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Equity Returns and the Business Cycle: The Role of Supply and Demand Shocks

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Abstract

The equity premium in the UK appears to have risen significantly since the start of the financial crisis and the associated extended recession. This paper examines the relationship between the business cycle and equity market returns to see how robust this association is. Several classifications of UK business cycle quarters are examined and related to the returns from an investment strategy which buys the market one or more quarters after a business cycle quarter and holds it for one year. Official business cycle dating methods as well as identified structural macroeconomic shocks are examined. The findings are that there is clear evidence for counter-cyclicality in excess returns. Returns are significantly higher in the year following a recession rather than an expansion quarter. There is also a significant difference in the pattern of returns if the downturn in the quarter is the result of a supply or demand shock. Negative supply shocks are found to have an especially large and significant counter cyclical impact on returns. This paper analyses a long period of UK data for determining realised returns using revised data as well as expected returns using a shorter dataset of real-time data. The paper finds similar results for the two datasets suggesting that realsied and expected returns may not be so different from one another. The paper also assesses the ability of the models to forecast outside of their sample period.

Keywords

Equity Returns, Equity Premium, Business Cycle.

JEL Classification

G12, C32, C51, E44

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The equity premium in the UK appears to have risen significantly since the start of the financial crisis and the associated extended recession. This paper examines the relationship between the business cycle and equity market returns to see how robust this association is. Several classifications of UK business cycle quarters are examined and related to the returns from an investment strategy which buys the market one or more quarters after a business cycle quarter and holds it for one year. Official business cycle dating methods as well as identified structural macroeconomic shocks are examined. The findings are that there is clear evidence for counter-cyclicality in excess returns. Returns are significantly higher in the year following a recession rather than an expansion quarter. There is also a significant difference in the pattern of returns if the downturn in the quarter is the result of a supply or demand shock. Negative supply shocks are found to have an especially large and significant counter cyclical impact on returns. This paper analyses a long period of UK data for determining realised returns using revised data as well as expected returns using a shorter dataset of real-time data. The paper finds similar results for the two datasets suggesting that realsied and expected returns may not be so different from one another. The paper also assesses the ability of the models to forecast outside of theoir sample period.

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1 Introduction

Fixed investment in the UK and other developed economies fell and has hardly recovered since the start of the recent financial crisis and the associated deep recession. The equity premium appears to have risen and remained high, even as the recession has formally come to an end. Investors appear to require a higher rate of return than before the downturn. More broadly, there is enduring interest in the relationship between the state of the business cycle and returns on financial markets. We examine in this paper the relation between the nature of a business cycle quarter and returns to see how robust this association is. Several classifications of UK business cycle quarters are employed to predict returns from an investment strategy buying the market one or more quarters after a business cycle quarter and holding it for one year. Clear evidence for counter-cyclicality is found: expected returns are significantly higher following a recession than following an expansion quarter. Furthermore, we find a significant difference in the pattern of returns for periods following a downturn, depending on whether the downturn is the result of a supply or demand shock.

The classification of business cycle quarters follows from two sources of information. The first is the classification of quarters from official business cycle classification methods. The best known of these is the NBER business cycle dating system operated in the United States. It focuses on the ex-post dating of the start and end of recessions. Whilst this precise methodology does not exist for the UK (or other countries) several agencies either produce their own or have adopted various classifications of recession dating. We examine the relation between the three leading classifications and future equity returns. This paper also examines a more nuanced relationship between the state of the business cycle and returns by extracting a more detailed identification of shocks to GDP. The analysis below identifies aggregate supply and demand shocks using the scheme proposed by Blanchard and Quah (1989), providing quarterly measures of business cycle shocks and their relationship with future returns. These identified aggregate GDP shocks provide a more finely calibrated measure for the status of any business cycle quarter. Finally, we estimate the relationship between returns and the interaction of these shocks with the official business cycle classification. The results of our study show that returns are clearly countercyclical. Returns on a quarterly basis can be as much as 3.36% higher five quarters following a recession quarter compared with an expansion quarter.

We examine two datasets; the first is a long set of quarterly data from 1956 which allows for the impact of a significant number of recession periods on returns to be assessed. The relatively small number of complete business cycles makes analysis of their impact on returns depend to some degree on sample size. The second dataset is for real-time data and allows us to assess models that are closer to being implmentable by investors. We use data on vintages of announced GDP growth and inflation levels which could have been used by investors in practice. We also assess the ability of all of the models to forecast out of sample.

The literature on the relationship between the state of the business cycle and returns has examined a number of alternative measures of the business cycle and a number of different ways of measuring returns. Peña et al (2002) show that GDP growth alone predicts future returns rather poorly. Cooper and Priestley (2009), on the other hand, demonstrate that the output gap has predictive strength for both returns and excess equity returns. Their favoured measure of the business cycle is the deviation of GDP from a quadratic trend. This business cycle measure relates to the recession indicators used in the current paper but identifies fewer recession quarters than the measures we use here. Cooper and Priestley find a counter-cyclical impact on returns but do not distinguish between the sources of deviations of the GDP from it's trend, as shown here. In related work, Aretz et al (2009) demonstrate that a number of macroeconomic risks correlated with a business cycle measure are priced in an equity factor model context. Rangvid (2006) forecasts equity returns for several years into the future for a number of countries including the UK, employing equity price/GDP ratio on an alternative normalization for the level of GDP. His results lend support in favor of counter-cyclical behaviour of returns. Broadening the context, Kaminska (2008) examines the impact of similar aggregate structural shocks on the UK interest rate term structure through the lens of an affine term structure model. She shows that supply shocks affect the whole yield curve whilst positive demand shocks increase the slope of the yield curve by increasing the long end. Finally, the analysis in this paper can be compared to that of Lustig and Verdelhan (2012) who concentrate on the impact of business cycle turning points on returns. Below we show that their approach is less robust than ours in establishing the counter-cyclicality of returns in the UK.

2 Recessions and Structural Shocks

We identify the state of the business cycle using two measures of macroeconomic shock. In the absence of an official recession, indicator such as that provided by the NBER in the United States, there are two official published recession indicators for the UK. The first is published by the OECD (OECD, 2011, for example) and is based on a set of component series from which a series of turning points are computed. The components include the results of business and consumer confidence surveys as well as new car registrations. The Bank of England employs a second indicator in its publications such as the *Inflation Report* (Bank of England, 2012) and adopts the popular definition of a recession as beginning when there have been two quarters of negative GDP growth. The recession ends when GDP rises from the previous quarter. The final measure we examine is the quarterly version of the Bry-Boschen algorithm proposed by Harding and Pagan (2002).

The methodology behind the NBER dating method is based on the discussion in Burns and Mitchell (1946) which presents ways of identifying turning points, including graphical methods. Whilst some have concentrated on examining detrended versions of GDP, the BBQ method presented by Harding and Pagan (2002) examines the log growth rate in GDP Δy_t. We use the steps of the Bry and Boschen (1971) algorithm proposed by Harding and Pagan, namely (1) that a local peak occurs at time t when $\{\Delta_2 y_t > 0, \Delta y_t > 0, \Delta y_{t+1} < 0, \Delta_2 y_{t+2} < 0\}$, [2] which makes y_t a local maximum relative to two quarters on either side. Here an analogous condition to the definition of a trough is used (thus generalising the definition of turning points in the measure used by the Bank of England); (2) that peaks and troughs alternate and (3) that a complete cycle last at least 5 quarters.[3]

Table 1A shows the turning points for the three alternative recession indicators. They differ in the number of turning points as well as in the length of the business cycle phases. In the period from 1955q1 - 2011q1 the OECD series has 13 recessions, the Bank of England series 7 recessions and the BBQ series 9 recessions. The analysis in this paper uses indicator or dummy variables where the series is equal to 1 for recession quarters and zero for expansion quarters. The correlation matrix in Table 1B shows significant differences between the recession indicators for the three series (see the lower part): the highest correlation is between the Bank of England and BBQ series at 0.619 and the lowest between the OECD and Bank of England series at 0.254. Similarity, in the estimates of the relationship between the state of the business cycle and equity returns for the three measures, provide robust evidence given the differences between the three measures.

The second set of macroeconomic shocks examined here are generated by a set of identifying restrictions on a vector autoregression (VAR) of output growth and price inflation. The identification of business cycle shocks also allows us to distinguish between the effects of small and large shocks; positive and negative shocks; as well as between the sources of shocks. The second contribution of this paper is therefore to examine the relationship between identified macroeconomic shocks and excess equity returns. We also examine the interaction of the official recession

[2] where $\Delta_2 y_t = y_t - y_{t-2}$

[3] Harding and Pagan use this value for a number of countries apart from the UK. We don't encounter the problem with the misidentification of the 1974 downturn, which caused them to use 4 quarters for the UK and so stick with 5 quarters. Experimentation with other values does not suggest any improvement in identification of cycles.

indicators and the identified structural shocks.

The identification of fundamental business cycle shocks has a long history and the initial research by Sims (1980) on how to identify structural shocks from a VAR representation of the macro economy has been followed by various strands including the identification of shocks based on the persistence of the response of output and price inflation to those shocks. More or less economic structure can be employed in identifying shocks. In this paper we use the minimal identification of aggregate supply and demand shocks proposed by Blanchard and Quah (1989) in their analysis of output growth and unemployment. Following Keating and Nye (1998) and Bullard and Keating (1995) this paper employs a two-variable VAR for price inflation and output growth. Two shocks which affect output growth and inflation are identified as aggregate demand and aggregate supply shocks by restricting their long-run impact. Aggregate demand shocks are assumed to have no long-run impact on output. This is similar to the method of Keating and Nye (1998) who also associate the permanent component in output with aggregate supply shocks.

Unit root tests suggest that prices and output in the UK are both integrated variables of order one, i.e., $I(1)$.[4] Hence, the bivariate structural VAR model used employs output growth and inflation, Δy_t and π_t, respectively. The standard first-order VAR, which can be estimated using quarterly output growth and price inflation data, is:

$$x_t = A_0 + A_1 x_{t-1} + e_t \tag{1}$$

where $x_t = \begin{bmatrix} \Delta y_t \\ \pi_t \end{bmatrix}$, $e_t = \begin{bmatrix} e_{yt} \\ e_{\pi t} \end{bmatrix}$ and the variance covariance matrix of the estimation errors is $= E[e_t . e_t']$.

Since interest here is in the effects of the primitive supply and demand shocks ε_{st} and ε_{dt} on GDP growth and inflation, the following VAR shows each variable as a function of those shocks:

$$x_t = C_0 + C_1 x_{t-1} + \varepsilon_t$$

where $\varepsilon_t = \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix}$ and the relationship between the two sets of shocks is defined to be:

$$\begin{bmatrix} e_{yt} \\ e_{\pi t} \end{bmatrix} = \begin{bmatrix} c_{11}(0) & c_{12}(0) \\ c_{21}(0) & c_{22}(0) \end{bmatrix} . \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix}$$

[4] Phillips-Perron tests of the null hypothesis of a unit root in Δy_t and π_t reject the null with p-value 0.000 and 0.000, respectively. The tests of the null for the levels y_t and p_t, fail to reject with p-values of 0.579 and 0.162, respectively.

As Blanchard and Quah (1989) show, identification of the two structural shocks from the estimation errors of the VAR requires two restrictions. The identification of structural innovations is achieved first by assuming that one of these shocks has only a temporary impact. In this application, it is assumed that the demand shock affects output but only in the short run, which means that the cumulative effect of demand innovations on output growth is zero, that is,

$$\sum_{i=0}^{\infty} c_{11}(i)\varepsilon_{dt-i} = 0 \tag{2}$$

Justification for this assumption follows Keating and Nye (1998) in their argument that if the aggregate supply curve is vertical and independent of aggregate demand factors, then supply shocks will affect output permanently (shown as a shift in the curve), whereas demand shocks will only have temporary effects on output. Similarly, supply and demand shocks will also have an immediate and enduring impact on inflation. The second assumption is that the two structural shocks are uncorrelated. They are normalized to have unit variance.

Given these identification assumptions, the structural shocks are, in practice, recovered from OLS estimation of the VAR in equation (1.). The restriction in (2) becomes[5] :

$$\left[1 - \sum_{k=0}^{\infty} a_{22}(i)\right] c_{11}(0) + \sum_{k=0}^{\infty} a_{12}(i)c_{21}(0) = 0 \tag{3}$$

The structural macroeconomic shocks ε_{st} and ε_{dt} that result are taken forward to relate to excess returns.

The two-variable VAR(1) in output growth and inflation is estimated over the period 1956 Q2 - 2011 Q1 for UK data. Δy_t is log growth in the output measure of GDP at 2010 prices and π_t is log inflation in the GDP deflator. The structural macroeconomic shocks ε_{st} and ε_{dt} are found by application of the restrictions including (3). The VAR is extended to include four lags in the vector x_t in order to ensure that the errors e_t are serially uncorrelated. One way of assessing the properties of these shocks is to examine the impulse response functions. The impact of one standard deviation positive impulses to these shocks on output growth and inflation are shown in Figure 1. The size of the impact of these shocks and the dynamic responses of output and inflation to the shocks are familiar from similar exercises in the literature. The impact of both the aggregate supply and demand shocks is to raise output growth for a time. The impact on the level of output of a supply shock is initially +0.87%, increasing to +1.3% in the long run. The impact of a demand shock on the level of output is +0.4% initially falling to zero in the long run

[5] Lippi and Reichlin (1993) question the invertibility of the VAR system required in generating this condition but this argument is countered by Blanchard and Quah (1993) and a general condition to check for invertibility is developed by Fernandez-Villaverde et al (2005).

in line with the identification scheme–this adjustment has a half life of about 3 years. Inflation is affected negatively by the supply shock and positively by the demand shock and, as can be seen in Figure (1 (c) and (d)) these effects are more persistent than the effects on output growth. The structural shocks are shown in Figure 2 where the association of the identified shocks with the most prominent recessions are clear. The large negative supply shocks at the time of the oil price-related recessions of the mid 1970's and early 1980's are matched by negative demand shocks in the most recent recession associated with the financial crisis.

Robustness of the results to the specification of the VAR and the identification restrictions is assessed by providing tests based on an alternative specification. The vector x_t is extended to include the interest rate r_t. The three-variable VAR is similar to that employed by Ang, Dong and Piazzesi (2005) and Kaminska (2008) and allows for business cycle fluctuations to be initiated by an identified monetary source . For this case, exact identification of supply, demand and interest rate shocks is achieved by firstly applying a second long-run restriction that the interest rate shock has no effect on the level of GDP in the long run, along with the demand shock. Secondly, the interest rate shock is restricted to have no immediate impact on GDP. The three restrictions, along with requiring the shocks to be uncorrelated. and normalised,provide exact identification of the three structural shocks. Below, we examine whether the structural supply and demand shocks have an impact on returns which differs from the baseline specification.

3 Realised Excess Returns in Recessions and Expansions

First, we examine how the return from an investment strategy r^m_{t+i} in excess of the risk-free rate r^f_t varies between recession and expansion periods as identified by the various official business cycle indicator variables. The return to the strategy is defined to be from buying the market index i periods after a recession or expansion quarter and then selling it four quarters later. The measure of returns is the Datastream total market index and the risk-free rate is the Bank of England base rate (and its previous incarnations) for the period 1956q2 to 2008q4[6] . The data definitions and sources are described in the Data Appendix below. Figure 3 shows the behaviour of the excess return over the sample period. The prounced variation in the earlier part of the sample indicates the turbulous nature of markets long before recent events. The fact that the returns from the strategy are calculated over four quarters explains the relatively smooth path shown in the figure. The relationship estimated is between the excess return at 1 to 5 quarter

[6] As the strategy holds the index for one year after period i,the final period for the returns of the longest strategy, r^m_{t+5} are for the period ending 2010q2. Thus data for 1956q1 - 2010q2 are used in the calculations in the paper.

horizons i and the dummy variable for a recession for the three different business cycle measures j, D_{jt}. We also condition on the lagged return. We describe these models as being of realised returns as the data on the positiion of the business cycle is provided either ex-post by the OECD or using revised GDP data for the other two cases. The regression is:

$$r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i D_{jt} + \gamma_i (r^m_t - r^f_t) + \epsilon_{it+i}, \quad i = 1, ..5. \tag{4}$$

Estimates of the β_i are presented in Table 2 with HAC (Newey and West, heteroscedastic and autocorrelation consistent) standard errors in brackets. Each column presents individual estimates of the impact of the business cycle indicator variable on the excess return. The first row shows the results of five individual regressions of the excess return on the OECD business cycle indicator variable for five different horizons. The estimates provide a consistent picture of higher excess returns in quarters following recession quarters than following expansion quarters. The first column shows estimates for the shortest horizon, $i = 1$. The estimated coefficients are all quarterly values and imply that returns are higher by between 0.87% and 1.5% for the quarter immediately after a recession quarter, depending on the business cycle measure. The estimates are consistent in size and significance for all business cycle measures despite the differences in the timing of recession quarters implied by the three. At five quarters after a recession quarter, the return from the investment strategy provides a quarterly excess return of between 2.74 and 3.36% above that for the average expansion quarter. The size of the effect peaks between 4 and 5 quarters after a recession quarter, depending on the particular recession measure chosen. The BBQ measure provides a steeper gradient of response, rising from 0.87% after one quarter to 3.36% after five quarters. The remaining two measures provide a flatter profile. The estimated coefficients are significantly different from zero, especially at longer horizons, according to the size of the HAC standard errors given in brackets in the Table. The results imply that the excess return to the investment strategy increases significantly in the quarters following a recession quarter, while the opposite is true for expansion quarters. The size of these effects can be compared to the sample standard deviation of returns of 5.00%, on a comparable quarterly basis. This strong evidence in favour of counter-cyclicality in returns also shows that the effect is persistent over a horizon of more than a year.

We assess the robustness of these results by assessing the stability of the coefficients using a Chow test based on robust estimates of the residual covariance matrix which splits the sample in half at 1982q3. This splits two parts of the sample where the behaviour of returns was very different, being persistently more variable in the earlier period and more occasionally variables in the second part. The figures in the final row of Table 2 indicate that there is no evidence against the stability of the coefficients across the two parts of the sample given that the 99% significance level of this F test is 1.53.

3.1 Excess Returns Following Business Cycle Turning Points

In related research, Lustig and Verdelhan (2012) evaluate the size of equity returns following business cycle turning points, i.e., following the quarters at which the economy is said to move from expansion into recession and vice versa. They demonstrate a large, significantly positive and increasing response of returns over the quarters following entry into a recession for the United States. They also show that the initially large increase in excess returns following exit from a recession and entry into an expansion falls back below that following the start of a recession after a couple of quarters. However, Lustig and Verdelhan also show that this shape of response is much smaller for other countries such as for the UK.

This particular effect can be examined for the three measures of business cycles for the UK. Figure 2 shows the three sets of results. They show the return from the same investment strategy as presented above; that is quarterly excess returns from an investment that buys the UK stock market index one or more periods after the business cycle turning point and holds it for one year. The figures show that equity returns are lower for the initial two quarters of a recession followed by increased excess returns for quarters further into the future. However, this pattern is also followed by returns following the start of an expansion after the end of a recession. Unlike the results that Lustig and Verdelhan find for the United States, the two lines do not cross for any of the three business cycle measures that we examine. The results for the OECD business cycle measure show the pattern of results closest to those of Lustig and Verdelhan. In this case, whilst excess returns increase following the start of an upturn and are reduced following the start of a recession, returns 5 quarters after a cyclical turning point are essentially the same whether the turning point is a peak or a trough. In the case of the remaining two business cycle definitions returns are greater following troughs than peaks at all horizons, although the gap is reduced as time passes from the turning points. Thus, in contrast to Lustig and Verdelhan, the results for the UK given in Table 1 show that conditioning on turning points excess equity returns are not counter-cyclical. Conditioning on all recession and expansion quarters provides much stronger, statistically significant, evidence of counter-cyclical behaviour by excess returns at all horizons.

4 The Relative Importance of Supply and Demand Shocks for Realised Excess Returns

Section 3 shows significant relationship between the state of the business cycle and excess equity returns: returns are significantly higher following recession than expansion quarters. This result remains robust to the various leading definitions of a recession. In this section we take the argument one step further by examining the relationship between more narrowly defined structural macroeconomic shocks and excess equity returns. The relationship between the state of the business cycle and returns is fleshed out by taking the identified aggregate supply and demand shocks and examining their relationship with the business cycle. The structural shocks we use in this first exercise are computed using revised data and we therefore describe these models as being for realised returns. First, we analyze the broad relationship between all supply and demand shocks and returns with the regressions:

$$r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i \varepsilon_{kt} + \gamma_i (r^m_t - r^f_t) + \epsilon_{it}, \quad i = 1, ..., 5. k = s, d \tag{5}$$

where the return is from the simple investment strategy, i.e., buying the market index i periods after a shock and selling it four quarters later, r^m_{t+i} in excess of the risk-free rate r^f_t, and the structural demand and supply shocks ε_{dt} and ε_{st} are constructed from the structural VAR model shown in Section 2. Table 3 presents the estimates of equation (5) hand shows that negative supply and demand shocks are almost always associated with higher levels of excess returns. The size of the effects of a one standard deviation shock are between 0.38% and 0.71% for supply shocks and 0.15 and 0.65% for demand shocks. Supply and demand shocks are more significantly related to future returns at the longer horizons, according to the HAC standard errors shown. The estimated coefficients on the lagged returns suggest a degree of persistence in the reponse of shorter horizon returns to the structural shocks when compared to the longer horizon returns. These apparent differences in behaviour imply rather similar longer term responses to shocks as the persistence in short-horizon returns will serve to amplify the impacts of the shocks over the periods following a shock. Thus the medium term response of all strategies to shocks appears rather similar across the strategies. These estimates support those for the models for the official business cycle indicators, shown in Table 2, in showing that downturns are associated with higher excess returns.

The robust Chow test for these models also splits the sample in half at 1982q3. The figures in the final row of Table 3 indicate that there is no evidence against the stability of the coefficients across the two parts of the sample given that the 99% significance level of this F test is 1.53.

4.1 Robustness of the Results

We assess the robustness of the results of estimating equation (5) to two alternative approaches. First, we consider the alternative specification of the structural shocks to include the monetary shock. Table 4 provides estimates of equation (5) for this alternative model of the shocks, ie equation (5) where $k = s, d, r$. Comparison with Table 3 shows very little difference in the impact on returns of the identified supply shock, which has a permanent impact on GDP. The supply shock has a negative impact on returns at all horizons confirming the results in Table 3. The impact of these shocks on returns is somewhat attenuated beyond the shortest horizon. The demand shock also has a similar effect to that shown in Table 3 beyond the shortest horizon, with the size of the impact being slightly increased in size. The monetary shock has a less well determined effect that the original two effects that switches in sign along the horizon. The positive longest horizon effect suggests a positive impact between interest rates and returns Given the positive correlation between equity and bond yields, this is consistent with the results in Kaminska (2008) who finds a positive relation between the interest rate shock and bond yields at several horizons in her no-arbitrage model.

Second, we consider the role of alternative predictor variables for future returns. Table 5 provides alternative estimates for returns at the longest horizon, ie equation (5) with $i = 5$. The first column reproduces the entry in Table 3. The second column adds, as Z_t the deviation of log GDP from a quadratic trend employed by Cooper and Priestley (2009), whilst the third column alternatively adds the log equity price / GDP ratio examined by Rangvid (2006). Comparison of the results shows that the size and significance of the impact of the two structural shocks on future returns is essentially unchanged across the alternative estimates. In addition, the output gap variable has some significant impact with a negative sign which appears to have a small correlation with the demand shock but the negative effect of the price/GDP ratio has little statistical significance and has little effect on the impact on the two structural shocks.

These two alternative respecifications of the structural shocks models of equation (5) show little significant modification of the results. The strong counter-cyclicality of returns demonstarted in Table 3 is sustained and the size of the relationship between the structural macro economic shocks and returns is robust to the modifications examined.

5 The Impact of Shocks on Expected Returns

5.1 Real Time Business Cycles

In this section we analyse the relationship between the measures of business cycles and business cycle shocks and the returns from the investment strategy using real-time measures of the underlying variables. This version of the models provides strategies which are closer to being achievable in practice. Whilst it is reasonable to assume that financial data is available to investors immediately, this is not the case for national accounts data such as GDP where both announcement lags and data revisions may be relevant. We analyse real-time versions of two recession-dating measures discussed above; BBQ and the Bank of England measures, as well as real-time versions of the identified structural demand and supply shocks. The data for the underlying variables that we use is the first publication vintage of the GDP growth rate and GDP deflator inflation rate for each quarter, following the approach of Garratt and Vahey (2006). This vintage is published early in the subsequent quarter and can therefore be considered to be available to investors at that point.[7] We examine two sets of estimates with this data. We estimate models in equations (4) and (5) using real-time equivalent data. In both cases we include the business cycle variables dated $t-1$, rather than t to allow for the publication lag. The results are given in Table 6 and 7. Comparison with earlier results confirms the results from the revised data. There is evidence of counter-cyclicality of future returns at all horizons. The stregth of that evidence varies across the horizons, but is strongest at the longer horizons. The impact of a recession quarter varies from 0.41% and 2.4% on a quarterly basis. The data period available for real-time analysis is significantly shorter than that for the revised data; the sample for GDP, and therefore the business cycle indicator variables, starts in 1976 whilst that for the GDP deflator starts in 1981. These shorter sample periods have a reduced number of business cycles compared to the period examined with the revised data. Also, the impact of the long period of low GDP variation in the 1990's commonly known as the "great moderation" can be expected to reduce the information content of the data. The relative imprecision of the estimates in Tables 6 and 7 is therefore unsurprising. The estimates in Table 7 confirm those for the revised data, or realised returns in showing that supply shocks always have a counter cyclical impact on returns which is largest at the longest horizons. The impact of a one standard deviation supply shock is 0.57% at the one-year horizon and 0.09% for a demand shock. These are somwhat lower than for the longer realised returns sample period, although returns themselves are slightly lower on average in the shorter sample

[7] The real-time GDP and GDP deflator data are available from the Bank of England GDP Real Time Database: http://www.bankofengland.co.uk/statistics/Pages/gdpdatabase/default.aspx
We have extended some deflator data backwards in time with data from Garratt and Vahey (2006), with thanks to Tony Garratt.

period with a standard deviation which is 25% smaller. Despite the increased imprecision of the estimates, there is, however, evidence of predictability of returns from both business cycle indicators and the structural shocks. Again, the results suggest that this relationship is stronger for longer horizon returns.

5.2 Out of Sample Evidence

Existing evidence suggests that models that fit well in sample are unable to predict well out of sample. Goyal and Welch (2006), for example, look at the out of sample predictive ability of a number of models and find that few can predict better than a constant. The recent turbulent behaviour of equity market and other financial market returns provides us with a stiff out of sample forecasting test to expose our models to. The test that we apply is of the ability of the models to improve on the forecast that would be made by a simple forecasting model which uses just the lagged return and a constant. This is therefore a more challenging comparison than that examined by Goyal and Welch. We use the MSE-F test proposed by McCracken (2007) which tests the null hypothesis that a simple autoregressive model $r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta(r^m_t - r^f_t) + \epsilon_{it+i}$, $i = 1, ..5.$ has a mean-squared forecasting error that is equal to or smaller than that of the business cycle model. The alternative hypothesis is that the business cycle model has a lower mean-squared error. The statistic is

$$MSE - F = (P - \tau + 1) \left(MSE_{\varepsilon} - MSE_e \right) / MSE_e$$

for the prediction period P and step size τ and mean-squared error MSE_{ε} from the autoregressive model and MSE_e from the business cycle model. The critical values for this test are non-standard and we use the bootstrap values provided by McCracken (2007) which are also shown to be appropriate for real time data by Clark and McCracken (2009). In each case we set the prediction period $P = 4$ for models estimated up to 2007q4. Thus the tests are truly out of sample even though we have reported estimates for periods ending in 2008q4. We do this to conserve datapoints for the estimation. We can, however, test the ability of models to predict returns over a recent turbulent period; for example for $r^m_{t+4} - r^f_{t+4}$ we will be assessing the ability of models to forecast four-quarter ahead returns from 2008q4 - 2009q4 from the model estimated up to 2007q4.

We return to the realised returns models in Tables 2 and 3 to examine the first sets of forecast tests which provide a clear set of results. The business cycle indicator models in Table 2 and the business cycle shock models in Table 3 all show a clear dominance over the autoregressive model. In each case of the structural shocks models in Table 3, the structural shocks in the forecast period are generated recursively using estimates to 2007q4.The levels of significance vary but are at the 1% level of significance at the long horizon. We can also compute these tests for a comparison with the constant returns model used by Goyal and Welch (2008). In these unreported results the dominance of the business cycle models in forecasting is even more apparent.

The results of the out of sample forecast comparison tests for the real time data are broadly consistent with those for the realised returns sample. The forecasts for the models using the official recession indicators are one step ahead forecasts based on the vintage of data announced in the quarter concerned. The forecasts for returns are compared with those for the autoregressive model in the last rows for each measure in Table 6. Whilst the performance of the BBQ measure is mixed across the horizons, the Bank of England measure produces a superior forecasting performance at all horizons and this is most significant at the shortest.

In the case of the structural shocks model, the shocks in the forecast period are generated recursively using estimates of the VAR to 2007q4. In terms of the MSE-F test results in the final row of Table 7, there is a superior forecasting performance than the autoregressive model at the longest horizon, which is significant at the 10% level. Comparison of the forecast performance of these models with the constant returns model, not shown, shows a more positive result, as would be expected. Thus in a challenging environment we have shown a strong forecasting performance for the business cycle models in the realised returns dataset and consistent, but less significant, performance in the real-time dataset. We examine forecast tests for further models below.

6 Further Generalisations

The final models that we estimate examine the interaction of the structural macroeconomic shocks with the business cycle recession indicator variables. That is, we examine the differential impact of the supply and demand shocks in periods identified separately to be recession or expansion quarters. We estimate the following set of equations for the excess return from the investment strategy at the longer horizons of 4 and 5 quarters:

$$r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i D_t.\varepsilon_{kt} + \gamma_i(r^m_t - r^f_t) + \epsilon_{it}, \quad i = 4, 5. \tag{6}$$

for the business cycle indicator variable D_t and the structural shocks ε_{kt}. In the estimation we employ the BBQ business cycle indicator D_t.[8] We estimate equation (6) for the two supply and demand shocks, $k = s, d$. The official recession indicator variables and the structural shocks measure quite different things. The interaction of the two can be thought of as providing a more

[8] We report only the results using the BBQ business cycle indicator variable. The results for the other two definitions are very similar.

nuanced measure of the nature of a recession or expansion period by measuring the nature of the shocks that occur in those periods. The estimates of equation (6) show how that combined measure affects returns. The results of the estimation in Table 8 are for both realised and expected returns. Comparison of the impact of supply shocks in BBQ recessions and expansions shows significant evidence of a larger impact in recessions for all four cases. The differences between the impact of demand shocks is less marked although there is a little evidence of a larger counter-cyclical impact following recession quarters. In all cases the coefficients are better determined in the realised returns models with longer data periods. All four models show a good ability to out forecast the autoregressive model. These results suggest that differentiating the imapct of the structural shocks between official cyclical periods is important.

The final models that we estimate examine whether positive and negative supply and demand shocks have different sized coefficients by sub-dividing the shocks included in equation (6) into positive and negative shocks, so $k = s^-, s^+, d^-, d^+$. Thus we examine whether, for example, negative aggregate supply shocks in recessions have a more important impact on future returns that positive demand shocks in an expansion. The estimates are shown in Table 9. The impact of negative supply shocks on returns isgenerally larger and more significant than for other shocks at both horizons, in both datasets .This result complements those in Smith, Sorensen and Wickens (2010) for the impact of structural supply and demand shocks on the risk premium in US equity returns, where the risk premium is that of a stochastic discount factor (SDF) model with conditional moments modelled as GARCH processes. These models all have a superior out of sample forecasting perfromance than the aurtoregressive model according to the MSE-F statistics.

7 Conclusions

This paper analyses the relationship between the state of the business cycle and excess equity returns. It does so by examining three business cycle indicator variables drawn from business cycle dating and identified structural macroeconomic shocks. The results provide strong support for the hypothesis of counter-cyclical excess equity returns. We show that there is a significant relationship between recession quarters identified by business cycle indicator variables and excess equity returns at horizons between one and five quarters. Comparison with analysis based only on business cycle turning points shows much more support for counter-cyclicality in returns when all recession and expansion quarters are identified. Conditioning on turning points provides little evidence of counter cyclicality at any horizon for the UK.

Analysis of the relationship between identified structural aggregate supply and demand shocks supports the broader results and provides more detail. In particular, the estimates show that aggregate supply shocks are more important for excess returns than are demand shocks. This result is amplified further by concentrating on the sign of structural shocks that occur during recession periods, as identified by the business cycle indicator variables. Negative supply shocks appear to be particularly important in terms of size and statistical significance.

The results are shown to be robust to the inclusion of additional return predictor variables and an alternative identification scheme for the structural shocks., Further, we show that the approach can applied to real-time measures and can successfully forecast expected returns out of sample.

The analysis in this paper does not depend on a particular asset pricing model. The methods of identifying business cycle quarters examined here could be employed in cross-section analysis of portfolios of individual stocks or other financial assets. There then follows the quest for structural models that exaplain the counter-cyclicality of returns and the importance, in particular of negative aggregate supply shocks. Cochrane (2007) provides a comprehensive survey of consumption-based models, some of which, for example some habit-based models, generate a strong counter-cyclical risk premium. Production-based models might provide a route for supply shocks which would match some of the features we have found in returns.

The relationships between business cycle indicators and shocks that we have found in this paper are consistent with the existence of market efficiency. This can be checked by providing a full-blown asset pricing model with these shocks as inputs. The fact that we focus on measures from the real economy and their relationship with future returns means that the results are not driven by the washing out of fads in returns or other behavioural effects in financial markets which are identified by Goyal and Welch (2008), amongst others, as part of the reason for the failure of out of sample predictability from models built on financial variables.

Developments of the approach in this paper could include examining the relationship between political business cycle measures and returns and examining the predictability of the variability of returns along with the level of returns.

References

Ang, A., Dong, S. and M. Piazzesi, (2005), "No arbitrage Taylor rules", mimeo.

Aretz , K., S. Bartram and P. Pope (2009), "Macroeconomic risks and characteristic-based factor models", *Journal of Banking and Finance*, 34, 6, pp 1383-1399.

Bank of England (2012), *Inflation Report*, August.

Blanchard, OJ and Quah, D (1989). "The Dynamic Effects of Aggregate Demand and Supply Disturbances", *American Economic Review*, 79, 4, pp 655-673.

Blanchard, OJ and Quah, D (1993). "The Dynamic Effects of Aggregate Demand and Supply Disturbances: Reply", *American Economic Review*, 83, pp 653-658.

Bry, G. and C. Boschan (1971), *Cyclical analysis of time series: selected procedures and computer programs*, New York NBER.

Bullard, J and Keating JW (1995). The long run relationship between inflation and output in postwar economies. *Journal of Monetary Economics,* 36, pp.477-496.

Burns, A. and W. Mitchell (1946), *Measuring Business Cycles*, New York, NBER.

Clark, T. and M. McCracken (2009), "Tests of equal predictive ability with real-time data", *Journal of Business and Economic Statistics*, 27(4), pp 441-454.

Cochrane, J. (2007), "Financial markets and the real economy", in R. Mehra (ed), Handbook of the Equity Premium, Elsevier, pp 237-325.

Cooper, I. and R. Priestley (2009), "Time-varying risk premiums and the output gap", *Review of Financial Studies,* 22, 7, pp 2801-2833.

Fernandez-Villaverde, J., J. Rubio-Ramirez and T. Sargent (2005), "A,B,C's (and D's) for Understanding VARs", *NBER Technical Working Paper* 308.

Garratt, A. and S. Vahey (2006), "UK Real-Time Macro Data Characteristics," *Economic Journal*, 116, (509), pp F119-F135.

Goyal, A. and I. Welch (2008), "A comprehensive look at the empirical performance or the equity premium prediction", *Review of Financial Studies*, 21 (4), pp 1455-1508.

Harding, D. and A. Pagan (2002), "Dissecting the cycle: a methodological investigation", *Journal of Monetary Economics*, 49, pp 365-381.

Harding, D. and A. Pagan (2006), "Synchronization of cycles", *Journal of Econometrics*, 132, pp 59-79.

Kaminska, I. (2008), "A no-arbitrage structural vector autoregressive model of the UK yield curve", *Bank of England Working Paper* No. 357.

Keating, J., and J. Nye (1998), "Permanent and transitory shocks in real output: estimates from nineteenth-century and postwar economies", *Journal of Money Credit and Banking,* 30, 2, pp 231-251.

Lippi, M. and L. Reichlin (1993), "The Dynamic Effects of Aggregate Demand and Supply Disturbances: Comment", *American Economic Review*, 83, pp. 644-652.

Lustig, H. and A. Verdelhan (2012), "Business cycle variation in the risk-return trade-off", *Journal of Monetary Economics,* 59, pp 35-49.

OECD (2011), "OECD composite leading indicators: reference turning points and component series", OECD Statistics Directorate, Paris.

Peña, I., R. Rodriguez and F. Restoy (2002), "Can output explain the predictability and volatility of stock returns?", *Journal of International Money and Finance*, 21, 2, pp 163-182.

Rangvid, J. (2006) "Output and expected returns", *Journal of Financial Economics*, 81, pp 595-624.

Sims, C. (1980), "Macroeconomics and reality", *Econometrica*, 48, pp 1-39.

Smith, P. N., Sorensen, S. and M. R. Wickens (2010),. "The equity premium and the business cycle: the role of demand and supply shocks*", International Journal of Finance and Economics*, 15, pp134-152.

Data Appendix

The data series used in this paper are as follows:

y_t Real GDP

Gross Domestic Product at market prices, 2010 prices, seasonally adjusted, ONS code: ABMI.

Real time data: Vintages of ONS codes: CAOO before ESA-95, ABMI thereafter.

p_t GDP Price deflator

Implied GDP deflator, seasonally adjusted, ONS code YBHA/ABMI.

Real time data: Vintages of ONS codes: CAOO/CAOB before ESA-95, YBHA/ABMI therafter

r_t^f Interest rate

Base Rate

r_{t+i}^m Equity strategy return

Rate of return on UK equity market investment strategy. Computed as: $r_{t+i}^m = \ln(re_{t+i+4}) - \ln(re_{t+i})$

re_t Datastream total return index for the UK including dividend payments, Datastream code: TOTMKUK.

Summary Statistics

Realised returns models			Expected returns models		
	Mean	SD		Mean	SD
$r_{t+5}^m - r_t^f$	0.0123	0.0511	$r_{t+5}^m - r_t^f$ †	0.0116	0.0402
r_t^f	0.0194	0.0083	r_t^f †	0.0212	0.00915
OECD	0.526	0.501			
BBQ	0.194	0.397	BBQ †	0.212	0.410
Bank of England	0.104	0.306	Bank of England†	0.0985	0.299
Structural Shocks			Structural Shocks		
ε_{st}	0.0199	1.0	ε_{st} $*$	0.00259	1.0
ε_{dt}	0.0107	1.0	ε_{dt} $*$	0.0241	1.0
1956q2 - 2008q4			†1976q1 - 2008q4		
			$*$1983q1 - 2008q4		

Table1A : Reference chronology of turning points

1. **OECD Reference Turning Points, OECD (2011).**

Trough 1958Q4, Peak 1960Q1, Trough 1963Q1, Peak 1965Q1, Trough 1967Q3, Peak 1969Q2, Trough 1972Q1, Peak 1973Q2, Trough 1975Q3, Peak 1979Q2, Trough 1981Q1, Peak 1983Q4, Trough 1984Q3, Peak 1988Q4, Trough 1992Q2, Peak 1994Q4, Trough 1999Q1, Peak 2000Q4, Trough 2003Q2, Peak 2004Q2, Trough 2005Q3, Peak 2008Q1, Trough 2009Q2, Peak 2011Q1

2. Bry-Boschen Quarterly Turning Points, Harding and Pagan (2002).

Peak 1955Q4, Trough 1956Q3, Peak 1961Q2, Trough 1961Q4, Peak 1964Q4, Trough 1966Q4, Peak 1973Q2, Trough 1974Q1, Peak 1974Q3, Trough 1975Q3, Peak 1979Q3, Trough 1981Q1, Peak 1990Q2, Trough 1991Q3, Peak 2008Q1, Trough 2009Q3, Peak 2010Q3

3. Bank of England Recession Indicator, Bank of England (2011).

Peak 1956Q1, Trough 1956Q3, Peak 1957Q2, Trough 1957Q3, Peak 1961Q3, Trough 1961Q4, Peak 1973Q3, Trough 1975Q3, Peak 1980Q1, Trough 1981Q1, Peak 1990Q3, Trough 1999Q3, Peak 2008Q2, Trough 2009Q3

Table 1B: Correlation Matrix

	OECD	BBQ	Bank of England
OECD	1	0.313	0.254
BBQ		1	0.550
Bank of England			1

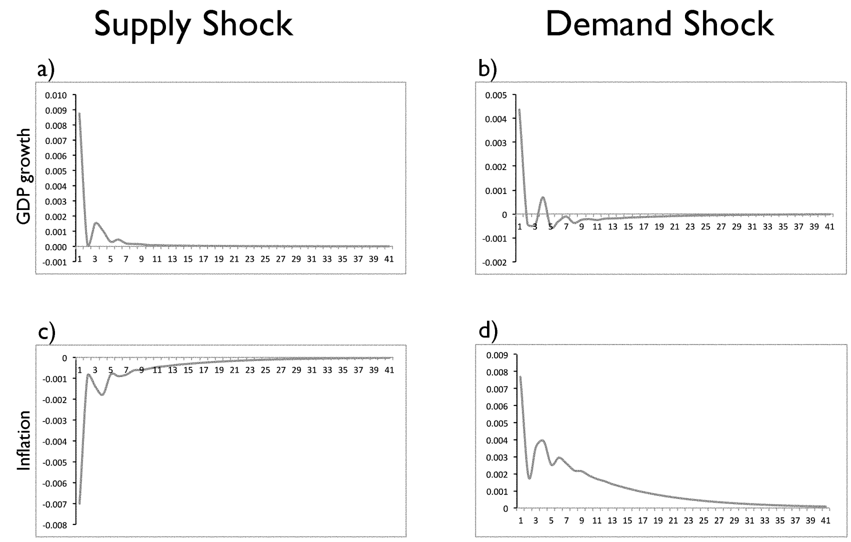

Figure 1

Figure 1 :Structural Supply and Demand Shocks

The panels of this chart show the responses of GDP growth and inflation to positive one standard deviation sized, impulses in the structural supply and demand shocks ε_{kt}, $k = s, d$

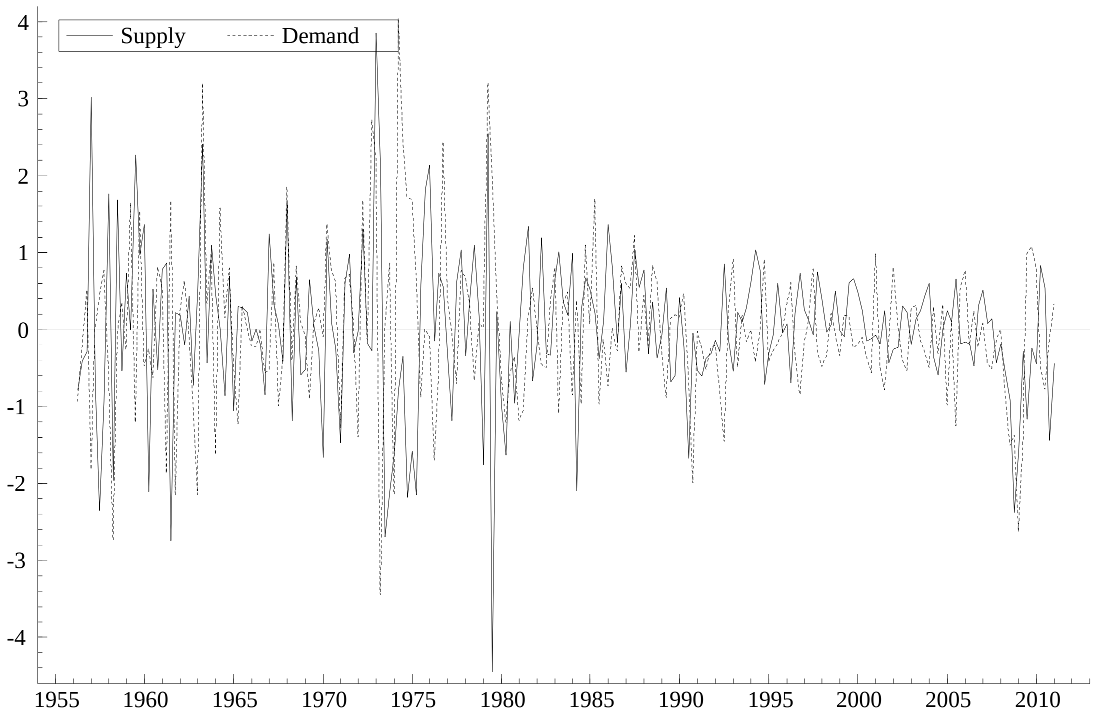

Figure 2

Figure 2 :Structural Supply and Demand Shocks

The panels of this chart show the structural supply and demand shocks ε_{kt}, $k = s, d$

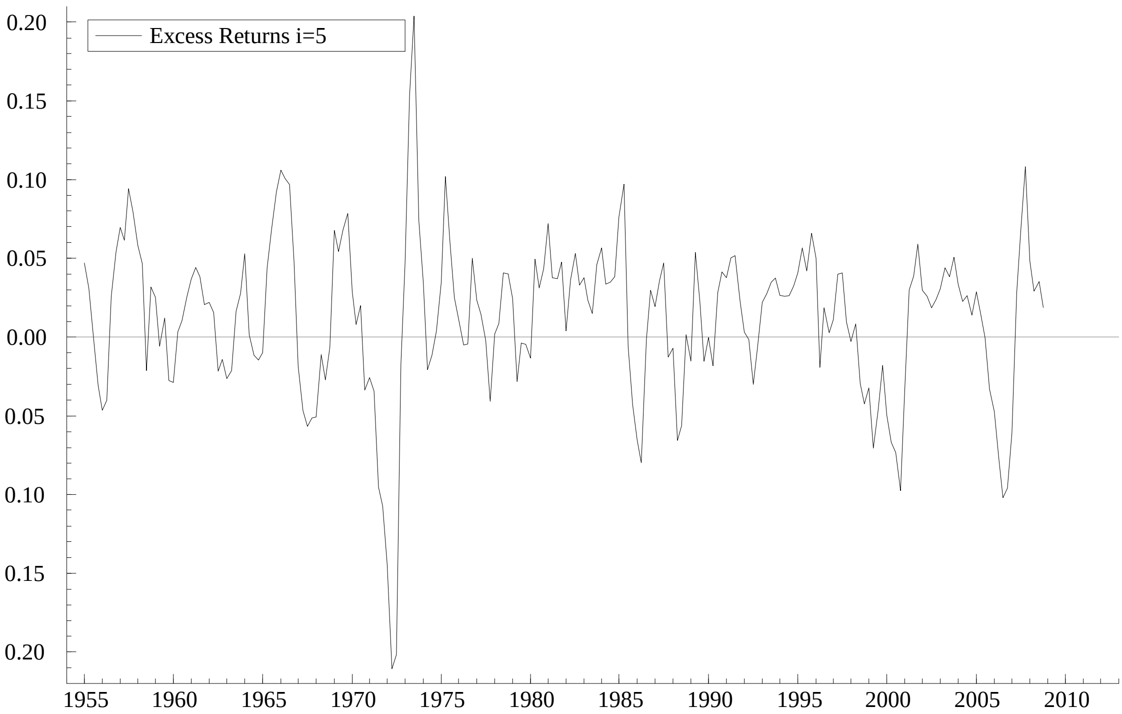

Figure 3

Figure 3 : Excess Return of the Equity Investment Strategy

The figure shows the return for the strategy at the longest horizon, i=5.

Table 2: The Impact on Excess Equity Returns of Recession Measures

The table shows the quarterly excess returns from an investment strategy that buys the UK stock market index one or more periods after a recession quarter and holds it for one year compared with buying the index after an expansion quarter. The stock market return index is the total return index for the UK market provided by Datastream. The risk-free rate of interest is the Base Rate. HAC standard errors are given in brackets. The equations also include an unreported constant. MSE-F compares the out-of-sample forecasting ability of the model with an estimate of the model excluding the recession measure; significant improvement in forecasting at 90%†, 95%* , 99% ** from simulations in McCracken (2007). Number of observations: 212. Period of estimation: 1956 Q1 - 2008 Q4

Quarterly excess returns $r^m_{t+i} - r^f_{t+i}$					
Percentage fraction	Quarters ahead i				
Recession Measure	1	2	3	4	5
OECD	0.0104 (0.0055)	0.0202 (0.00995)	0.0272 (0.0110)	0.0305 (0.0104)	0.0275 (0.0088)
$r^m_t - r^f_t$	0.761 (0.0609)	0.440 (0.0995)	0.117 (0.126)	-0.185 (0.121)	-0.231 (0.108)
Regression standard error	0.0330	0.0449	0.0491	0.0486	0.0483
MSE-F	$0.679^{\dagger}$	1.07^{*}	1.65^{**}	3.34^{**}	8.20^{**}
Bank of England	0.0150 (0.0148)	0.0231 (0.0187)	0.0235 (0.0135)	0.0271 (0.012)	0.0274 (0.0089)
$r^m_t - r^f_t$	0.763 (0.0646)	0.445 (0.108)	0.126 (0.180)	-0.175 (0.128)	-0.223 (0.107)
Regression standard error	0.0331	0.0455	0.0505	0.0501	0.0494
MSE-F	0.786^{*}	$0.526^{\dagger}$	0.0442	$0.476^{\dagger}$	12.07^{**}
BBQ	0.00866 (0.0068)	0.0158 (0.0109)	0.0241 (0.013)	0.0290 (0.013)	0.0336 (0.00759)
$r^m_t - r^f_t$	0.772 (0.0654)	0.460 (0.107)	0.146 (0.132)	-0.152 (0.123)	-0.196 (0.0764)
Regression standard error	0.0332	0.04558	0.0501	0.0494	0.0484
MSE-F	$0.557^{\dagger}$	1.02^{*}	1.98^{**}	5.14^{**}	2.87^{**}
Chow (106,102)	0.546	0.496	0.503	0.496	0.546

Table 3: The Impact on Excess Equity Returns of Business Cycle Shocks

The table shows the results of estimating equation $r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i \varepsilon_{kt} + \epsilon_{it}$, $i = 1, ..5.$ for shocks ε_{kt}, $k = s, d$. The dependent variable is quarterly excess returns from an investment strategy that buys the UK stock market index one or more periods after the business cycle shocks and holds it for one year. The stock market return index is the total return index for the UK market provided by Datastream The risk-free rate of interest is the Base Rate. HAC standard errors are given in brackets. The equations also include an unreported constant. MSE-F compares the out-of-sample forecasting ability of the model with an estimate of the model excluding the recession measure; significant improvement in forecasting at 90%†, 95%* , 99% ** from simulations in McCracken (2007). Number of observations: 212.

Period of estimation: 1956 Q1 - 2008 Q4

Quarterly excess returns $r^m_{t+i} - r^f_{t+i}$					
Business Cycle Shock	Quarters ahead i				
	1	2	3	4	5
Supply	-0.00375 (0.00333)	-0.00821 (0.00633)	-0.00853 (0.00580)	-0.00543 (0.00389)	-0.00706 (0.00248)
Demand	0.00210 (0.00325)	-0.00149 (0.00414)	-0.00770 (0.00454)	-0.00628 (0.00388)	-0.00650 (0.00301)
$r^m_t - r^f_t$	0.765 (0.64)	0.452 (0.101)	0.139 (0.124)	-0.162 (0.125)	-0.210 (0.107)
Regression standard error	0.0513	0.0513	0.0513	0.0513	0.0511
MSE-F	0.447†	1.11*	0.834*	1.16*	8.48**
Chow (106,101)	0.579	0.550	0.544	0.559	0.624

Table 4: The Impact on Excess Equity Returns of Business Cycle Shocks

The table shows the results of estimating equation $r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i \varepsilon_{kt} + \gamma \left(r^m_t - r^f_t \right) + \epsilon_{it}$, $i = 1, ..5.$

for shocks ε_{kt}, $k = s, d$. The dependent variable is quarterly excess returns from an investment strategy that buys the UK stock market index one or more periods after the business cycle shocks and holds it for one year. The stock market return index is the total return index for the UK market provided by Datastream The risk-free rate of interest is the Base Rate. HAC standard errors are given in brackets. The equations also include an unreported constant.

Number of observations: 212. Period of estimation: 1956 Q1 - 2008 Q4

Quarterly excess returns $r^m_{t+i} - r^f_{t+i}$					
Business Cycle Shock	Quarters ahead i				
	1	2	3	4	5
Supply	−0.00371 (0.00305)	−0.00670 (0.00598)	−0.00484 (0.00482)	−0.000994 (0.00389)	−0.00516 (0.00286)
Demand	0.000330 (0.00282)	−0.00389 (0.00414)	−0.00956 (0.00549)	−0.00883 (0.00388)	−0.00727 (0.00258)
Interest Rate	−0.00158 (0.00274)	0.000174 (0.00292)	0.00132 (0.00259)	−0.000309 (0.00325)	0.00447 (0.00287)
$r^m_t - r^f_t$	0.765 (0.0640)	0.454 (0.101)	0.139 (0.124)	-0.165 (0.125)	-0.206 (0.107)
Regression standard error	0.0513	0.0513	0.0513	0.0513	0.0511
MSE-F	−0.172	$0.531^{\dagger}$	$0.632^{\dagger}$	1.09^{*}	10.98^{**}

Table 5: The Impact on Excess Equity Returns of Alternative Business Cycle Variables

The table shows the results of estimating equation $r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i \varepsilon_{kt} + \gamma_i \left(r^m_t - r^f_t \right) + \delta_i Z_t + \epsilon_{it}$, $i = 1, ..5.$

for shocks ε_{kt}, $k = s, d$. The dependent variable is quarterly excess returns from an investment strategy that buys the UK stock market index one or more periods after the business cycle shocks and holds it for one year. The stock market return index is the total return index for the UK market provided by Datastream The risk-free rate of interest is the Base Rate. HAC standard errors are given in brackets. The equations also include an unreported constant.

Number of observations: 212. Period of estimation: 1956 Q1 - 2008 Q4

Quarterly excess returns $r^m_{t+i} - r^f_{t+i}$			
Business Cycle Shock	5 Quarters ahead, $i = 5$		
	1	Cooper/Pr	Rangvid
Supply	-0.00706 (0.00248)	-0.00685 (0.00280)	-0.00707 (0.00324)
Demand	-0.00650 (0.00301)	-0.00395 (0.00350)	-0.00852 (0.00389)
Z_t		-0.372 (0.154)	-0.00825 (0.00754)
$r^m_t - r^f_t$	-0.210 (0.107)	-0.299 (0.106)	-0.226 (0.113)
Regression standard error	0.0511	0.0482	0.0517

Table 6: The Impact on Excess Equity Returns of Real Time Recession Measures

The table shows the quarterly excess returns from an investment strategy that buys the UK stock market index one or more periods after a recession quarter and holds it for one year compared with buying the index after an expansion quarter. The stock market return index is the total return index for the UK market provided by Datastream. The risk-free rate of interest is the Base Rate. HAC standard errors are given in brackets. MSE-F compares the out-of-sample forecasting ability of the model with an estimate of the model excluding the recession measure; significant improvement in forecasting at 90%†, 95%* , 99% ** from simulations in McCracken (2007)

Number of observations: 131. Period of estimation: 1976 Q2 - 2008 Q4

Quarterly excess returns $r^m_{t+i} - r^f_{t+i}$					
Percentage fraction	Quarters ahead i				
Recession Measure	1	2	3	4	5
BBQ	0.00906 (0.012)	0.0175 (0.0060)	0.0227 (0.0083)	0.0242 (0.0095)	0.0234 (0.0091)
$r^m_t - r^f_t$	−0.0969 (0.14)	0.398 (0.10)	0.119 (0.131)	−0.139 (0.14)	−0.0969 (0.14)
Regression standard error	0.0353	0.0362	0.0391	0.0393	0.0395
MSE-F	−0.736	−0.0817	−0.266	−0.253	0.132
Bank of England	0.00406 (0.0075)	0.00966 (0.0066)	0.0116 (0.0092)	0.0145 (0.0085)	0.0132 (0.0080)
$r^m_t - r^f_t$	0.730 (0.064)	0.424 (0.104)	0.153 (0.137)	−0.104 (0.142)	−0.0626 (0.142)
Regression standard error	0.0289	0.0368	0.0400	0.0403	0.0404
MSE-F	1.20*	0.253	0.0613	0.0622	0.132

Table 7: The Impact on Excess Equity Returns of Real Time Business Cycle Shocks

The table shows the results of estimating equation $r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i \varepsilon_{kt} + \epsilon_{it}$, $i = 1, ..5.$ for shocks ε_{kt}, $k = s, d$. The dependent variable is quarterly excess returns from an investment strategy that buys the UK stock market index one or more periods after the business cycle shocks and holds it for one year. The stock market return index is the total return index for the UK market provided by Datastream The risk-free rate of interest is the Base Rate. HAC standard errors are given in brackets. The equations also include an unreported constant. MSE-F compares the out-of-sample forecasting ability of the model with an estimate of the model excluding the recession measure; significant improvement in forecasting at 90%†, 95%* , 99% ** from simulations in McCracken (2007). Number of observations: 104. Period of estimation: 1983 Q1 - 2008 Q4

Quarterly excess returns $r^m_{t+i} - r^f_{t+i}$					
Business Cycle Shock	Quarters ahead i				
	1	2	3	4	5
Supply	−0.00410 (0.00415)	−0.00516 (0.0042)	−0.000441 (0.0041)	−0.00573 (0.00318)	−0.00175 (0.0037)
Demand	−0.00369 (0.00315)	0.00165 (0.0043)	0.00223 (0.0038)	-0.000916 (0.0037)	0.000743 (0.0037)
$r^m_t - r^f_t$	0.752 (0.0739)	0.464 (0.116)	0.185 (0.155)	-0.0849 (0.164)	-0.0764 (0.162)
Regression standard error	0.0286	0.0386	0.0430	0.0431	0.0434
MSE-F	−0.231	0.504	−0.352	−0.0506	0.738†

Table 8: The Impact on Excess Equity Returns of Interacted Real Time Business Cycle Shocks and Recession Measures

The table shows the results of estimating equation $r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i D_t.\varepsilon_{kt} + r^m_t - r^f_t + \epsilon_{it}$, $i = 1, ..5.$

for shocks ε_{kt}, $k = s, d$ and the BBQ business cycle indicator variable D_t

The dependent variable is quarterly excess returns from an investment strategy that buys the UK stock market index one or more periods after the business cycle shocks and holds it for one year.

The stock market return index is the total return index for the UK market provided by Datastream

The risk-free rate of interest is the Base Rate. HAC standard errors are given in brackets.

The equations also include an unreported constant. MSE-F compares the out-of-sample forecasting ability of the model with an estimate of the model excluding the recession measure; significant improvement in forecasting at 90%†, 95%* , 99% ** from simulations in McCracken (2007).

Periods of estimation: revised data: 1956 Q1 - 2008 Q4, number of observations: 212;

real time data 1983:Q1 - 2008Q4, Number of observations: 104.

Quarterly excess returns				
Business Cycle Shock	Quarters ahead			
	Revised		RealTime	
	4	5	4	5
Recession Supply	−0.00904 (0.0085)	−0.0116 (0.0053)	−0.00652 (0.0044)	−0.00725 (0.0037)
Expansion Supply	−0.00300 (0.0029)	−0.00454 (0.0030)	−0.00528 (0.0044)	0.00124 (0.0046)
Recession Demand	−0.00592 (0.0039)	−0.0130 (0.0054)	−0.000318 (0.0029)	0.00270 (0.0021)
Expansion Demand	-0.00680 (0.0055)	−0.00350 (0.0035)	−0.00143 (0.0062)	−0.00109 (0.0057)
$r^m_t - r^f_t$	−0.165 (0.123)	−0.196 (0.103)	−0.0846 (0.17)	−0.0778 (0.17)
Regression standard error	0.0504	0.0493	0.0504	0.0436
MSE-F	1.43**	2.03**	0.476†	0.686†

Table 9: The Impact on Excess Equity Returns of Interacted Real Time Business Cycle Shocks and Recession Measures

The table shows the results of estimating equation $r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i D_t.\varepsilon_{kt} + r^m_t - r^f_t + \epsilon_{it}$, $i = 1, ..5$.
for shocks ε_{kt}, $k = s^-, s^+, d^-, d^+$ and the BBQ business cycle indicator variable D_t
The dependent variable is quarterly excess returns from an investment strategy that buys the UK stock market index one or more periods after the business cycle shocks and holds it for one year.
The stock market return index is the total return index for the UK market provided by Datastream
The risk-free rate of interest is the Base Rate. HAC standard errors are given in brackets.
The equations also include an unreported constant. MSE-F compares the out-of-sample forecasting ability of the model with an estimate of the model excluding the recession measure; significant improvement in forecasting at 90%†, 95%* , 99% ** from simulations in McCracken (2007).
Periods of estimation: revised data: 1956 Q2 - 2008 Q4, number of observations: 211;
real time data 1983:Q1 - 2008Q4, Number of observations: 104.

Quarterly excess returns				
Business Cycle Shock	Quarters ahead			
	Revised		Real Time	
	4	5	4	5
Recession Negative Supply	−0.00926 (0.0085)	−0.0116 (0.0075)	−0.0155 (0.0068)	−0.0205 (0.0063)
Expansion Positive Supply	0.00192 (0.0029)	−0.0012 (0.0049)	−0.0207 (0.0087)	−0.0118 (0.0099)
Recession Negative Demand	−0.00797 (0.0039)	−0.0179 (0.0063)	0.00047 (0.0081)	0.00127 (0.0054)
Expansion Positive Demand	−0.0131 (0.0055)	−0.00686 (0.0058)	−0.00216 (0.0090)	0.00242 (0.0092)
$r^m_t - r^f_t$	−0.160 (0.123)	−0.196 (0.103)	−0.110 (0.165)	−0.114 (0.164)
Regression standard error	0.0500	0.0489	0.0418	0.0426
MSE-F	1.29*	0.73†	1.20*	0.570†

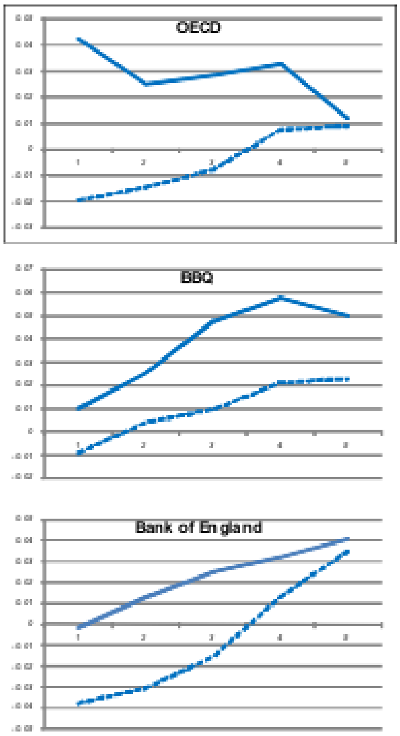

Figure 4

Figure 4: Excess Equity Returns Following Cyclical Turning Points

The panels of this chart show the average quarterly excess returns from an investment strategy that buys the UK stock market index one or more periods after the business cycle turning points and holds it for one year. The unbroken lines are for expansion quarters following a business cycle trough and the dashed lines for recession quarters after a business cycle peak. The panels shows the returns for turning points for each of three business cycle dating methods for the period 1956q2 - 2008q4