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Returns to equity, investment and *Q*: evidence from the United Kingdom

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Abstract

Conventional wisdom has it that Tobin's Q cannot help explain aggregate investment. This is puzzling, as recent evidence suggests the closely related user cost approach can do so. We do not attempt to explain this puzzle. Instead, we take an entirely different approach, not using the first-order conditions from the firm's maximisation problem but instead exploiting the present-value expression for the firm's value. The standard linearised present-value asset price decomposition suggests that Q should be able to predict other variables, such as stock returns. Using UK data we find that it has strong long-horizon predictive power for debt accumulation, stock returns and UK business investment. The correctly signed results on both returns and investment appear to be robust, and are supported by the commonly used and bootstrapped standard error corrections, as well as recently developed asymptotic corrections.

Key words: Investment, Tobin's Q, long-horizon forecasting.

JEL classification: E22, E27.

Summary

Tobin's Q is the ratio of the market value of a firm to the value of the firm's capital stock. The simple idea that makes it so attractive is that the larger this ratio the cheaper it is for the firm to increase the capital stock by issuing more equity. So one might expect that investment would be positively related to it, and this can be given a rigorous theoretical explanation. But it is commonly believed that, contrary to this neoclassical theory, Tobin's Q is of little practical use in explaining aggregate business investment. By contrast, recent evidence suggests that the user cost of capital (effectively, the equivalent to the cost of renting capital) has a statistically significant impact on investment. This is odd, because the theory in both cases is based on the same conditions, those required by firms seeking to maximise their value to shareholders. We do not attempt to resolve this empirical puzzle, but take a different approach to using the information in the data.

The value of a firm can be thought of as the discounted sum of future profits; the present-value. Q is therefore the ratio of this present-value to the cost of replacing capital. Standard finance theory predicts that because this present-value condition comes from future profits, Q should contain information about market participants' expectations of future events. The intuitive explanation is that if Q rises above its long-run average value, this should be an indication that either (i) future investment opportunities are expected to be good or (ii) that future investment is discounted at a lower than normal rate (or both). Some recent work on US data suggest that the same present-value condition relates Q to expected values of several financial variables such as bond yields, the ratio of debt to capital, growth in debt, and stock returns. In this paper we contribute to this debate by employing data using Bank of England estimates of the capital stock of the UK business sector.

The approach implied by standard investment theory strictly requires us to work with a marginal measure (the discounted profits relative to the cost of an extra unit of capital). Unfortunately, this can be proxied by the average (which is much more easy to measure) only under stringent restrictions which are unlikely to hold in practice, and this might explain the lack of success in some previous empirical applications. But the present-value approach employed in this paper relies on a small number of assumptions, and requires only an average value of Q. The main condition for the present-value framework to be valid is that average Q is stationary (meaning that the mean and variance of the variable in question do not tend to change over time). It is quite

reasonable, theoretically, to expect this to hold. Using a battery of statistical tests for stationarity, we find evidence that this is the case. Having established this, we then look at the short and long-run relationships between Q and the variables it might predict, as implied by a close examination of the present-value condition. This is done in two ways.

First, we look at a system of equations to see if past values of Q have any additional predictive power when other lagged variables are also used to explain the data. Our results indicate that Q does predict the debt to capital ratio, growth in debt and investment. However, contrary to some US results, we do not find evidence that it predicts short-run fluctuations in equity returns or firms' earnings.

Second, we look at the question of whether Q can by itself predict variables for horizons ranging from 1 to 32 quarters, a common method in empirical finance studies. There are some well-known statistical problems arising from the fact that the tests for statistical significance are biased by the 'overlapping' nature of the data, which (among other things) causes forecast errors to be very strongly correlated between observations. We use some standard test corrections to take care of this, but we also consider some less commonly used corrections. These included 'bootstrapped' standard errors (where the uncertainty about our estimates is estimated by taking repeated samples of the original data), and a newly developed theoretical correction (derived under the standard assumption of a 'long' sample length). These different methods provide a coherent picture, in the sense that Q is able to predict equity returns as well as the investment to capital ratio and changes in the capital stock. In particular, as predicted by theory, Q is negatively related to returns and positively related to investment and capital growth, over medium and long horizons.

We therefore conclude that, at least for UK data, the common perception that Q is interesting from a theoretical perspective, but of little empirical relevance, is not true. In contrast, it appears to be a rich source of information about real and financial quantities.

1 Introduction

Neoclassical theory predicts that from the first-order conditions of the firm's maximisation problem a relationship exists between the user cost of capital and investment. This can be reformulated to yield a relationship between Tobin's *Q* and investment. It has become a commonplace to observe that Tobin's *Q* has no practical use when we wish to explain aggregate business investment. Examples include Oliner *et al* (1995) for the United States, where in the cases when *Q* is significant it is wrongly signed. In his survey, Chirinko (1993, page 1,891) concludes that the 'model's empirical performance has been generally unsatisfactory': see also Caballero (1999). This is somewhat odd, as although a similar consensus held about the user cost in the 1980s, the recent view is that the user cost is significant in the aggregate investment relation.(1) Tobin (1969) did not provide a formal model when he introduced the concept. The link to the neoclassical model was made explicit by Mussa (1977), but the notion was a marginal one. Hayashi (1982) showed how marginal and average *Q* could be linked in specific cases, which encouraged the empirical exploitation of the concept, while Abel and Eberly (1994) extended the theory to encompass various realistic features, including irreversibility and fixed costs.(2)

This paper makes no attempt to resolve this puzzle. Instead, we examine another theoretical prediction, superficially related but in fact quite different, from the present-value approach to firm valuation. *Q* is based on stock market valuations. In the modern finance literature, it is widely accepted that asset prices contain information about future developments. For example, there is evidence that the price-earnings ratio is a predictor of future returns over some horizons.(3) This follows from a decomposition of the linearised asset price present-value condition. A similar decomposition of *Q* suggests that it may predict a variety of series, including investment, but also

(1) Controversy persists about the size of the effect. Caballero (1994) for the United States and Schaller (2003) for Canada emphasise the bias induced by adjustment costs, and find long-run estimates close to unity. Caballero *et al* (1995) find a similar average elasticity with plan-level data, while Goolsbee (1998), emphasising the supply elasticity, obtains similar results. But Chirinko *et al* (2002) using a very large US panel find a precisely estimated user cost elasticity of approximately 0.40. In the United Kingdom, Ellis and Price (2004) find a well-determined value of around 0.45.

(2) Hayashi showed that if firms are price takers and the production and adjustment cost functions are linearly homogenous, average *Q* is a sufficient statistic to explain investment. These conditions do not obviously hold, and the evidence is against it: for example, Cooper and Haltiwanger (2000) find that the profit function is homogenous of degree 0.5. The effect of imperfect competition is that the marginal return to investment is declining, so average *Q* lies above the marginal. Average *Q* should exceed one, the extent depending inversely on the elasticity of demand (the more market power, the higher average *Q*), quite plausibly with a cyclical component. Robertson and Wright (2002) suggest other reasons why the average *Q* may differ from unity. These are a failure of market efficiency following from differences between the market's and firm's information sets, and mismeasurement of capital.

(3) Early work includes Campbell and Shiller (1998a,b) and Fama and French (1988).

financial variables.

The basic insight is simple. The value of the firm is given by a discounted sum of future earnings. This present-value condition, together with the assumption of a stable long-run condition for its value (after suitable normalisation), provides a direct relationship between current market prices and expected future outcomes. For example, a high value of the price-earnings ratio relative to its long-run average indicates that either future earnings are expected to be above, or the rate at which they are discounted (the rate of return demanded by the market) is expected to be below equilibrium values. Under rational expectations, systematic deviations of the price-earnings ratio should predict either or both of earnings and returns. Similarly, the present-value of Tobin's Q is directly connected to future variations in debt and the capital stocks, as well as the relevant disount rate which corresponds to expected future stock returns.

The central question this paper aims to answer is therefore whether variation in Q is systematically related to movements in stock returns and the capital stock. Since this relationship derives from a present-value condition, we build our empirical analysis on an average measure of Q that can be easily constructed with available data. It should be clear, moreover, that this approach is not an alternative to the neoclassical model, but simply a part of it. For the present-value method to work, Q must be mean reverting. As theory predicts that marginal Q is stationary, a sufficient condition is that the marginal and average values do not diverge in a non-stationary manner.

Robertson and Wright (2002) find Q cannot predict US investment, despite having a very long time series; this is a puzzle. To anticipate our results, by contrast we find that Q does have predictive power for UK investment data. Furthermore, it is also informative about some other variables, including returns. The latter result is based on long-horizon regressions, and appears to be robust to the conventional corrections (Hansen and Hodrick (1980), Hodrick (1992)), to bootstrap-standard errors, and corrections derived from asymptotic theory developed by Hansen and Tuypens (2004).

The plan of the paper is as follows. In Section 2 we discuss the theoretical role of Q. In Section 3 we consider the data. Section 4 examines the information in the series, and Section 5 concludes.

2 The present-value approach to Q

Following Tobin (1969), average Q is defined as

$$Q_t = \frac{P_t + L_t}{K_t} \quad \textbf{(1)}$$

where P denotes the value of equity, L is total liabilities (debt) and K is the value of the capital stock. Normalising the number of shares issued at unity, we can think of P as the price of equity. In logs, indicated by lower case,[(4)] linearising around the mean value of $l - p$, $\widehat{l-p}$, we obtain

$$q_t \approx \xi + (1-\zeta)p_t + \zeta l_t - k_t \quad \textbf{(2)}$$

where $\xi = \ln(1 + e^{\widehat{l-p}})$ and $\zeta = e^{\widehat{l-p}}/(1 + e^{\widehat{l-p}})$.

Traditionally, q has been used as part of a structural neoclassical investment equation. The relevant concept was marginal, but Hayashi (1982) helped popularise this approach, by showing the conditions under which average q could be used in empirical relationships.

Building on earlier work by Campbell and Shiller (1988a) and Cochrane (1991), two papers by Lettau and Ludvigson (2002) and Robertson and Wright (2002) investigate the question of what information q might contain in addition to that about expected future investment.

To simplify the exposition we begin by assuming there is no debt, so **(2)** becomes

$$q_t = p_t - k_t \quad \textbf{(3)}$$

The key to understanding this approach is in the standard decomposition of the equity price. The log stock return is defined by

$$r_{t+1} = \ln(R_{t+1}) = \ln\left(\frac{P_{t+1} + E_{t+1}}{P_t}\right) \quad \textbf{(4)}$$

where E_t is dividends.[(5)] From Campbell and Shiller (1988a), we can approximate this by

$$r_{t+1} \approx \theta + \Delta p_{t+1} + (1-\rho)(e_{t+1} - p_{t+1}) \quad \textbf{(5)}$$

(4) The convention in the paper is to use lower case for logs. However, as q is a monotonic transformation of Q, to keep things tidy lower case is primarily used when referring to it in the text in the rest of the paper, except when it is explicitly the level being discussed.

(5) The return R_{t+1} can also be expressed as $\frac{EA_{t+1}}{EA_t}\frac{PE_{t+1}+PO_{t+1}}{PE_t}$, where EA_t is earnings, PE_t is the price-earnings ratio and PO_t is the dividend payout ratio, E_t/EA_t. Dividend growth can be decomposed into earnings growth and a payout ratio. Practically, it may be helpful in finite samples to work with earnings rather than dividends, as the latter may be smoothed or set to zero, and firms may buy back stock and issue new equity, all of which make dividends less helpful as a guide to the value of a firm. For a finitely lived firm where the terminal value of the firm's assets are distributed, the present-value of earnings (including the terminal value of the firm) is equal to the present-value of dividends. In the empirical part of the paper we use aggregate earnings.

where $\rho = \frac{1}{1+e^{\widehat{e-p}}} < 1, \theta = \ln(1 + e^{\widehat{e-p}}) - (1-\rho)\widehat{e-p}$ and $\widehat{e-p}$ is the mean of the ratio $e - p$. If we rewrite **(5)** as an expression explaining p_t, we have a forward-looking equation in the price. This can be solved (with a transversality condition) to express the current price as a weighted sum of future returns and dividends.[(6)] If the price is high, it must be that dividends are expected to grow rapidly and/or that future returns are expected to be low. The return is the required market rate of return, given the risk of holding the asset. It is the rate at which future dividends are discounted. A useful interpretation of the relationship is in terms of the dividend-price ratio. If dividend growth is relatively constant, as is often thought to be the case, fluctuations in the dividend-price ratio should forecast future returns. It is often argued that the evidence supports this proposition. We return to some issues surrounding this below.

For the present-value approach to work, there must be a reason why returns would vary. Standard models of intertemporal choice predict that assets should be priced according to their covariance with the stochastic discount factor or intertemporal marginal rate of substitution. It is often thought that the market price of risk (the required excess return on risky assets) varies with marginal utility.

The interesting corollary for our purposes is that there are implications for q, and therefore investment. This was explored by Abel and Blanchard (1986), who were concerned partly with constructing a measure of marginal q but who looked explicitly at the present-value condition. Using the same approach as in the literature examining the information in the dividend-price ratio, we can use **(1)** to eliminate p_t, solve for q_t and then solve **(5)** forward and substitute into **(3)**, using the transversality condition $\lim_{i\to\infty} \rho^i q_{t+i} = 0$, to obtain

$$q_t \approx \frac{\phi}{1-\rho} + \sum_{i=1}^{\infty} \rho^{i-1} f_{t+i} \tag{6}$$

where

$$f_t = \Delta k_t + (1-\rho)(e_t - k_t) - r_t \tag{7}$$

In the general case where firms issue debt, f_t is redefined as

$$f_t = \Delta k_t + (1-\rho)[(1-\zeta)(e_t - k_t) + \zeta(l_t - k_t)] - \zeta \Delta l_t - (1-\zeta) r_t \tag{8}$$

where as above $\zeta = e^{\widehat{l-p}}/(1 + e^{\widehat{l-p}})$, the share of debt in total value. Therefore q may have

(6) This derivation assumes away bubbles. The consensus view in the finance literature (eg, Cochrane (2001, pages 399-402)), is that bubbles are implausible. This is partly on theoretical grounds and partly empirical. For example, if there were bubbles price-earnings ratios would be non-stationary; but they are not (see Table A below). In this view, possible counter-examples such as the great dot-com fiasco must have been sustained by mistaken expectations.

forecasting power for investment, the yield, gearing, the growth in debt and stock returns.[7]

If q is stationary, then the right-hand side of **(6)** must also be stationary. Stationarity of average q is not assured, but there are strong arguments to suggest that marginal q is stationary, so if the divergence of marginal and average q is stationary, q will be mean reverting. Given **(6)**, stationarity holds if each of Δk_t, $e_t - k_t$ and r_t are stationary. If not, then $(\Delta k_t, e_t - k_t, r_t)$ must be a cointegrating set. This makes the question of what is and what is not stationary important, and we spend some time on this in the empirical work.

To summarise, in this alternative interpretation we need no longer worry about divergence between average and marginal measures, and it reinforces the belief q should help us forecast investment. The mystery remains that it has not been found to do so. Lettau and Ludvigson (2002) and Robertson and Wright (2002) do not resolve that puzzle, but instead derive a potential relationsghip of q with other variables such as bond yields, the gearing ratio, the growth in debt and stock returns.

3 Data

3.1 Definitions

We use our own estimates of the capital stock (Oulton and Srinivasan (2003)). Ideally, we would like a measure of Q for the business sector. It has to be recognised that there are profound difficulties with measuring it. Not least is that the capital stock includes firms operating in the United Kingdom but owned by non-residents and therefore generating profit streams in other countries, while firm valuations refers to UK-based firms many of which generate a part of their profits and therefore value from capital in other countries. As usual, we assume these two offsetting effects cancel. Looking more specifically at industrial coverage, we have two proxies available.[8] These are a measure for the private non-financial corporations (PNFC) sector, and

(7) Abel and Eberly (2004) use a similar conceptual framework. They examine a model without adjustment costs but where marginal and average Q diverge due to monopoly power. Marginal Q is continually equal to one, but because profits vary with monopoly power average Q can vary, and is informative about investment. Although the connection to the present-value approach to asset pricing is not explicitly made, it is nevertheless within this framework. For simplicity, they assume returns are constant, and focus on variations in profits. They observe that their model suggests the impact of Q will be small, which confounds the standard empirical criticism that implied adjustment costs are implausibly high. They also find cash flow has an effect on investment, a common empirical result. See also Abel and Eberly (2002).

(8) Fuller data descriptions and sources are given in the appendix: data are available on request.

another for a broader PNFC plus public corporations sector (PNFC+). Neither of these is perfect.

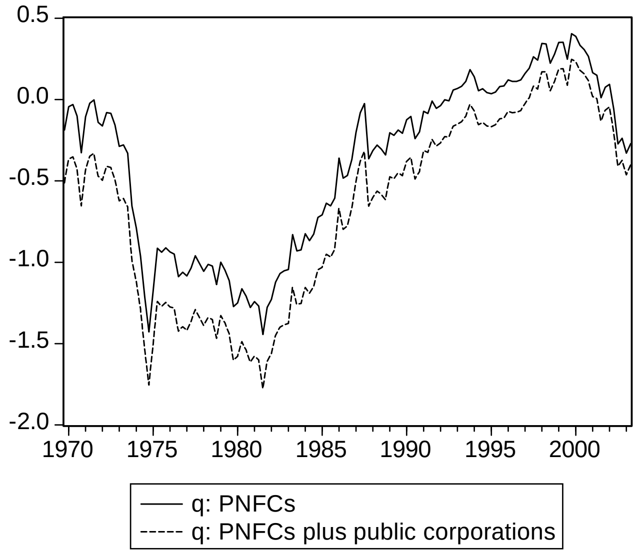
The first will be distorted by privatisations. The impact of privatisations is that the underlying capital stock series will increasingly understate the 'true' PNFC' net capital stock over time.

The second measure overcomes the privatisations problem by using a broader sector than PNFC that includes public corporations (PNFC+). But our measure of the numerator of Q, as well as the inventories part of the denominator, is for PNFC rather than PNFC+. Arguably, this series is to be preferred, as the impact of the data problems associated with this estimate are likely to be small in relation to the privatisation problem, and this is what we use in the subsequent analysis although, numerically, it must be too small.

Chart 1 shows the two (log) measures. As expected, the narrower measure lies above the broader. But there are systematic variations in the discrepancy. Looking at the narrower measure, in natural levels the series ranges between 0.24 and 1.50: the sample mean is below unity, at 0.77. This is odd, as the arguments regarding why it might differ from one largely push the measured value up. Another such might be thought to be the stock of 'intangible investments' in software, firm-specific human capital, and knowledge.(9) But one interpretation could be that the United Kingdom suffered from a lengthy period of 'negative intangibles'. Hall (2001b) acknowledges that these are a somewhat puzzling idea, but provides a number of possible explanations for the phenomenon.(10) The first argument was introduced in an earlier paper by Hall (2001a), referring in turn to work by Greenwood and Jovanovic (1999). The falls in stock markets in the early 1970s coincided with the implications of the information technology (IT) revolution becoming apparent. Although the overall effect on productivity was positive, existing firms with human and physical capital tied to existing practices were not able or willing to exploit the benefits of IT and therefore lost value. At the same time, new firms able to exploit the IT revolution had not yet been founded. This is supported by the observation that (in the United States) on aggregate, the stock market value of firms present in 1968 fell sharply over the next three years and never recovered, while the rise in the overall stock market capitalisation was driven by firms which entered after 1968. A second related argument could be made with reference to the oil price shocks that hit the global economy in the 1970s. These may have made much of the existing capital stock obsolete. Third, Hall (2001b) points out that shareholders have the last claim on corporate revenue and may during

(9) For a discussion of the United States context see Nakamura (2001) and Lev (2003).
(10) The discussion here is drawn from Eliades and Weeken (2004).

Chart 1: The two measures of q



the early 1970s have lost to other stakeholders such as suppliers, workers, managers or governments. But the length and magnitude of this phenonomenon, as suggested by Chart 1, is somewhat puzzling.

From the analysis in Section 2 (equation **(8)**), we are interested in Δk_t, $e_t - k_t$, $l_t - k_t$, Δl_t and r_t. We also examine the excess return, $r_t - r_t^f$, where the risk-free rate r_t^f is the return on 20-year government bonds.[(11)] 'Dividends' are earnings net of interest payments and therefore include retained earnings. The business investment to capital stock ratio is defined to include all corporations.

3.2 Time-series properties

As we observed above, **(6)** implies that if q is stationary, then the right-hand side of the expression must also be stationary. It then follows that either each of the components of f, namely Δk_t, $e_t - k_t$, r_t, $l_t - k_t$ and Δl_t, are stationary or form linear combinations that cointegrate. Then mean reversion implies that q must predict some of these variables. Were q not stationary, there would be a common stochastic trend which would dominate the variance. So a consideration of the order of integration and cointegration of the data is vital.

(11) Data definitions and plots of all series are in the appendix.

Of the series we consider, a visual impression suggests that not all are unambiguously stationary. This is confirmed by the formal unit root tests in Table A. We report ADF, Phillips-Perron and KPSS tests. The first two of these take the null of non-stationarity. The KPSS test has a null of stationarity and may therefore be more appropriate, given our strong prior of mean reversion.[(12)] Only the earnings ratio, the growth in debt, the business investment to capital ratio and returns are apparently stationary. From a theoretical perspective, this absence of mean reversion is odd. For marginal q, the neoclassical prediction is that the steady-state value is invariant to most structural parameters. There are no compelling reasons to suppose the gap between average and marginal q should be non-stationary.[(13)] Empirically, (log) investment is an I(1) variable, as we would expect on theoretical grounds. In the long run the capital stock accumulation identity ensures the capital stock has the same order of integration so long as the depreciation rate is stationary. This is the case in our data set, so the growth in the capital stock should also be stationary. The debt to capital ratio can certainly not be unbounded, although that does not rule out non-stationarity.

Table A: Univariate stationarity tests (no trend)

	q	q^{PP}	Δk_t	$e_t - k_t$	$l_t - k_t$	Δl_t	$i_t - k_t$	r_t	$r_t - r_t^f$
ADF: 5% critical value -2.88									
level	-1.31	-1.17	-2.58	-3.11	-0.96	-5.25	-2.90	-5.84	-6.56
change	-4.66	-4.59	-4.22	n/a	-4.90	n/a	n/a	n/a	n/a
Phillips-Perron: 5% critical value -2.88									
level	-1.24	-1.08	-2.05	-3.75	-0.86	-9.71	-2.30	-11.1	-11.1
change	-4.66	-4.59	-4.22	n/a	-11.03	n/a	-12.46	n/a	n/a
KPSS: 5% critical value 0.46									
level	0.80	0.88	0.57	0.19	0.68	0.22	0.19	0.16	0.26
change	0.20	0.21	0.06	n/a	0.32	n/a	n/a	n/a	n/a

However, stock accumulation processes can be long-lived, and it is possible that the series are long-memory, but nevertheless stationary, an alternative against which the tests have low power. Examining this, a generalisation of the I(0) and I(1) dichotomy is fractional integration, I(d), which nests the two classical cases, and is a flexible way of modelling long-memory stationary processes. The autoregressive fractionally integrated moving average is a convenient way of modelling highly persistent data that defines regions of stationarity and non-stationarity. Table B reports a test introduced by Robinson (1994). All the estimates of d lie below 0.5, the limit below

(12) We report results using four lags for the ADF and recommended bandwidths for the other tests: however, results are not sensitive to lag length.
(13) See Robertson and Wright (2002) for an extended discussion.

which a time series is both mean reverting and has finite variance. This is evidence for stationarity.[14]

Table B: Test for fractional integration

	q_t	Δk_t	$e_t - k_t$	$l_t - k_t$	Δl_t
$\hat{d}$	0.48	0.25	0.10	0.47	0.09
se	0.02	1.98	0.57	0.03	0.58
$t \ (d = 0)$	25.4	0.12	0.17	15.2	0.15

se denotes standard error.

An alternative, joint, test for stationarity is offered by the Johansen method. Examining q_t, Δk_t, $e_t - k_t$, $l_t - k_t$, r_t and Δl_t, our null is that either these variables are all stationary or some form cointegrating relationships. The interest rate r_t is unambiguously stationary, so there are five variables in question. Table C reports the results of performing a Johansen test on q_t, Δk_t, $e_t - k_t$, $l_t - k_t$ and Δl_t. The VAR length selected by the SIC is two, but a longer lag is required to remove autocorrelation.[15] The interesting conclusion is that we can reject the hypothesis that the cointegration rank is 4 against the alternative it is 5. As the VECM is full rank, this must imply all the series are stationary.[16] Together with the evidence from the long-memory model, we proceed on the basis that all the series are stationary.

4 Information in *Q*

From the present-value condition we know stock market prices and q summarise information about the entire future path of the relevant variables. While the neoclassical theory suggests that q will be informative about short-run movements in the capital stock and investment, the present-value approach suggests that it is additionally informative about long-horizon movements. As q_t is a weighted sum of future values, it follows immediately from **(6)** that q_t may be able to forecast some or all of these series. The relationship is not a causal, structural one, but is rather to

(14) However, it is weak as for q_t and $l_t - k_t$ the estimates are close to and insignificantly different from 0.5.
(15) Dummies for the 1974:1 oil shock and a change in tax incentives affecting 1985:1 and 1985:2 are also included. Each equation in the VAR comfortably passed tests for skewness, but there was evidence for excess kurtosis at the 1% level in Δk_t, q_t and $l_t - k_t$ and at the 5% rate for Δl_t. Hendry and Juselius (2000) conclude that inference is 'moderately robust' to kurtosis.
(16) We repeated this for all lag lengths between 1 and 8. For lags 1 to 3 we cannot reject $r = 4$ but for lags higher than 4, once again we cannot reject the hypothesis that $r = 5$ (all the variables are stationary).

Table C: Johansen tests; linear deterministic trend

Variables: q_t, Δk_t, $e_t - k_t$, $l_t - k_t$, Δl_t Sample 1971:3 to 2003:1, 8 lags				
H0: r	Eigenvalue	Trace statistic	5% Critical value	1% Critical value
0 **	0.200	85.00	68.52	76.07
At most 1 **	0.18	57.31	47.21	54.46
At most 2 *	0.12	33.40	29.68	35.65
At most 3 *	0.10	17.30	15.41	20.04
At most 4 *	0.038	4.84	3.76	6.65

* (**) denotes rejection of the hypothesis at the 5% (1%) level.

be understood in the sense that q_t contains information that may help predict future outcomes, based as it is on agents' expectations.

Two types of econometric analysis are used to explore this. First, we employ a VAR framework to examine whether q_t Granger-causes some of the elements of f. We can think of this as giving us information about the short-run dynamics of the process.[(17)] One shortcoming follows from the fact that as the standard VAR is a reduced-form representation of the data, the dynamics are not immediately interpretable. The second approach, to which we give more weight, follows the finance literature and examines predictive power at different horizons. It can be argued that q will forecast better at medium to long horizons, for both investment and returns, as these variables are generally believed to comove with business-cycle frequencies.

4.1 Evidence from a VAR

As we have explained above, q may have predictive power for some elements of the forward set. One way to examine this is to examine block exogeneity, using pairwise Granger causality tests. These tests are valid under either stationarity or the existence of cointegrating relationships, although the conclusion we reach in the previous section is that stationarity may be maintained.

From the results in Table D, q is able to predict the liability rate and growth in liabilities. It does not significantly predict investment: the p-value is 11%. However, when we use the change in the

(17) We can also interpret 'investment equation' ARDLs in this context.

capital stock instead of the investment ratio (Table E) q does have predictive power for investment; predictability of the liability ratio is now only marginally significant, at 10%. But in both cases, contrary to the results in Robertson and Wright (2002), q does not predict returns or earnings. Neither are the long-run effects significantly different from zero. However, the VAR-based tests are conditional on a large information set. q summarises a large amount of information, and this is quite consistent with the result that it contains no additional news beyond that in the other conditioning variables. In addition, VARs are inevitably over-parametrised, which reduces the precison of the estimates. Moreover, VARs may be most informative about (conditional) short-run dynamics. The point is that q is a type of summary statistic, summarising agents' expectations of future developments. The fact that in a multivariate approach lagged q can be excluded from a regression does not imply that it contains no information. So if we are interested in a single parameter – forecastability over a particular horizon – long-horizon tests are more appropriate, and it is to these which we now turn.

4.2 Long-horizon tests

Returns are usually thought to be predictable at medium to long-term horizons. The standard predictive variable is the price-earnings ratio, but other variables may also have predictive power. Economic theory suggests the deviation from the long-run relationship between consumption, income and wealth should be one such, and in both Lettau and Ludvigson (2004) for US data and Fernandez-Corugedo *et al* (2003) for UK data, returns are predictable from this series. Similarly, there is evidence from the papers cited above that q has this property for the United States.[18] So it is of interest to see if this result holds for our data, despite the failure to find Granger causation. Recall that theory predicts that *ceteris paribus* a large value of q should be associated with smaller future expected returns.

4.2.1 Econometric issues

We consider equations of the form

$$R_{h,t} = \beta_0 + \beta_1 z_{t-1} + \varepsilon_t \qquad \textbf{(9)}$$

(18) This is consistent with the results from Abel and Blanchard (1986), who find that for their measure of marginal q the majority of the variation is driven by returns, as opposed to marginal profits.

where

$$R_{h,t} = \prod_{j=0}^{h-1}(1 + r_{t+j}) - 1$$

or approximately

$$R_{h,t} \approx \sum_{j=0}^{h-1} r_{t+j}$$

where r_t is the return, h the forecast horizon and z_t is the predictor variable. That is, a single-period variable is used to predict cumulated ('long-horizon') returns.

There are some econometric issues to consider. While the notion that returns are predictable at medium to long horizons has acquired stylised-fact status, there has been something of a counter-revolution recently. In particular, it has been argued that there are three potential problems with the standard tests of overlapping horizon returns. First, persistence of the instruments predicting returns; second, the corrections employed to account for heteroscedasticity and the autocorrelation induced by the overlapping nature of the data; and third, endogeneity of the predictor. An influential paper was Nelson and Kim (1993). Thus Ang and Bekaert (2006) provocatively ask about the predictability of equity returns: 'Is it there?'. The answer appears to be, not as much as some people thought. This may be welcome: as Cochrane (2001, pages 406-07) observes the high estimates previously obtained were a puzzle. Wetherilt and Wells (2004) conclude that for the United Kingdom there is weak evidence that dividend yields predict long-horizon excess returns. The emerging new consensus remains that there is predictability; indeed, it may be that one of the other stylised facts (that long-run dividend growth is unpredictable) will be overturned (Lettau and Ludvigson (2005)). Ang and Berkaert themselves conclude that returns can be predicted, as do Campbell and Yogo (2006). Ang and Bekaert (2006) argue that Newey-West standard errors are downwardly biased in small samples, and that the bias can be substantial. The Hansen and Hodrick (1980) correction is also biased, although less so. They advocate using the Hodrick (1992) correction.

In a recent contribution, Hansen and Tuypens (2004) develop a spectral theory of long-run regressions which provides an alternative correction. The main innovation they propose is to reformulate the standard tests as balanced long-run regressions, and then to apply a simple correction to the OLS standard errors. The standard predictability test regresses returns cumulated over a j-period horizon on a single-period explanatory variable (in our case, q). Hansen and Tuypens argue that a more efficient method is to cumulate the explanatory variable, to generate a balanced regression. They also derive an asymptotic correction (as the horizon goes to infinity) to the standard error of β_1 in the OLS regression

$$R_{h,t} = \beta_0 + \beta_1 Z_{h,t-1} + \zeta_t \tag{10}$$

where

$$Z_{h,t} = \sum_{j=0}^{h-1} z_{t-j}$$

The adjusted t-statistics are simply

$$tstat_{HT} = \frac{tstat_{OLS}}{\sqrt{\frac{2}{3}k}}$$

Furthermore, they derive an asymptotic condition for the distribution of the slope coefficient β_1 in the unbalanced regression **(9)**, namely

$$\sqrt{\frac{T}{k}}\left(\hat{\beta}_1 - \beta_1\right) \to N\left(0, E(x_t x_t')^{-2}\, 2(\omega_{11}\omega_{22} + \omega_{12}^2\right)$$

That is, the variance can be split into short ($E(x_t x_t')^{-2}$) and long-run terms. The short run is estimated by the sample mean. The long-run variances are $\omega_{ij} = \sum_{k=-\infty}^{\infty} \gamma_{ij}^{k}$ where γ_{ij}^{k} is the k-th autocovariance of the variables. With finite sample sizes, we approximate these statistics – in our case using the Newey-West estimator with the Bartlett kernel. Thus the long-run covariance matrix of the short-run return and the predictor together with the variance of the predictor are being used, rather than the long-run covariance matrix of the estimator (a function of the long-run return and the predictor). Finally, they provide a simple variance-ratio test

$$E(x_t x_t')^{-1}\omega_{22} \geq \frac{1}{\sqrt{3}}$$

to determine whether the balanced regression is more efficient than the standard regression. It should be noted that these are asymptotic results (for large values of both sample size T and horizon h), so it is unclear whether the corrections are preferable to the standard corrections at low to medium horizons; the simulations in Hansen and Tuypens do not shed light on this.

Another robust method is to bootstrap the model.[19] In the current paper, our results are based on 100,000 bootstrap resamples using the stationary bootstrap (Politis and Romano (1994)). The optimal blocklength was estimated using the method by Politis and White (2004) based on the residual series of the OLS regression.[20] Specifically, in the (long-horizon) regression $Y = X\beta + \epsilon$, where ϵ is the residual, we proceed as follows.

(19) Nelson and Kim (1993), early critics of the standard corrections, used a parametric subsampling method to generate corrected statistics.

(20) We are grateful to Andrew Patton for making his Matlab code available to us (Patton (2004)).

1. Compute $\hat{\beta} = (X'X)^{-1}X'Y$ and the OLS residuals.
2. Use the OLS residuals to determine the optimal blocklength. As a rule of thumb, time series with a higher degree of persistence will need a bigger blocklength.
3. Compute 100,000 stationary bootstrap resamples of X and Y. The resamples are matched in the sense that the indices of X and Y are the same.
4. Compute 100,000 OLS coefficients.
5. Divide $\hat{\beta}$ by the standard deviation of the 100,000 OLS coefficients to obtain the bootstrap t-value.

4.2.2 Results for stock returns

We report the estimates of β_1 and a range of corrected OLS standard errors, together with the uncorrected OLS values, which are given purely for reference. The Newey-West and Hansen-Hodrick corrected results in Tables F and G for excess and real returns, respectively, reveal strong evidence of correctly signed predictive power at medium to long horizons. Charts 2 and 3 give examples of the fitted relationship.(21) The penultimate row in the first panel reports the Hansen-Tuypens 'truncated' corrections. Only results for horizons of 8 or greater are reported, as the correction's properties have been examined only for 'long' horizons – ten years (on annual data) in Hansen and Tuypens (2004), and as observed above it is not clear how we should interpret these asymptotic results. None of the estimates for excess returns approach significance, and are well below the Newey-West estimates. Hansen and Tuypens report very similar results (their Table 4) for ten-year horizon returns on both dividend and earnings yields. However, although the adjusted t-statistics are lower than the Newey-West and other corrections for real returns, for horizons over four years they are significant. Nevertheless, this would seem to suggest a cautious interpretation. But the bootstrapped results in the last lines are much more in line with the standard corrections.

And there is more evidence for predictive power from the balanced regressions with long-run (cumulated) q, reported in the second panel. The Hansen-Tuypens variance ratio is 25.81 at a

(21) In our data set estimation of the Hodrick tests proved to be numerically infeasible, which was also true for Hansen-Hodrick 24 and 28-period horizons with excess returns. However, the t-statistics, which are substantially below the uncorrected OLS values, are large enough at medium to long horizons to suggest the results would be preserved after such corrections. Wetherilt and Wells (2004) find that for UK excess returns, the Newey-West, Hansen-Hodrick and Hodrick t-statistics are respectively 3.16, 2.70 and 2.02 for the coefficient on the dividend yield in a one-year horizon regression.

24-period horizon, well over the critical 0.59 value. As one would expect in these balanced regressions, the value of the coefficients are roughly constant across the forecast horizons, consistent with the approximately linear increase in the coefficients with increasing horizon in the unbalanced cases. The effects are less significant at longer horizons with the Hansen-Tuypens correction but there is significant evidence of predictability up to 16 quarters; and the bootstrapped t-ratios are higher for the longer horizons. Overall, this provides strong evidence for the hypothesis that q can predict real and excess stock returns over horizons of at least five years.

Table D: Pairwise Granger Causality Wald Tests: $i - k$ (VAR(8))

Excluded	Dependent variable					
	$i-k$	q	$e-k$	$l-k$	Δl	$r-r^f$
$i-k$	-	0.470	0.951	0.527	0.367	0.737
q	0.113	-	0.368	0.022	0.005	0.949
$e-k$	0.476	0.220	-	0.031	0.053	0.417
$l-k$	0.123	0.590	0.707	-	0.012	0.897
Δl	0.505	0.875	0.117	0.101	-	0.938
$r-r^f$	0.067	0.760	0.816	0.389	0.099	-
all	0.039	0.078	0.525	0.000	0.000	0.587

Sample: 1971:4 2003:1

Table E: Pairwise Granger Causality Wald Tests: Δk_t (VAR(8))

Excluded	Dependent variable					
	Δk	q	$e-k$	$l-k$	Δl	$r-r^f$
Δk	-	0.824	0.748	0.386	0.289	0.999
q	0.013	-	0.432	0.100	0.020	0.932
$e-k$	0.580	0.401	-	0.029	0.049	0.580
$l-k$	0.011	0.849	0.955	-	0.016	0.799
Δl	0.227	0.987	0.308	0.048	-	0.925
$r-r^f$	0.779	0.564	0.956	0.619	0.189	-
all	0.005	0.232	0.409	0.000	0.000	0.787

Sample: 1971:4 2003:1

Table F: Regression of *h*-period excess returns $R^x_{h,t}$ on q

Dependent variable $R^x_{h,t}$ Independent variable q_{t-1}									
Horizon	1	4	8	12	16	20	24	28	32
coeff.	-0.02	-0.09	-0.15	-0.20	-0.26	-0.36	-0.39	-0.44	-0.45
t OLS	-1.75	-3.63	-5.02	-6.79	-8.46	-10.12	-11.34	-10.86	-12.58
t NW(4)	-1.79	-2.10	-2.66	-3.22	-3.98	-4.84	-5.21	-5.00	-6.60
t NW(h)	-1.62	-2.10	-2.42	-2.82	-3.39	-4.19	-5.53	-7.66	-10.92
t HH(h)	-1.62	-1.99	-2.23	-2.92	-3.87	-6.62	N/A	N/A	-44.57
t HTtr(h)	-	-	-1.15	-1.12	-1.12	-1.21	-1.08	-1.05	-0.87
t SB	-1.84	-1.99	-2.57	-3.01	-3.65	-4.28	-5.07	-5.40	-7.25
Independent variable $\sum_{i=0}^{h} q_{t-1-i}$									
Horizon	1	4	8	12	16	20	24	28	32
coeff.	-0.022	-0.021	-0.019	-0.018	-0.017	-0.016	-0.017	-0.017	-0.017
t OLS	-1.75	-2.43	-3.05	-3.39	-5.12	-6.91	-7.09	-6.70	-9.01
t HT(h)	-	-	-2.21	-2.43	-2.16	-1.83	-2.24	-1.77	-1.36
t SB	-1.84	-1.76	-1.89	-1.97	-2.69	-3.06	-3.42	-3.69	-3.98

Newey West with 4 lags: NW(4)
Newey West with h lags equal to horizon: NW(h)
Hansen-Hodrick with h lags equal to horizon: HH(h)
Hansen-Tuypens truncated with h lags equal to horizon: HTtr(h)
Hansen-Tuypens with h lags equal to horizon: HT(h)
Stationary bootstrap: SB

Chart 2: Actual and fitted excess returns: horizon 32 quarters

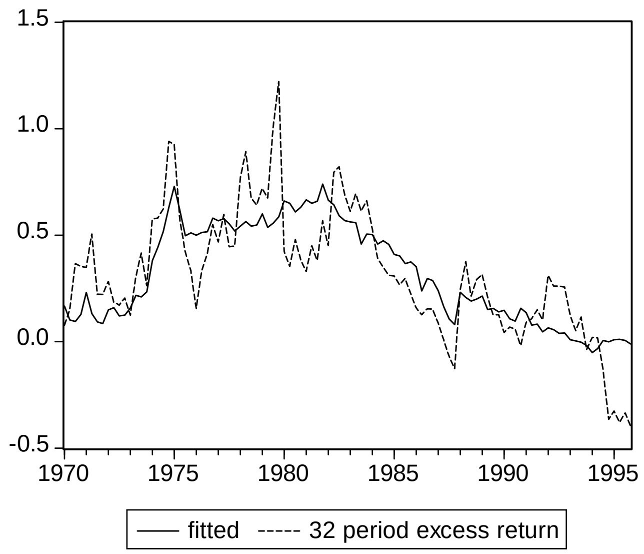


Table G: Regression of *h*-period real returns $R^r_{h,t}$ on q

Dependent variable $R_{h,t}$ Independent variable q_{t-1}									
Horizon	1	4	8	12	16	20	24	28	32
coeff.	-0.04	-0.17	-0.32	-0.55	-0.79	-1.07	-1.45	-1.85	- 2.40
t OLS	-2.37	-4.89	-7.45	-9.11	-11.13	-12.83	-14.68	-16.17	-16.08
t NW(4)	-2.22	-3.18	-4.54	-4.91	-5.83	-6.61	-7.22	-8.22	-8.27
t NW(h)	-1.87	-3.18	-3.88	-3.97	-4.37	-5.00	-5.59	-6.24	-5.88
t HH(h)	-1.96	-3.24	-3.18	-3.45	-3.97	-5.04	-5.75	-5.94	-5.69
t HTtr(h)	-	-	-1.60	-1.87	-2.08	-2.26	-2.56	-2.80	-3.03
t SB	-1.84	-3.24	-3.85	-4.18	-4.31	-5.03	-5.60	-6.18	-6.04
Independent variable $\sum_{i=0}^{h} q_{t-1-i}$									
Horizon	1	4	8	12	16	20	24	28	32
coeff.	-0.040	-0.041	-0.041	-0.040	-0.039	-0.043	-0.049	-0.051	-0.052
t OLS	-2.37	-3.39	-4.07	-4.55	-7.26	-6.84	-6.91	-6.72	-7.53
t HT(h)	-	-	-3.13	-2.41	-2.11	-1.83	-1.87	-1.32	-0.95
t SB	-1.84	-2.78	-3.05	-3.72	-5.25	-3.66	-3.59	-3.49	-3.05

Newey West with 4 lags: NW(4)
Newey West with h lags equal to horizon: NW(h)
Hansen-Hodrick with h lags equal to horizon: HH(h)
Hansen-Tuypens truncated with h lags equal to horizon: HTtr(h)
Hansen-Tuypens with h lags equal to horizon: HT(h)
Stationary bootstrap: SB

Chart 3: Actual and fitted returns: horizon 32 quarters

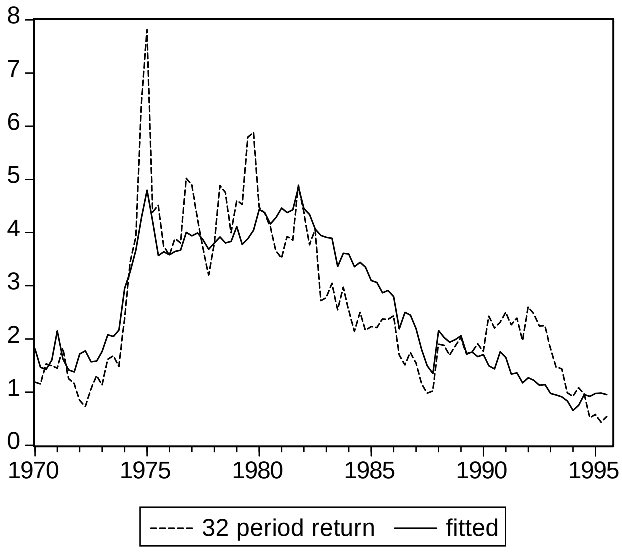


Table H: Regression of future log investment to capital ratio and growth in capital on q

Independent variable q_{t-1}									
Horizon	1	2	3	4	8	12	16	20	24
Dependent variable $i_{t+i} - k_{t+i}$ (PNFC)									
coeff.	0.19	0.18	0.19	0.18	0.17	0.14	0.11	0.08	0.06
t OLS	9.84	9.69	9.72	9.55	7.97	5.79	3.99	2.80	2.07
t NW(4)	6.50	6.52	6.54	6.38	5.20	3.49	2.25	1.43	0.92
t SB	4.50	4.37	4.37	4.22	3.49	2.48	1.57	1.00	0.65
Dependent variable $i_{t+i} - k_{t+i}$ (Business)									
coeff.	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.09	0.09
t OLS	5.61	6.04	6.39	6.70	7.47	7.14	6.49	5.82	5.05
t NW(4)	2.66	2.89	3.09	3.31	3.96	4.07	3.90	3.31	2.57
t SB	1.90	2.06	2.21	2.35	2.85	3.07	2.82	2.27	1.71
Dependent variable $k_{t+i} - k_t$ (Business)									
coeff.	0.001	0.003	0.004	0.006	0.012	0.019	0.025	0.031	0.034
t OLS	5.91	6.17	6.38	6.59	7.46	8.08	8.52	8.96	9.36
t NW(4)	2.69	3.05	3.16	3.08	3.70	3.99	4.20	4.42	4.66
t NW(h)	4.09	3.56	3.26	3.08	2.78	2.75	2.83	3.13	3.57
t HH(h)	3.37	2.79	2.51	2.36	2.17	2.28	2.67	3.79	5.81
t HTtr(h)	-	-	-	-	0.49	0.50	0.46	0.44	0.40
t SB	2.14	2.23	2.30	2.37	2.60	2.81	2.98	3.16	3.31
Independent variable $\sum_{i=0}^{h} q_{t-1-i}$									
Horizon	1	2	3	4	8	12	16	20	24
Dependent variable $k_{t+i} - k_t$ (Business)									
coeff.	0.0014	0.0014	0.0015	0.0015	0.0017	0.0017	0.0017	0.0015	0.0013
t OLS	5.91	6.34	6.68	6.99	7.73	7.74	7.28	6.24	4.84
t HT(h)	-	-	-	-	3.32	2.77	2.29	1.80	1.29
t SB	2.15	2.29	2.43	2.55	2.91	2.93	2.58	2.06	1.53

Newey West with 4 lags: NW(4)
Newey West with h lags equal to horizon: NW(h)
Hansen-Hodrick with h lags equal to horizon: HH(h)
Hansen-Tuypens truncated with h lags equal to horizon: HTtr(h)
Hansen-Tuypens with h lags equal to horizon: HT(h)
Stationary bootstrap: SB

4.2.3 Results for investment and growth in the capital stock

A starting point for this paper was the observation that conventional wisdom has it that aggregate average q cannot explain investment, contrary to the neoclassical theory, and this motivated the search for variables it does explain. However, while interest in the financial literature is focused on stock returns, the present-value theory predicts that q may also have predictive power for investment. It should be stressed, however, that we do not put a structural (first-order condition) interpretation on our results.

A direct test of this hypothesis can be performed by extending the preceding results to see whether q can predict growth in investment over different horizons. Table H shows that q does indeed have predictive power for the investment to capital ratio at short to medium horizons for PNFC, with a fairly flat impact for three or four years, and peak power at a three-quarter horizon. For the business investment ratio,[22] the profile is flatter and smaller, but with some forecasting power remaining at six years. The table also reports the results of using the change in the business capital stock (cumulative net investment) at the same horizons, and there is a significant effect here as well, which is stronger at longer horizons. The Hansen-Tuypens truncated correction suggests no significant effect, but the bootstrapped standard errors are comparable to the standard corrections, and the long-horizon balanced regressions are significant up to 16 quarters.[23] Again, the unbalanced coefficients rise with the horizon (the third panel), which is consistent with the balanced results, where the coefficient is roughly the same at all horizons. All these results are correctly signed. So it appears that a measure of q has explanatory power for investment.

5 Conclusions

When Q is interpreted within a present-value framework it follows that the data summarises future developments in a range of variables of interest, including physical investment and stock returns. Research on a long series of US data suggest that for that data set it has little predictive power for investment, but does help forecast returns and earnings. Examining these issues for the United Kingdom on a shorter span of data, by contrast we find that Q does forecast investment. It also forecasts debt and returns. Long-horizon predictability tests suggest, as theory would predict, that Q is negatively related to returns over medium to long horizons. Long-horizon regressions also

(22) See the appendix for a definition.
(23) The variance ratio is 20.21 at a 24-period horizon, suggesting the appropriate method is the balanced regression.

provide evidence that Q is able to predict different measures of investment, as well as growth in the capital stock, and again with the sign we expect. The standard tests and associated corrections have aroused controversy recently, but those corrections thought to be most robust, bootstrapped estimates and new tests recently developed by Hansen and Tuypens confirm there is predictability. We conclude, therefore, Q is a valuable source of information about real and financial quantities.

Appendix: Data sources and definitions

Four-letter identifiers are Office for National Statistics (ONS) codes.

Investment and the capital stock

Business investment is available from the (ONS) National Accounts data, with quarterly backruns to 1965 and 1955 respectively. The capital stock and associated depreciation series are constructed in-house following Oulton and Srinivasan (2003). In particular, a four-asset wealth measure of the non-housing capital stock (NHK) is employed, assuming that the asset split of business investment is the same as whole-economy investment (excluding dwellings), which is available from National Accounts data. ONS temporarily suspended their estimates of the capital stock in the 2002 *Blue Book*: see National Statistics (2002).

Differences between the business sector and PNFC

PNFC are comprised of UK Shelf companies (oil companies), manufacturing, non-financial service sector, and 'others' (including eg agriculture, construction, energy and mining). Only nominal quarterly investment data are published by the ONS for this sector (Quarterly National Accounts (QNA) Table K2). The business sector is comprised of PNFC + financial corporations + public corporations. The quarterly ONS business investment release gives separate series (nominal and real) for: private manufacturing; construction; distribution services; other services; other production (including eg agriculture, oil and gas, energy and mining); and public corporations (split into manufacturing and non-manufacturing). Adding public corporations to PNFC means that the only difference between the two sectors is financial services companies. The shares in nominal business investment in 2002 were: PNFC (88%); financial corporations (7%); and public corporations (4%).

Alternative measures of Q constructed for PNFC

The measures of Q can be defined as:

(Net financial value of the corporate sector)/(Current value of capital stock and inventories).

The numerator is an ONS series (NYOT) which can be defined as the sum of the current market values of PNFC net debt (definition below) and equity. The denominator has two versions: one that includes public corporations (PCs), and another that excludes them. To calculate measures of PNFC real capital stock, consistent with the Bank measure of whole-economy capital stock (KNH), three pieces of information are required for each variant: an investment series; a starting value for the capital stock; and a depreciation rate.

Investment: as observed above, the ONS only publish a nominal PNFC investment series (ROAW). To obtain real investment, ROAW is deflated by the implied ONS total business investment deflator (NPEK/NPEL). The measure that includes public corporations' investment is calculated by adding nominal PCs investment to ROAW and deflating in a similar fashion.

Starting value: the starting value of the non-housing capital stock (KNH) is scaled by taking the proportion of the constructed PNFC (or PNFC + PCs) real investment in real whole-economy minus dwellings investment in 1969 Q4.

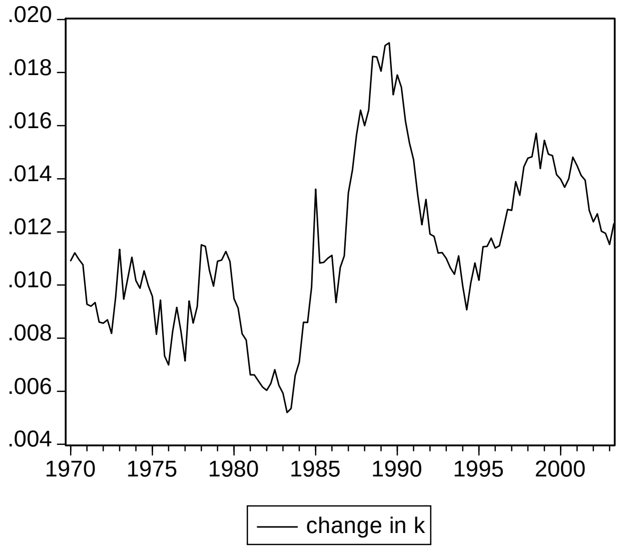
Depreciation rate: this is the implied depreciation rate from the KNH calculations.

The real investment series, together with the starting values and (implied) real depreciation rate for KNH allows calculation of two variants of PNFC real capital stock by employing the Perpetual Inventory Method (PIM). In order to obtain the current values of these measures including inventories, the real measures are divided by by the KNH deflator and PNFC stock of inventories added to each. PNFC stock of inventories is based on ONS data for inventory flows and holding gains.

Net earnings and net debt

Net earnings are defined as PNFC gross operating surplus less taxes on income, interest payments and depreciation. Apart from depreciation, all series in this calculation are published by the ONS in QNA Tables K1 and K2. Depreciation is the nominal level of depreciation of PNFC capital stock implied by the above calculations.

Chart A1: Capital stock (PNFC) growth



Net debt is calculated solely from ONS data, and is defined as:

Domestic bank debt + foreign bank debt + total bonds - liquid assets

where the relevant ONS codes are NLBE (domestic bank debt), NLBI (foreign bank debt), NKZA (total bonds), and NKJZ (liquid assets).

FTSE returns

Returns are the quarterly return of FTSE All-Share (price appreciation plus dividends) or equivalent. For excess returns, the risk-free rate is a 20-year government bond (coupon plus price appreciation).

Chart A2: Net earnings to capital stock ratio (PNFC)

Chart A3: Debt to capital stock ratio (PNFC)

Chart A4: Debt (PNFC) growth

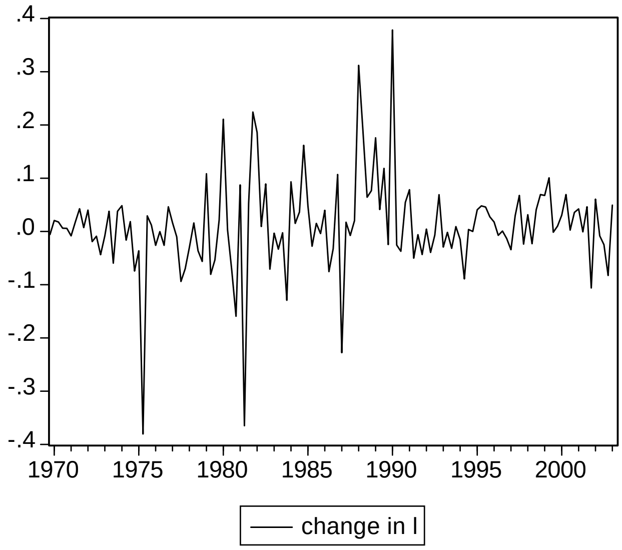


Chart A5: FTSE All-Share real return

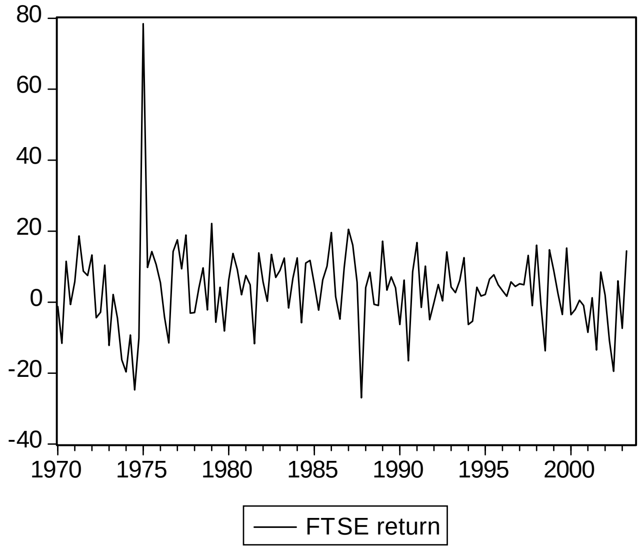


Chart A6: FTSE All-Share excess return

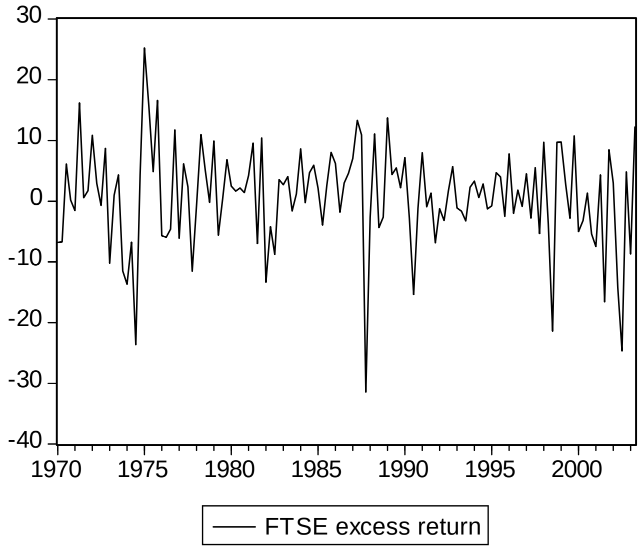


Chart A7: Investment to capital stock ratio (business)

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