0.90 and 0.79 respectively).
(3) See Larsen, J (1999) for a detailed description of the assumptions underlying the model.
(4) See Pesaran, H (1984) for a fuller discussion of modelling firms' expectations.
(5) See Cuthbertson, K (1996) for a formal derivation of this result.
(6) The comparisons presented here are based on internal work with John Power of the Bank's Monetary Assessment and Strategy Division.
(7) The root mean square error (RMSE) is the square root of the difference between the forecast value and the actual outturn for business investment. A lower RMSE indicates a superior forecast performance. Here the comparisons are based on the forecasts in log levels for the period 1991 Q1 to 2000 Q3.

Chart 6
Four-quarter ahead forecast comparison



survey model improves at longer forecast horizons, which could reflect the forward-looking nature of the surveys since they ask directly about investment plans. In other words, the survey model provides relatively more information for periods beyond one quarter ahead.(1)

Forecast comparisons: root mean square error (RMSE) (x 100)

	One quarter ahead	Four quarters ahead
Survey model	3.57	4.03
MM equation	2.29	4.46
Adjusted model	2.25	4.06

We also tested for the significance of the difference in forecast performance between the survey model and the MM equation. We calculated the probability of the models producing the difference between the RMSEs reported here when in fact the RMSEs are the same, ie they actually have the same forecast performance. The probability that the survey model and the MM equation have the same forecast performance one quarter ahead is fairly low at 12%. At the four-quarter horizon, however, it is much more likely, ie with a probability of 68%, that the two models perform equally well. Neither of the differences, however, is statistically significant.

Using survey information efficiently

Although at horizons of around a year the survey model outperforms the MM equation, it cannot replace it. First, since the survey model only uses data on investment intentions, we cannot use it to simulate how firms' investment behaviour will respond to changes in the economic environment. For instance, it cannot tell us how investment will respond to a change in interest rates. Second, for the survey model to produce a projection further than one year ahead, we would need to model firms' investment intentions. A model of investment intentions would in turn need to be based on the behaviour of firms, which would be similar to the current MM equation; the survey model can be a complement to the MM equation, but not a substitute. So does the survey model provide information that is not already contained within the business investment equation? And how can we adjust the MM equation forecast to incorporate information from the survey model?

To explore these questions, we regressed the level of business investment on both the levels of the survey model projections and the MM equation projections.(2) The resulting coefficients were used to weight together the two forecasts in order to produce an adjusted forecast for business investment using both these sources.(3) This forecast is called the adjusted model in the table.

We found two things. First, the weight that should be given to the survey model increased as the forecast horizon increased, eg a greater weight was given to the surveys at the four-quarter ahead horizon than at the one-quarter ahead horizon. This concurred with our previous results, which showed that the relative forecast performance of the survey model improved as the forecast period lengthened. This could reflect the fact that over longer periods, timing issues related to implementing investment plans are less influential. Second, we found that the forecast performance of the adjusted model using both sources outperformed the MM equation. This provides some evidence that the survey model contains different information from that contained within the MM equation, and adds value to the MM forecast. The incremental information of the survey model over the MM equation may reflect the forward-looking nature of the surveys. Again, the survey model cannot replace the MM equation, but our results provide evidence that the survey model is a useful (but not exclusive) source of information for a forecast of business investment.

(1) We also compared the survey model with a simple statistical model, which relies on past observations of the variable itself to generate short-run projections. Again, we found that the survey model outperformed the statistical model at the four-quarter horizon but not at the one-quarter horizon.
(2) Since the two models are forecasting the same variable, they should tend to move together over time.
(3) We did not restrict the OLS coefficients to sum to unity, since this weighted average technique has been shown to be inferior to an unrestricted model; see Granger, C and Ramanathan, R (1984).

Conclusion

This article outlines how the qualitative information from surveys of investment intentions can be used to forecast the growth of business investment. It describes how the Bank has constructed a model based on these surveys, and shows that the relative forecast performance of this model improves as the forecast period lengthens. It also provides evidence that the survey model contains useful information that is additional to the Bank's MM equation for business investment. The added value of the survey model may reflect the forward-looking nature of the survey balances.

References

Britton, E, Cutler, J and Wardlow, A (1999), 'The Bank's use of survey data', *Bank of England Quarterly Bulletin*, May, pages 177–82.

Cunningham, A (1997), 'Quantifying survey data', *Bank of England Quarterly Bulletin*, August, pages 292–300.

Cuthbertson, K (1996), *Quantitative Financial Economics*, John Wiley and Sons.

Granger, C and Ramanathan, R (1984), 'Improved methods of combining forecasts', *Journal of Forecasting*, Vol. 3, pages 197–204.

Larsen, J (1999), 'Quantifying survey data on investment', *mimeo*, Bank of England, available on request from jens.larsen@bankofengland.co.uk

Pesaran, H (1984), 'Expectations formations and macroeconometric modelling', in Malgrange, P and Muet, P (eds), *Contemporary Macroeconomic Modelling*, Basil Blackwell, pages 27–54.