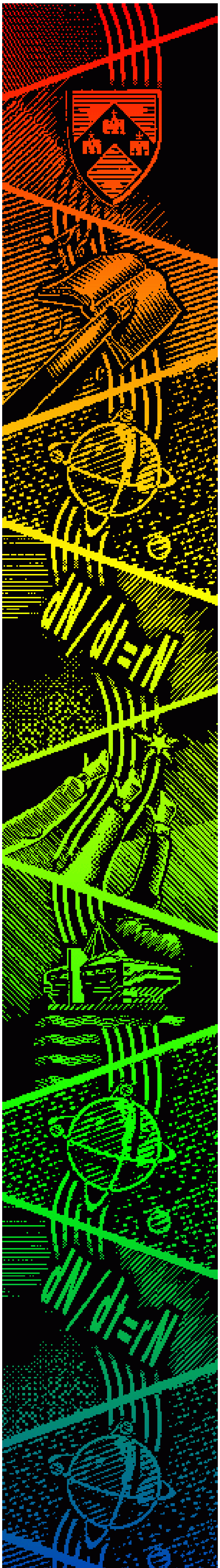

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Equity Returns and the Business Cycle: The Role of Supply and Demand Shocks

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

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Abstract

The price of aggregate risk 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.

JEL Classification: G12, C32, C51, E44

Keywords: Equity Returns, Risk Premium, Business Cycle.

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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 price of aggregate risk appears to have risen and remained high, even as the recession has formally come to an end. Firms 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 annalysis 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 clasification.

The results of our study show that returns are clearly countercyclical. Returns are 3.5% higher following a recession quarter compared with an expansion quarter. Similarly, returns are 1.5% higher following a 1% point negative aggregate supply shock. They are also 1.5% higher following a 1% point negative supply shock in an OECD recession quarter.

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 (2011) 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 it's 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. We examine final measure of recession that emerges from application of 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 and we follow this lead in all of the analysis in this paper. The algorithm proposed by Bry and Boschen (1971) for monthly data translated into the quarterly frequency by Harding and Pagan (2002) has three steps:

1. Determine a potential set of turning points.
2. Ensure that peaks and troughs alternate.
3. Use a set a censoring rules which restrict the minimum length of a phase or complete cycle.

Here we use the steps 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

[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.

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.

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 incluid 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., $I(1)$. 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 $= E[e_t . e_t']$.

The Infinite Moving Average (IMA) representation can be expressed as follows:

$$x_t = \mu + \sum_{i=0}^{\infty} A_1^i e_{t-i} \tag{2}$$

or similarly

$$\begin{bmatrix} \Delta y_t \\ \pi_t \end{bmatrix} = \begin{bmatrix} \bar{\Delta y_t} \\ \bar{\pi}_t \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} e_{yt-i} \\ e_{\pi t-i} \end{bmatrix}. \tag{3}$$

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 $\varepsilon_t = \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix}$ with IMA representation:

$$\begin{bmatrix} \Delta y_t \\ \pi_t \end{bmatrix} = \begin{bmatrix} \bar{\Delta y_t} \\ \bar{\pi_t} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} c_{11}(i) & c_{12}(i) \\ c_{21}(i) & c_{22}(i) \end{bmatrix}^i \begin{bmatrix} \varepsilon_{dt-i} \\ \varepsilon_{st-i} \end{bmatrix}. \tag{4}$$

and the relationship between the two sets of shocks is defined to be:

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

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,

$$\sum_{i=0}^{\infty} c_{11}(i)\varepsilon_{dt-i} = 0 \tag{5}$$

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, so their variance-covariance matrix is:

$$\Sigma_\varepsilon = \begin{bmatrix} \sigma^2_{\varepsilon_{\Delta y}} & \sigma_{\varepsilon_{\Delta y}\varepsilon_\pi} \\ \sigma_{\varepsilon_{\Delta y}\varepsilon_\pi} & \sigma^2_{\varepsilon_\pi} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \tag{6}$$

Given these identification assumptions, the structural shocks are, in practice, recovered from OLS estimation of the VAR in equation (1.). The restriction in (5) becomes[4] :

$$\left[1 - \sum_{k=0}^{\infty} a_{22}(i)\right] c_{11}(0) + \sum_{k=0}^{\infty} a_{12}(i)c_{21}(0) = 0 \tag{7}$$

[4] 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).

Below, the response of excess equity returns to the structural macroeconomic shocks ε_{st} and ε_{dt} is estimated.

The two-variable VAR(1) in output growth and inflation is estimated over the period 1956 Q2 - 2008 Q4 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 (7). One way of assessing the properties of these shocks is to examine the impluse 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 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 the Figure (INDICATE) these effects are more persistent than the effects on output growth.

3 Excess Returns in Recessions and Expansions

This section examines how the return from the investment strategy r^m_{t+i} in excess of the risk-free rate r^f_t varies between recession and expansion periods. 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 it's previous incarnations) for the period 1956q1 to 2008q4. The relationship estimated is between the excess return at 1 to 5 quarter horizons i on the dummy variable for a recession for the three different business cycle measures j, D_{jt}. The regression is:

$$r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i D_{jt} + \epsilon_{it}, \quad i = 1, ..5. \tag{8}$$

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 estimates imply that returns are higher by between 1.5% and 2.1% (on an annualised basis) for the quarter immediately after a recession quarter, depending on the business cycle measure (see first column). 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 2.62 and 3.54% above that for the average expansion quarter. The size of the effect peaks between 3 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 1.6% after one quarter to 3.5% 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. 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.

3.1 Excess Returns Following Business Cycle Turning Points

In related research, Lustig and Verdelhan (2011) 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 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. First, we analyze the broad relationship between all supply and demand shocks and returns with the regressions:

$$r_{t+i}^m - r_{t+i}^f = \alpha_i + \beta_i \varepsilon_{kt} + \epsilon_{it}, \quad i = 1, ..., 5.k = s, d \tag{9}$$

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_{t+i}^m in excess of the risk-free rate r_t^f, and the structural demand and supply shocks ε_{dt} and ε_{st} are constructed from the structural VAR model shown in Section 2. Panel A of Table 3 presents the estimates of equation (9) hand shows that positive supply and demand shocks are mostly associated with lower levels of excess returns. At horizons of more than 2 quarters, positive supply shocks associate with lower excess returns and significantly so at the 95% level, according to the HAC standard errors. Positive demand shocks are also negatively associated with returns at horizons from 3 quarters; but less significantly so. These estimates support those from Section 3 in showing that negative business cycle states are associated with higher excess returns. The coefficients on supply shocks are generally much larger than those on demand shocks.

The scale of these effects on returns over the sample can be judged by taking account of the average sizes of positive and negative supply and demand shocks. Panel B of Table 3 shows the size of the impact on returns of an average-sized shock of each type (ie $\widehat{\beta}_i\overline{\varepsilon_{kt}}$). The figures show that negative supply shocks generate around 1% per quarter higher excess returns for horizons of three to five quarters. Negative demand shocks, on the other hand, generate lower returns of only around 0.25% per quarter. Thus, as the structural shocks of each sign have similar average sizes, the fact that we find that excess returns to the investment strategy are more sensitive to aggregate supply shocks, the average impact of these shocks is much larger in the case of supply shocks. The response is significantly counter cyclical in both cases

Next, we examine whether positive and negative supply and demand shocks have different sized coefficients by sub-dividing the shocks included in equation (9) into positive and negative shocks, so $k = s^-, s^+, d^-, d^+$. The estimates and average impacts are shown in Table 4. The estimated impact of positive and negative supply shocks is somewhat asymmetric but not significantly so. The impact of negative supply shocks on returns is bigger at all horizons beyond 2 quarters. Asymmetry is much more striking in the case of demand shocks. Negative demand shocks have the anticipated negative, counter-cyclical effect. Beyond 2 quarters from the shock and the impact increases in size strikingly to 1.67 for excess returns 5 quarters after the shock. However, positive demand shocks have a pro–cyclical impact on returns at all horizons, although these estimates are not very significantly larger than zero. Thus demand shocks of both signs have a positive impact on excess equity returns. 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.

Finally, we interact the structural macroeconomic shocks with the business cycle recession indicators examined in Section 2. 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 5 horizons:

$$r_{t+i}^m - r_{t+i}^f = \alpha_i + \beta_i D_t.\varepsilon_{kt} + \epsilon_{it}, \quad i = 1, ..., 5. \tag{10}$$

for the business cycle indicator variable D_t and the structural shocks ε_{kt}. We estimate equation (10) for, firstly, the two supply and demand shocks, $k = s, d$ and, secondly, splitting them into positive and negative values $k = s^-, s^+, d^-, d^+$. In the estimation we employ the OECD business cycle indicator D_t.[5] Table 5 shows the estimation results for the first case, where shocks can be positive or negative. Previous results above have shown that supply shocks of either sign have a

[5] We report only the results using the OECD business cycle indicator variable. The results for the other two definitions are very similar. Equivalent tables to Tables 5 and 6 for these measures can be supplied by the authors, on request.

large, counter-cyclical impact on excess returns, especially at longer horizons. The estimates in the first two rows of Table 5 reinforce and extend that conclusion. In these results, the counter cyclical effect is bigger in recessions than expansions. These coefficients are significant from a horizon of 3 quarters onwards and the impact in recessions is significantly larger than in expansions at these longer horizons. Demand shocks also have a counter-cyclical impact. The estimates in rows three and four of Table 5 show that these effects are smaller and less significant than for supply shocks. Panel B of Table 5 shows that supply shocks in a recession are on average negative and have a positive impact on excess returns of 0.7% per quarter at the 3 quarter horizon, increasing to 1.0% at the 5 quarter horizon. Supply shocks in expansions are on average positive and result in a fall in returns of around 0.5% per quarter. Interestingly, demand shocks in a recession are, on average, but positive for expansions. Therefore, combined with the estimates, rows seven and eight in Table 5 show that demand shocks in recessions are associated with lower returns at longer horizons and demand shocks in expansions with higher returns. These pro-cyclical results are quite small and not very significant.

In Table 6 we present the final set of estimates and impacts for the version of equation (10), where we interact the recession indicator variable D_t with the negative and positive supply and demand shocks. ε_{kt}, $k = s^-, s^+, d^-, d^+$. The estimates in Panel A of Table 6 provide the clearest picture of the counter-cyclical impact of aggregate supply and demand shocks on returns. Negative supply and demand shocks in recessions have the biggest and most significant counter-cyclical impact on excess equity returns. The negative coefficients are significant from 2 quarters in the case of negative supply shocks and 4 quarters for negative demand shocks. Positive shocks have a pro-cyclical effect on returns for both supply and demand shocks in expansions. Panel B shows the size of response of returns to the average shocks. Returns are nearly 1% per quarter higher at the 5 quarter horizon following negative supply shocks in a recession and increases two thirds of that size following negative demand shocks in a recession. The impact of positive shocks in an expansion are smaller: quarterly returns are around 0.5% lower. These effects decline in size over the time horizon according to the figures in Panel B.

5 Conclusions

This paper analyses the relationship between the state of the business cycle and excess equity returns. It does so by examining two 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 is especially evident when shocks are split into positive and negative shocks. Negative supply shocks are particularly important in terms of size and statistical significance. This result is amplified further by concentrating on negative shocks that occur during recession periods, as identified by the business cycle indicator variables.

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.

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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 1955Q3, Trough 1956Q3, Peak 1961Q1, Trough 1961Q4, Peak 1964Q3, Trough 1966Q4, Peak 1973Q1, Trough 1974Q1, Peak 1974Q2, Trough 1975Q3, Peak 1979Q2, Trough 1981Q1, Peak 1990Q1, Trough 1991Q3, Peak 2007Q4, Trough 2009Q3, Peak 2010Q2

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	0.339	0.254
BBQ		1	0.618
Bank of England			1

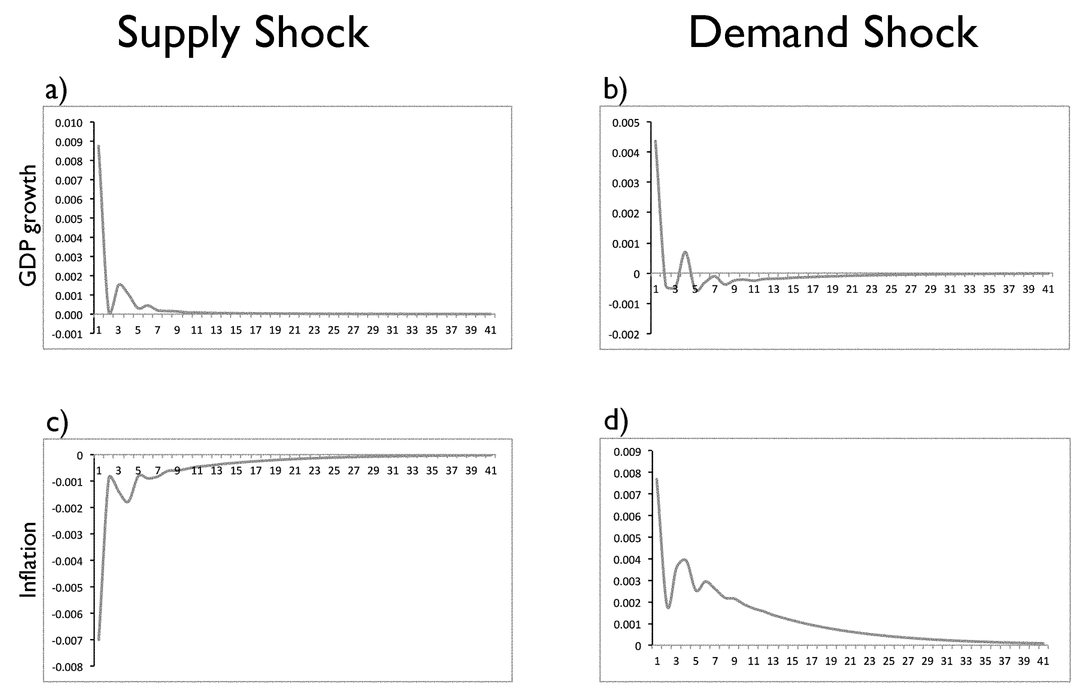

Figure 1

Figure 1 :Structural Supply and Demand Shocks

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

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.

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

Quarterly excess returns					
Percentage fraction	Quarters ahead				
Recession Measure	1	2	3	4	5
OECD	0.0149 (0.0094)	0.0228 (0.011)	0.0279 (0.011)	0.0294 (0.0099)	0.0262 (0.0084)
BBQ	0.0160 (0.012)	0.0115 (0.0098)	0.0227 (0.013)	0.0304 (0.014)	0.0354 (0.013)
Bank of England	0.0208 (0.018)	0.0265 (0.018)	0.0244 (0.017)	0.0257 (0.012)	0.0274 (0.0095)

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 coefficient estimates are shown in panel A. Panel B shows the quarterly expected returns from the investment strategy at each horizon evaluated at the mean values of the shocks $(\beta_i \varepsilon_{kt})$. 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					
Business Cycle Shock	Quarters ahead				
A. Estimates	1	2	3	4	5
Supply	0.0169 (0.52)	−0.652 (0.60)	−1.207 (0.67)	−0.904 (0.42)	−1.02 (0.30)
Demand	0.0169 (0.50)	0.419 (0.51)	−0.191 (0.32)	−0.295 (0.36)	−0.276 (0.29)
Regression standard error	0.0510	0.0507	0.0502	0.0509	0.0505
B. Expected Returns					
Neg Supply	−0.00017	0.00639	0.0118	0.00885	0.00999
Neg Demand	0.00018	0.00436	−0.00199	−0.00307	−0.00287

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

The table shows the results of estimating the equation $r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i \varepsilon_{kt} + \epsilon_{it}$, $i = 1, ..5$. for shocks ε_{kt}, $k = s^-, s^+, d^-, d^+$. 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 coefficient estimates are shown in panel A. Panel B shows the quarterly expected returns from the investment strategy at each horizon evaluated at the mean values of the shocks ($\beta_i \varepsilon_{kt}$). 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					
Business Cycle Shock	Quarters ahead				
A. Estimates	1	2	3	4	5
Negative Supply	0.0884	−1.060	−1.551	−0.941	−0.725
	(1.04)	(0.64)	(0.75)	(0.85)	(0.73)
Positive Supply	−0.0478	−0.351	−0.899	−0.791	−1.110
	(0.83)	(1.18)	(1.17)	(0.46)	(0.52)
Negative Demand	0.728	0.533	−0.638	−1.147	−1.672
	(1.2)	(1.2)	(0.54)	(0.51)	(0.78)
Positive Demand	0.560	0.209	0.106	0.439	1.022
	(1.1)	(0.86)	(0.55)	(0.68)	(0.64)
Regression standard error	0.0513	0.0509	0.0502	0.0506	0.0498
B. Expected Returns					
Negative Supply	-0.00052	0.00623	0.00912	0.00553	0.00426
Positive Supply	−0.00030	−0.00217	−0.00556	−0.00489	−0.00687
Negative Demand	−0.00438	−0.00321	0.00384	0.00691	0.01007
Positive Demand	0.00376	0.00140	0.00071	0.00295	0.00686

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

The table shows the results of estimating equation $r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i D_t . \varepsilon_{kt} + \epsilon_{it}$, $i = 1, ..5.$ for shocks ε_{kt}, $k = s, d$ and the business cycle indicator variable D_t computed by the OECD. 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 coefficient estimates are shown in panel A. Panel B shows the quarterly expected returns from the investment strategy at each horizon evaluated at the mean values of the shocks $(\beta_i \varepsilon_{kt})$. The stock market return index is the total return index for the UK market provided by Datastream The risk-free rate ofinterest 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					
Business Cycle Shock	Quarters ahead				
A. Estimates	1	2	3	4	5
Recession Supply	0.869 (0.96)	−0.0681 (0.66)	−1.066 (0.56)	−1.036 (0.56)	−1.484 (0.51)
Expansion Supply	−0.695 (0.65)	−1.106 (0.95)	−1.297 (1.02)	−0.742 (0.42)	−0.602 (0.39)
Recession Demand	0.899 (0.68)	0.737 (0.54)	−0.0415 (0.33)	−0.139 (0.44)	−0.299 (0.30)
Expansion Demand	0.540 (0.99)	0.142 (1.06)	−0.377 (0.54)	−0.606 (0.70)	−0.432 (0.84)
Regression standard error	0.0508	0.0507	0.0504	0.0509	0.0505
B. Expected Returns					
Recession Supply	−0.00583	0.00046	0.00716	0.00696	0.00996
Expansion Supply	−0.00468	−0.00744	−0.00873	−0.00499	−0.00405
Recession Demand	0.00724	0.00593	−0.00033	−0.00112	−0.00241
Expansion Demand	−0.00350	−0.00092	0.00244	0.00393	0.00280

Table 6: The Impact on Excess Equity Returns of Positive and Negative Business Cycle Shocks

The table shows the results of estimating equation $r^m_{t+i} - r^f_{t+i} = \alpha_i + \beta_i D_t.\varepsilon_{kt} + \epsilon_{it}$, $i = 1, ..5$. for shocks ε_{kt}, $k = s^-, s^+, d^-, d^+$ and the business cycle indicator variable D_t computed by the OECD. 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 coefficient estimates are shown in panel A. Panel B shows the quarterly expected returns from the investment strategy at each horizon evaluated at the mean values of the shocks ($\beta_i \varepsilon_{kt}$). 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

Business Cycle Shock	Quarters ahead				
A. Estimates	1	2	3	4	5
Recession Negative Supply	−0.163 (0.92)	−1.176 (0.58)	−1.718 (0.78)	−1.330 (0.89)	−1.656 (0.76)
Expansion Positive Supply	−0.861 (0.79)	−1.193 (1.14)	−1.301 (1.11)	−0.635 (0.40)	−0.702 (0.52)
Recession Negative Demand	0.146 (0.72)	0.176 (0.65)	−0.953 (0.61)	−1.532 (0.53)	−1, 571 (0.49)
Expansion Positive Demand	−1.010 (1.06)	−1.755 (1.07)	−1.312 (1.77)	−1.777 (1.91)	0.619 (0.96)
Regression standard error	0.0512	0.0498	0.0491	0.0498	0.0500
B. Expected Returns					
Negative Supply	0.00094	0.00678	0.00991	0.00767	0.00955
Positive Supply	−0.00514	−0.00712	−0.00777	−0.00379	−0.00419
Negative Demand	−0.00061	−0.00073	0.00397	0.00639	0.00655
Positive Demand	−0.00337	−0.00585	−0.00438	−0.00593	0.00207

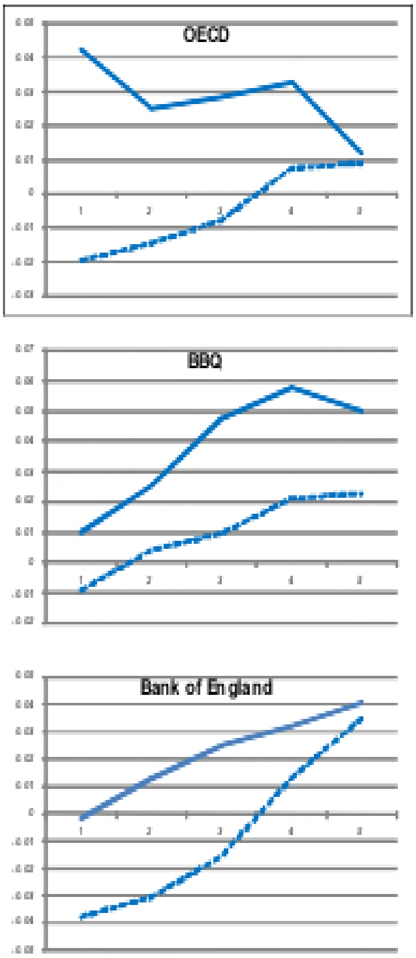

Figure 2

Figure 2: 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 1956 Q1 - 2008 Q4