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When and Why Do Stock and Bond Markets Predict Economic Growth?

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Abstract

We consider whether major financial variables predict key macroeconomic growth series. Full sample results suggest that aggregate stock returns and the 10-year minus 3-month term structure exhibit a positive and significant predictive effect on subsequent output, consumption and investment growth. Additionally, the change in the 3-month Treasury bill has predictive power for output and investment growth. Sub-sample analysis reveals that while the term structure exhibits relatively constant predictive power, that arising from stock returns largely occurs only during the great moderation period, whereas predictability from the change in the short-term rate largely arises in the period following the financial crisis. Results also reveal similarity in the predictive relations for output growth and investment growth but less so for consumption growth. Extending the analysis to include commodity, housing and the corporate bond markets, full sample results reveal limited additional predictive ability, with the REIT returns providing positive predictive power for output and investment growth over a one-quarter horizon and the default return doing likewise at the four-quarter horizon. Sub-sample results, however, reveal a change in the sign of the predictive coefficient around the dotcom bubble and crash period. As leading indicator measures include financial variables, these results, suggesting that the predictive relation is time-varying, are key for policy-makers.

Keywords: Stock Returns, Term Structure, Interest Rates, GDP Growth, Consumption, Investment
JEL Codes: C22, E44, G12

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1. Introduction.

The movement of financial markets should predict subsequent macroeconomic conditions. Financial markets act as a window to future economic activity as their prices depend upon investor expectations of future economic performance and risk. As financial markets move quicker than real markets, we should observe a (Granger) causal relation from the former to the latter. Moreover, movements in asset prices can directly affect the economy through its impact on household consumption and firm investment decisions.[1] Much of the cognisant research focuses on the predictive power of stock and government bond markets for subsequent economic growth and despite the theoretical appeal, supportive empirical evidence is mixed.[2] Understanding the mixed nature of the results and knowledge of such a predictive relation is important for policy-makers, as financial markets can act as a leading indicator and thus an early warning for subsequent economic risks.[3]

The last twenty years have witnessed notable extremes within financial markets. In the stock market, this includes the market highs of the dotcom bubble and late 2010s boom to the lows of the dotcom crash and financial crisis. In the bond market, we have seen the secular decline in interest rates from the mid-1980s highs, including the more recent period of quantitative easing, which targets long-rates, and very low policy rates, which influence short-rates. Across other financial markets, we have seen the dramatic rise of commodity prices in the 2000s, notably in oil and industrial metals, and in gold during the early 2010s, with subsequent declines in each of these markets. House prices also saw a rapid rise in the 2000s leading up to the financial crisis, with a similar rise in the mid-2010s. Such movements will

[1] The question of whether bond and stock markets exhibit predictive power for subsequent output activity has a long history in empirical research (e.g., Harvey 1989, 1991; Estrella and Hardouvelis, 1991; Estrella and Mishkin, 1998) and is reviewed in the work of Stock and Watson (2003) and Wheelock and Wohar (2009).
[2] Stock and Watson (2003) highlight that results vary over countries and time.
[3] For example, The Conference Board Leading Economic Index uses both a term structure and stock market variable in its construction, while the Federal Reserve Bank of Philadelphia leading indicator includes the term structure.

raise the question of stability in any predictive relation. Notably, Chinn and Kucko (2015) argue that predictive power is enhanced with increased economic volatility, while Kuosmanen and Vataja (2019) argue that forecast power is linked to turbulent economic conditions. This lends towards the view that the mixed nature of existing empirical results arises from temporal variation in the strength of the predictive relation.

The ability of the bond market to predict future economic activity is captured by changes in short-term interest rates, which are linked to monetary policy and the shape of the term structure. The term structure of interest rates between long and short dated government debt represents investor views on how current policy will affect future economic activity. A steepening of the yield curve will indicate that investors expect future output growth and inflation to rise, while a flat or negative slope is synonymous with recessionary expectations. Evidence in favour of the term structure providing predictive content for future output growth is provided by Estrella and Hardouvelis (1991), Harvey (1997), Estrella and Mishkin (1998) and Lange (2018). Of interest, Stock and Watson (2003) note that much of the literature argues the term structure exhibits greater predictability than the change in the short rate, although the evidence is not unanimous, while Evgenidis et al. (2020) provide a review of the literature.

The predictive power of the stock market for future economic activity arises from our view that stock returns represent movements in investor expectations regarding the discounted stream of future earnings. Where investors expect subsequent economic activity to increase, this will result in higher expected earnings and a lower expected discount rate (risk premium). Thus, a rise in current returns can signal a future economic expansion. While, early evidence (e.g., Fischer and Merton, 1984; Fama, 1990; Schwert, 1990) often finds supportive evidence for a causal relation from stock returns to output growth, mixed evidence is also reported. Notably, both Stock and Watson (1990) and Binswanger (2000) suggest the potential for the predictive relation to breakdown. Notwithstanding this, Mauro (2003) and Henry et al. (2004)

provide more recent supportive evidence.

The above evidence suggests that both bond and stock markets may exhibit predictive power for subsequent economic activity. Moreover, while movements in interest rates and stock returns depend on investor expectations of future economic performance, the nature of the two instruments is different. Bonds are a claim on a nominal income stream and thus their movements depend on changes to inflationary expectations, while stocks represent a claim on a real income stream, with movements dependent on expectations of real cash flows and risk. As such, several authors examine the relative predictive power of stocks and bonds for future output growth. For example, Harvey (1989) indicates that the term structure provides stronger predictive power, while the review in Stock and Watson (2003) suggests little predictive power arising from stock returns. In contrast, Kuosmanen et al. (2015) and Kuosmanen and Vataja (2019) argue that the joint predictive power of the two financial variables is greater than their individual power. This again, highlighting the mixed nature of the empirical work.

Furthermore, alternative financial market variables not considered to exhibit predictive power within earlier studies have grown in importance to portfolio managers and may now reflect their expectations of future economic conditions. Specifically, we have seen the financialisation of commodities, in which their relation with stocks has strengthened over time (see, for example, Falkowski, 2011; Tang and Xiong, 2012; Basek and Pavlova, 2016), while Bakshi et al. (2011) sought to examine whether commodities exhibit any predictive power for economic activity.[4] Notably, Hamilton (1996, 2003, 2009) links oil price shocks to the onset of a recession. The housing market is also implicated in the financial crisis (e.g., Acharya and Richardson, 2009), while house prices and home ownership have seen large rises and are likely to exhibit wealth effects that can impact the economy (e.g., Apergis et al., 2015; Guren et al.,

[4] Moreover, several authors examine the links between commodities and stocks (see, for example, Vivian and Wohar, 2012; Creti et al, 2013; Jacobsen et al, 2013; Olson et al, 2014; Black et al, 2014).

2018). In addition, we can consider the corporate bond market, which may exhibit greater sensitivity to perceived economic risk, where a downturn is associated with an increased risk of bankruptcy. Stock and Watson (2003) survey evidence that finds a supportive relation during the first half of the 20th century, but not during the latter half and the relation has received little attention since. However, given the large increase in the size of the corporate bond market, this is an issue worthy of re-examination.[5]

This paper seeks to address, and contribute to the literature, in three broad areas. First, we consider whether stock returns and interest rates exhibit predictive power for output, consumption and investment growth in the US. Notably, we are interested in which market provides stronger evidence of predictive power, and whether any predictive power for output growth is reflected more in equivalent household or firm behaviour. Second, we argue that the mixed existing empirical evidence arises from time variation in the nature of the relations. Therefore, we examine temporal variation in the predictive relation by considering sub-samples that are determined by monetary policy regimes and endogenously through Bai and Perron (1998, 2003a,b) tests. Third, we expand the analysis by considering a further set of financial series that have become more prominent in portfolio holdings over the past twenty years. Again, we consider time-variation in the predictive nature of these additional variables, not least as their importance has arisen in the more recent past.

In preview of the results, we provide confirmatory evidence that both stock returns and the term structure exhibit predictive power for subsequent macroeconomic growth. The change in the short-term rate also exhibits positive predictive power, except for consumption growth. Evidence of time-variation suggests that the term structure exhibits relatively consistent predictive power over the sample period (with an exception around the peak of the dotcom

[5] Information held by SIFMA (Securities Industry and Financial Markets Association) shows a more than quadrupling increase in total corporate bond issuance from the mid-1990s to the mid-2010s.

bubble). In contrast, stock returns exhibit greater predictive power during more stable economic conditions, while the change in short-term rates does so in more turbulent times and notably after the financial crisis. For the alternative variables, there is evidence that REIT returns predict one-period ahead economic growth, and the default return predicts activity four-quarters ahead. However, for all additional series (except the default return) there is a break in the nature of the relation, with the coefficient sign switching from positive to negative after the dotcom period. The results support the use of financial markets in a leading indicator role for economic conditions, but crucially the nature and strength of the relations is prone to change over time, thus, a need to use multiple variables rather than a single series. Notably, interest rates are more prominent as a predictor in a crisis period and stock returns in an expansion.

2. Literature Review and Theoretical Background.

Why do Financial Markets Predict Output Growth?

The underlying logic in understanding why stock and bond markets (and financial markets in general) should exhibit predictive power for subsequent output growth is broadly similar. Movements in asset prices reveal market expectations for future economic conditions. Notably, asset pricing theories suggest that the movement of asset returns varies with investors expected consumption. To smooth consumption, investors will invest in an asset that pays-off in a recessionary period. Thus, investors who expect a future economic downturn are likely to sell stocks and purchase long-term bonds. This reduces current stock returns and long-term yields and, with short-rates also likely to be rising prior to a downturn, a narrowing of the term spread. Falling stock returns will also exhibit a negative wealth effect on households leading to lower consumption,[6] while a lower market value can restrict firms access to capital, reducing investment. Rising short-term rates will increase debt repayments for both households and

[6] See, for example, Bosworth (1975) and Hall (1978).

firms and again, lead to lower consumption and investment. In contrast, with expectations of future economic growth, investors will purchase stock, increasing the current return. This will result in both a positive wealth effect for households and greater access to capital for firms, who will expand investment plans, raising the equilibrium rate of return on long-term debt. Short-term rates, and thus current debt repayments, are also likely to fall prior to an expansion, with a steepening of the term structure.

Empirical Evidence

Support for the view that interest rate movements predict subsequent economic activity is provided by several authors. With respect to US output growth, evidence that short-term interest rates provide predictive power includes that of Sims (1980), while Bernanke and Blinder (1992), Harvey (1997) and Hamilton and Kim (2002) provide supportive predictive evidence for the term structure. More recently, Engstrom and Sharpe (2019), while also supporting the predictive power of interest rate spreads, argue that a near term spread is preferred to a longer one (typically a 10-year Treasury bond). Considering a wider set of markets, supportive evidence is provided by Plosser and Rouwenhorst (1994), Estrella and Mishkin (1997) and Ahrens (2002). Hvozdenska (2015) focuses on Scandinavian countries and reports evidence in favour of the term structure as a predictor of output, while Lange (2018) does likewise for Canada. In addition to predictive regressions, several researchers, including Deuker (1997), Estrella and Mishkin (1998) and Lange (2018) report supportive evidence of the term structure in predicting recessionary periods. Beyond output growth, Harvey (1988) reports predictive power of the term structure for US consumption growth, while Estrella and Hardouvelis (1991) do likewise for consumption and investment (and output) growth.

Notwithstanding the above research, contrary evidence exists. Ang et al. (2006) and Rudebusch et al. (2007) note that the predictive coefficient is not statistically significant and may be of the incorrect sign. Further, several researchers argue that the strength of predictability declines over time. Haubrich and Dombrosky (1996) argue that predictive power of the term structure weakens during the 1980s and 1990s. Feroli (2004) argues that the strength of term structure predictive power varies with the behaviour of the monetary policy authorities. Specifically, linking predictive power with how strongly monetary policy targets inflation and the output gap compared to interest rate smoothing.

Regarding stock returns, early evidence, including that of Fischer and Merton (1984), Fama (1990) and Schwert (1990), support a causal relation from stock returns to output growth. Equally, more recent evidence is supportive, for example, Mauro (2003), Henry et al. (2004), McMillan and Wohar (2012), Croux and Reusens (2013) and Tsagkanos and Siriopoulos (2015). However, as with the literature on the predictive ability of interest rates, there is contrary evidence to stock markets predicting economic conditions. Barro (1990) examines the stock market's ability to predict recessions, and while reporting supportive results also notes the tendency to overpredict recessions. Stock and Watson (1990) and Binswanger (2000) both argue that the nature of the relation between stock returns and output growth varies over time, with Binswanger suggesting that the relation has broken down. The weaker predictive relation from stock returns is argued to occur due to confounding reasons for an increase in stock returns that has differing implications for subsequent output. A rise in stock returns can occur due to an increase in expected future cash flows (and an expanding economy) or an increase in expected future risk premium (and contracting economy).[7]

In regard of empirical evidence for consumption and investment predictability arising from the stock market, much initial work focusses on the permanent income hypothesis of Friedman (1957) in which shocks to wealth have only a low impact on consumption as effects

[7] Gregoriou et al. (2009) argue that the stock market response to falling interest rates changed with the financial crisis.

are smoothed over a lifetime. In addition, a line of research links movements in stock returns and consumption growth, whereby expectations of future economic conditions can lead to rising consumption growth being consistent with a higher current stock return (due to higher expected future cash flow leading to a current stock price rise) or a lower current stock return (due to a higher expected future discount rate leading to a current stock price fall). Theoretical work includes that of Campbell (2003) and Bansal and Yaron (2004), while some empirical evidence is provided by McMillan (2013). For firms, a rise in stock value can lead to a fall in the cost of equity capital and a rise in investment. Based on Tobin's Q, a rise in market value should also lead to higher investment. Notwithstanding, empirical evidence is mixed, see, for example, Caballero (1999), Bond and Cummins (2001) and Bond et al. (2004).

The above strands of literature examine the ability of bond and stock markets to predict economic growth separately. A line of work considers the comparative ability of the two markets. Within this research, interest rates tend to find favour over stock returns as exhibiting greater predictive ability. Harvey (1989) argues that the term structure can predict over thirty percent of the movement in US output growth, while stock returns predict less than five percent, with no predictive power in certain time periods. Likewise, Stock and Watson (1990) for the US and Hu (1993) for the G7, argue that the term structure exhibits superior predictive ability for subsequent economic activity. Kuosmanen and Vataja (2019) examine the G7 markets and argue that the predictive ability of the term structure, short-term interest rates and stock returns is time-varying and has re-emerged during the 2000s. Moreover, they link predictability to unsettled economic conditions, a view also espoused by Chinn and Kucko (2015). Kuosmanen and Vataja (2019) note that while interest rates typically perform better than stock returns on an individual basis, better predictive power is obtained by including all three variables.

Following the dotcom crash, both stocks and bonds attracted low yields. This encouraged investors to look at alternative investment opportunities. We consider three asset classes that have come to greater prominence over the last twenty years. The low yields on stock and bonds in the early 2000s led, most notably, to the financialisation of commodities (see, for example, Falkowski, 2011; Tang and Xiong, 2012). Subsequently, research examines the links between stocks and commodities (e.g., Vivian and Wohar, 2012; Black et al., 2014). However, little work examines the ability of commodities, as an asset class, to predict output growth, although work on individual commodities, notably, oil, has been undertaken.[8] In a sequence of papers, Hamilton (1996, 2003, 2009) notes that an oil price spike precedes US recessions. As the demand for commodities and hence their price, is driven in part by the strength of economic conditions, it would seem reasonable to consider that commodity prices will exhibit predictive power for output growth. As with stocks, through a wealth effect, the housing market can affect economic growth. A rising value of housing stock will allow households greater access to credit, increasing consumption. A series of papers highlight the wealth effect on consumption of house prices (e.g., Campbell and Coco, 2007; Attanasio et al., 2011; Carroll et al., 2011). Equally, however, a fall in house prices can lead an economic downturn, and is implicated in the financial crisis (e.g., Acharya and Richardson, 2009). The corporate bond market has also grown in importance and as with government bonds, we would expect the yield to change in response to movements in economic conditions. Notably, an increase in expected economic risk will lead to an increase in the yield attached to the bonds of companies regarded as riskier. Thus, an increase in the spread between riskier and safer assets can indicate worsening economic conditions (see, for example, Gertler and Lown, 1999).

Overall, the above literature presents sound theoretical reasons for why movements in financial markets can predict subsequent economic activity. However, the empirical evidence is mixed. This paper seeks to examine whether interest rates and stock returns do exhibit predictive power for GDP, consumption and investment growth. As the literature indicates the

[8] As an exception to this, see Ge and Tang (2020)

strength any predictability may vary over time, we include financial assets whose prominence has grown of late and the nature of time-variation across all financial variables.

3. Empirical Modelling.

To examine whether financial markets have any explanatory power for subsequent movements in economic growth, we use the predictive equation given by:

(1) $$\Delta y_{t+h} = \alpha + \beta_1 \, TS_t + \beta_2 \, \Delta IR_t + \beta_3 \, R_t + \rho \Delta y_{t-h} + \varepsilon_{t+h}$$

where Δy_t refers to the change in GDP, consumption or investment measured over time horizon h, TS_t refers to the term structure, ΔIR_t to the change in short-term interest rates, R_t to stock returns and ε_t is a white noise error term. We also include a corresponding autoregressive term for the macroeconomic growth series measured over the same time horizon as future growth. In applying equation (1), we consider time horizons h=1 (one quarter) and h=4 (one year).

As noted above, there is evidence that the nature and strength of predictability varies over time, and that this variability may depend on regimes of behaviour linked to monetary policy. Therefore, we consider sub-sample time-variation both where the sample break dates are imposed around recognised shifts in monetary policy regimes and where breaks are empirically determined.

To consider sub-sample variation in the predictive relation, we first define monetary policy regimes. Here, we follow Gavin (2018) who defines four regimes over our sample. The period from the beginning of the sample until 1979 is defined as one of high inflation where policy makers target business cycle stabilisation. The period from 1979 to 1982 covers the Volker reforms designed to bring inflation down and establish price stability credibility for the Federal Reserve. Third, the period from 1982 to 2008 is regarded as the great moderation where interest rate targeting ensured price stability and continued economic growth. Fourth, the period from 2008 until 2015, following the financial crisis, is regarded as a zero interest rate policy regime, with the Federal funds rate targeted in the 0% – 0.25% range and the establishment of quantitative easing.[9] Second, we estimate the breakpoints using the Bai and Perron (BP; 1998, 2003a,b) test for multiple breaks in the parameter values. The BP test is well-known and so to briefly state, the test sequentially examines the parameter values for breaks, starting from the null hypothesis of no breaks versus a single break using a F-test approach. We allow for up to five breaks in each regression and use a trimming value of 15%, this means that at least 15% of the observations must lie between each break.

While the established literature focusses on stock returns and government bonds, there is potential for other variables, that have come to greater prominence in portfolio building, to also exhibit predictive power for macroeconomic conditions. Therefore, we extend equation (1) to include these alternative variables and reconsider the sub-sample analysis. As noted above, we consider the ability of the commodity, housing and corporate bond markets to provide predictive power for economic growth. Primarily, we would expect such variables to only exhibit predictive power later in the sample period examined as they have become more important over time in portfolio management.

4. Data.

We obtain quarterly data on GDP, consumption and investment growth as the dependent variables from the Federal Reserve over the time period from 1975Q1 to 2017Q4. The predictor variables are the S&P500 stock index return, the difference between the 10-year Treasury bond and the 3-month Treasury bill and the first difference of the 3-month Treasury bill. The stock return series is obtained from Datastream and the interest rate series from the Federal Reserve. While, these three series represent the main predictor variables, we also consider commodity,

[9] Post 2015 is a period of monetary policy normalisation, but the available sample is too short for reliable inference to be made.

housing and corporate bond markets. For the commodity market, we use the S&P GSCI, which provides an overview of the commodity market, we also consider results for oil, gold and industrial metals separately.[10] For the housing market, we use a real estate investment trust (REIT), this allows investors to capture movements in the (relatively illiquid) housing market. For the corporate bond market, we use the default yield (defined as the difference between the yield on BAA and AAA rated corporate bonds) and the default return (defined as the difference between the return on long-term corporate and government bonds). The additional data is obtained from Datastream and the Federal Reserve, except the corporate bond data, which is obtained from the website of Amit Goyal.[11]

All the predictor variables data are presented in standardised form (i.e., demeaned and divided by the standard deviation), this allows a direct comparison of the estimated coefficients in the predictive regressions. Summary statistics are provided in Table 1, with the corresponding time-series plots in Figure 1. Notable within the data, we can see heightened economic risk in the late 1970s and early 1980s with falling macroeconomic growth, generally negative stock returns, falling policy rates and a higher default yield. This period is associated with the second OPEC oil price shock and a global recession. A downturn in economic growth is also observed in 1990 and this is also reflected in lower stock returns (both the general market and REIT), a fall in the short-term interest rates and an increase in the default yield. It is also noticeable that the term structure inverts in 1989. Similar effects are noted with the recessions of the early 2000s, caused by the dotcom crash, and between 2007-2009, arising from the financial crisis. In both cases we can see a fall in output, consumption and investment growth (although consumption growth does not turn negative following the dotcom crash), negative stock, commodity and REIT returns, an inverted term structure, a dip in the change in the short-

[10] These additional results are available upon request.
[11] http://www.hec.unil.ch/agoyal/

term rate and an increase in the default yield and return.

5. Predicting Macroeconomic Growth with Stock Returns and Government Bonds.

Table 2 presents the main set of results for equation (1) using stock returns and interest rate variables to predict subsequent output, consumption and investment growth. Examining the results for GDP growth, we can see that at the one-quarter horizon, all variables have a positive and statistically significant predictive relation. The term structure variable has the largest coefficient and highest level of significance, followed by the change in the short-term interest rate and stock returns. At the four-quarter horizon, the coefficient for all predictor variables are again positive and statistically significant. The term structure again exhibits the largest coefficient and strongest statistical significance, with the values for the stock return variable now greater than the change in the short-term interest rate.

These results support the view that financial markets do have predictive power for subsequent economic growth. Moreover, the positive relation indicates that an increase in stock returns, a steepening of the term structure and an upwards change in short-term rates predict an expanding economy. The results for stock returns and the term structure are consistent with theoretical view that higher stock returns result from investor expectations of higher future cash flows and a steepening term structure from higher returns on investments. The positive relation with the change in short-term interest rates is perhaps less expected as higher policy related interest rates are likely to lead to a future downturn, although higher interest rates may reflect policy-makers belief that output is expected to rise in the near term.[12]

Table 2 also presents the results for predicting consumption and investment growth over the one-quarter and four-quarter horizons. Here, we observe a different picture compared

[12] For example, the Bank of England notes that it can take two years for the full effect of monetary policy changes on the economy (www.bankofengland.co.uk/monetarypolicy).

to output growth where we see predictive ability for all variables across all horizons. For consumption growth, at the one-quarter predictive horizon, both stock returns and the term structure exhibit positive predictive power of similar magnitude. However, the coefficient on the change in the short-term interest rate is both negative and statistically insignificant. At the four-quarter horizon, the coefficient on the term structure is positive and significant, while the coefficient on stock returns is positive but only significant at the 10% level. Again, the coefficient on the change in short-term interest rates is not significant. The pattern of coefficient sign and statistical significance for investment growth is similar to that for output growth. At both the one-quarter and four-quarter horizons, all the predictor variables exhibit a positive and significant effect. These results support the view that an increase in consumption and investment growth is predicted by higher stock returns and a steeper term structure (and for investment growth, also by an increase in the short-term interest rate). Moreover, the stronger result for investment growth suggest that the main driver for predictability of output growth arises through the behaviour of firms as opposed to households.

Sub-Sample Results

Table 3 presents the results of the predictive regression in equation (1) estimated over different monetary policy periods as identified in Gavin (2018). The period from the beginning of our sample period until late 1979 is characterised as a high inflation period and is affected by the first oil price shock. Over this period, with a single exception, only the interest rate variables exhibit any predictive power for output, consumption and investment growth. Again, we can see that the pattern of significance for output and investment growth is similar in comparison to that for consumption growth. At the one-quarter horizon, both the term structure and the change in short-term interest rates exhibit positive and significant predictive power for both output and investment growth, while only the term structure has predictive power for consumption growth. At the four-quarter horizon, the term structure exhibits a positive and significant predictive effect for all the macroeconomic growth series, while stock returns now have a positive and significant predictive effect for investment growth.

In the period between 1979 and 1982, which is a period of contraction designed to control inflation, we see that the term structure has a significant and positive predictive effect for both output and consumption growth but not investment growth at both horizons (albeit only at the 10% level for four-quarter GDP growth). Stock returns have a predictive effect for one-quarter output, consumption and investment growth, while the change in short-term interest rates has a significant effect on four-quarter consumption and one-quarter investment growth.[13] Over the relatively longer time period from 1982 to 2008, which covers a period of largely sustained economic growth, known as the great moderation, where monetary policy is designed to ensure price stability, all variables again predict output growth for both time horizons (albeit at the 10% level for one-quarter GDP growth from the term structure). Stock returns exhibit predictive power for consumption growth (and at the 10% level for four-quarter investment growth), while the interest rate variables exhibit predictive power for investment growth (although the term structure also has predictive power at the 10% level for consumption growth). In the post-crisis period from 2009, which is characterised by quantitative easing and near zero policy interest rates, there is very little predictive power. Predictability is largely only observed at four-quarter horizon output (at the 10% level) and investment growth, positively from the term structure and negatively from the change in short-term interest rates. The change in short-term rates also negatively predicts one-quarter GDP growth. Stock returns, which have been on an extended bull run from the end of the financial crisis, exhibit no predictive power.

Taking an overview of the results, we can make the following observations. First, in

[13] Obviously, this period covers only a small number of observations and so the results must be treated with the appropriate caution. This also helps motivate the use of alternate sub-sample period analysis.

the sample there are two periods of heightened economic stress, the period in the late 1970s and following the financial crisis of 2007-2009. In these periods, stock returns exhibit little predictive power for the macroeconomic variables and there is limited predictability for consumption growth. In contrast, there is predictive evidence arising from the interest rate series for output and investment growth. Second, in the latter period there is a negative relation arising from the change in the short-term interest rate for both output and investment growth. This period is marked by falling and then flat interest rates, in contrast to earlier periods in which interest rates exhibit greater fluctuations. This reflects heightened sensitivity to changes in interest rates, with a notably larger coefficient, during this crisis period. Third, stock returns exhibit predictive power for each of the macroeconomic series during the period from 1982 to 2008 that ends with the financial crisis. This period, known as the great moderation, is characterised by an extended era of economic growth and, despite the 1987 and dotcom crash, generally rising stock markets. The period extending from 2009 also saw a rising stock market but is accompanied by very low interest rates and heightened economic uncertainty, which provides an interesting distinction from the earlier time period in terms of stock return predictive power for the macroeconomy. Fourth, the term structure of interest rates provides predictive power for investment and output growth for each of the identified time periods, but that predictive power is much weaken since the financial crisis. Fifth, the pattern of investment growth predictability mirrors more the pattern of output growth predictability suggesting that financial markets ability to predict subsequent economic conditions arises through the behaviour of firms rather than households, although the latter does have an impact during more favourable economic conditions.

Table 4 presents a further set of sub-sample results but uses the Bai and Perron (1998, 2003a,b) structural break tests to identify the sub-samples as opposed to imposing breaks around identified monetary policy regimes. While there is some natural variation in the break dates, there is a noticeable degree of similarity across the two tables. The Bai and Perron procedure identifies a break in the early 1980s, consistent with the monetary policy regimes around the period of high inflation and constrictive monetary policy (high short-term interest rates). The Bai and Perron test also identifies a break associated with the financial crisis period around 2007 or 2008. There is some distinction in the number of breaks between the one-quarter and four-quarter horizons and the different macroeconomic series. For output growth, two breaks (three periods) are identified for both horizons. For consumption and investment growth, again, two breaks (three periods) are identified for one-quarter growth, but for four-quarter growth, four breaks (five periods are identified). The additional periods identified occur in the early 1990s, which is associated with a recession, and the late 1990s, which is associate with the bursting of the dotcom bubble and another recession shortly afterwards.

In considering the results in Table 4, we can draw comparisons with those in Table 3. Of note, for the results that cover the 1970s, there is very little evidence of stock return predictability for the three macroeconomic series over the two time horizons (only four-quarter investment growth exhibits a significant relation). Over this period, we observe that both the interest rate series exhibit a positive and significant relation for output, consumption and investment growth over both horizons (except the change in the short-term interest rate for one-quarter consumption growth). Over the sub-samples that cover the 1980s, 1990s and early 2000s, we see that stock returns do now exhibit predictive power for consumption and output growth at both horizons but not investment growth. This pattern is similar to the results reported in Table 3. Over this time period, the term structure also exhibits a degree of predictive power for each of the macroeconomic growth series and, notably, for investment growth over both time horizons. For the post financial crisis time period, we observe predictability for the macroeconomic series arising from the interest rate series but not the stock return series.

Overall, the results in Table 4 are broadly similar in nature to those in Table 3.

Specifically, we observe two key results, first, stock returns only exhibit predictive power for macroeconomic growth during part of the sample and notably the great moderation period. In contrast, there is greater evidence of consistent predictive power arising from the interest rate series and the term structure in particular. Second, the pattern of predictability for investment growth closer reflects that of for output growth than occurs for consumption growth. This suggests that the predictability for output growth arises through the behaviour of firms. That is, for example, investors expecting an increase in firm investment plans leads to a rise in both the bond and stock markets, which in turn (Granger) cause economic growth.

Discussion

The full set of results presented above suggest an interesting dichotomy both in terms of the predictive power of stock and bond markets respectively over time and in terms of the pattern of predictability across output, consumption and investment growth.

Considering the first dichotomy, the full sample results in Table 2 suggest that both stock and bond markets have predictive power for the three macroeconomic growth series at the two time horizons considered. However, when we examine sub-sample results (Tables 3 and 4), determined by either by economic (monetary policy) regimes or Bai and Perron tests, we see a distinction in predictive power. Notably, these exercises indicate that stock return predictability largely arises only during the great moderation period, which is characterised by sustained economic growth. In contrast, for the interest rate series, while there is greater evidence of term structure predictability throughout the sample, it is strongest in the periods and regimes characterised by greater economic risk. Notably, and especially from Table 4, we see significant term structure predictability after the mid-1970s oil price shock and after the financial crisis. We also see the change in the short-term interest rate exhibiting greater predictive power in the 1970s and post-financial crisis. Thus, we see a (complementary) distinction in which stock returns are more likely to exhibit predictive power for positive economic growth and expansionary phases, while interest rates are more likely to exhibit predictive power with greater economic uncertainty and contractionary phases.

Regarding the second dichotomy, we see a distinction in the pattern of predictability for consumption growth and investment growth and how it relates to output growth. Again, the full sample results reveal little nuance as both stock returns and the term structure of interest rates exhibit predictive power for all macroeconomic growth series. Although, there is some distinction for the change in the short-term interest rate, which exhibits no predictive power for consumption growth. However, as we consider the sub-sample results, we observe a difference in the pattern of predictability. Notably, the predictability arising from the financial market series for output growth is reflected in broadly the same pattern of predictability for investment growth. For example, in Table 3 where we define sub-samples according to monetary policy regime, the predictability in output growth is exactly mirrored by that in investment growth in the first sub-sample. In the second sub-sample, while the term structure predictability is not matched in investment and output growth it is for stock returns. While in the third and fourth sub-samples the pattern of predictability in output growth is match in investment growth predictability, bar one coefficient across the two horizons. Although there is some correspondence between predictability in output growth and consumption growth, especially in the sample prior to the financial crisis, consumption growth predictability matches less with the predictability in output growth compared to investment growth. These results imply that the factors leading to the predictability of financial markets for output growth also lead to the predictability of financial markets for investment growth.

Predictive Power – Do Stock Returns and the Change in the T-Bill Help?

To further examine the time-varying predictive power of financial markets for the macroeconomy, we undertake a series of 10-year rolling regressions and consider the performance of the different model specifications. The above results suggest that the term structure exhibits the greatest amount of predictive power for macroeconomic growth and thus raises the question as to whether adding stock returns and the change in the short-term rate improves overall predictive power. Therefore, we estimate the predictive regression in equation (1) including only the term structure as the predictor and this serves as a baseline model. We then add, alternatively, stock returns and the change in the short-term rate and then both variables, with these three serving as alternative models. For each of these four models we obtain the AIC, BIC and adjusted R-squared value at each step of the rolling iteration.

Figure 2 presents the values of the AIC, BIC and Adjusted R-squared specification measures for the alternative models against the baseline model. We construct the figures such that a positive value indicates that the alternative model outperforms the baseline model according to each measure. The results present an interesting pattern in respect of the relative predictive power of the different financial series. Examining the results for including stock returns in the regression (the first column of results), we can see that the three specification measures indicate that including stock returns in the regression, improves the model fit over the term structure during the 1980s, the late 1990s and early 2000s and in the 2010s. In contrast, adding stock returns leads to a poorer model fit during the early and mid-1990s and the later 2000s. Thus, stock returns aid predictive power for output growth over differing sample periods, but not consistently across the full sample. However, we can also observe that the numerical values of the specification measures are relatively small, suggesting that any gain (or loss) through including stock returns in the predictive regression is relatively small.

Turning to examine the results where we include the change in the short-term interest rate in the predictive regression. Here, we can see that during the 1980s the additional variable improves the model fit across the AIC, BIC and adjusted R-squared values. However, throughout the 1990s and until the second half of the 2000s, the term structure only regression outperforms this alternative regression. From the late 2000s onwards, the expanded model again performs better. What is noticeable in comparison to the results that include the stock return series, is that the numerical gain is greater when including the change in the short-term rate. Further, in comparing the figures, there is an indication that including stock returns improves predictive power over different time periods compared to including the change in the short-term interest rate. Notably, the inclusion of stock returns improves predictive power during the late 1990s and early 2000s when the inclusion of the short-term interest rate results in a poorer fit. Conversely, during the late 2000s, when stock returns do not contribute to predictive power, short-term interest rates do. There are also periods of time (in the 1980s and 2010s) when both variables help improve predictive power.

The final column of results compares the regression that includes all three predictor variables against the term structure only regression. The pattern of results here largely follows that seen when including the short-term rate. During the 1980s the inclusion of the additional variables improves model performance. Likewise, from the late 2000s onwards, the additional variables lead to improved predictive power. In the late 1990s and early 2000s, there is some improvement in predictive power (arising from the stock returns series). However, it is a modest improvement and on the BIC measure, remains negative, indicating no improvement.[14]

These results support the view that the three financial variables exhibit different degrees of predictive power over the sample period. Based on the regression coefficients, the accompanying significance tests and the specification measures, stock returns improve predictive power during the 1980s, late 1990s and early 2000s and 2010s. However, the gain is marginal. The change in the short-term interest rate improves predictive power during the

[14] This contrasts with the small positive value when only stock returns are added such that on this measure the negative impact of the model fit from including short-term rates outweighs the positive gain from adding stock returns.

1980s and 2010s but otherwise does not aid predictive power. However, in contrast to the results for stock returns, the gain is noticeably larger. Thus, we can see a consistent view that while the term structure exhibits relatively consistent predictive power over the sample period, stock returns exhibit predictive power during periods of relative economic prosperity, and short-term interest rates exhibit predictive power during periods of heightened risk.[15]

6. Alternative Financial Market Predictors for Macroeconomic Growth

The above analysis uses three financial predictor variables, stock returns, the term structure and the change in the short-term interest rate. The results reveal time-variation within the predictive power of these variables. This also raises the issue of whether other financial variables may equally exhibit time-varying predictive power. Perhaps most notably, we have seen the rise of corporate bonds, commodities and housing as major asset classes over the recent past. Moreover, each of these asset classes have identifiable links to the macroeconomy.

Therefore, we re-consider equation (1) adding additional variables to capture these asset classes, with the results reported in Table 5. These results confirm those reported above regarding the predictive ability of stock returns and the term structure for each of the three macroeconomic variables across the two horizons. As with Table 2, the change in the short-term interest rate exhibits predictive power for GDP and investment growth but not for consumption growth. Of the additional variables, we observe some predictive power arising from the REIT variable as well as the corporate bond series. The REIT series exhibits predictive power for each of the macroeconomic variables at the one-quarter horizon (albeit only at the 10% level for consumption growth) but not at the annual horizon (except at the 10% level for investment growth). The results for the corporate bond series present an interesting picture.

[15] Equivalent results for consumption and investment growth are available and reveal a broadly similar pattern of results. Namely, that stock returns exhibit a greater contribution to predictive power during the later 1990s, early 2000s and later 2010s, while the change in the short-term interest rate exhibits greater predictive power in the post-crisis period as well as the mid-1980s.

The default yield exhibits predictive power for one-quarter output and investment growth, while the default return series exhibits predictive power for four-quarter output and investment growth. Neither series exhibits predictive power for consumption growth. The commodity return series does not exhibit predictive power for any of the macroeconomic series.[16]

However, as discussed above, the lack of significance across the three macroeconomic series and two horizons from these additional predictor series is unsurprising as their inclusion in financial portfolios is relatively recent. Thus, again, we consider the time-varying nature of the predictive relations, using first the Bai-Perron structural break test procedure as above and second, a 10-year window rolling regression approach.

The results of the Bai-Perron structural break tests are reported in Table 6. Within this table, to avoid presenting a large number of coefficient and significance values, we only include the variables that are statistically significant, the sign of the coefficient and the significance level. Focussing just on the additional variables, we observe that the sign and significance of the coefficients change over time, which may explain the limited significance reported in Table 5 for the full sample period. Looking at the results that cover the period over the latter 1970s and the 1980s, we see at the one-quarter horizon, the REIT return exhibits positive predictive power for each of the three macroeconomic series. The default yield exhibits negative predictive power for one-quarter output growth but only at the 10% significance level. For the four-quarter horizon, the default yield (consumption) and the default return (output and investment) exhibit positive predictive power. The REIT return also exhibits positive predictive power for four-quarter output and investment growth over the latter half of the 1980s. During the 1990s, we see negative predictive power from the default yield for one-quarter consumption and investment growth, with also negative predictive power from the default yield and positive

[16] As noted above, we also consider the individual commodities of aluminium, copper, oil and gold. However, no systematic relations are found, with only gold reporting any significant effect for consumption (and marginally oil) and investment growth.

predictive power from the default return for the latter macroeconomic series. At the four-quarter horizon, there is some positive predictive power for output and investment growth from REIT returns and for consumption growth from commodities and the default yield (both negative). In the pre-crisis 2000s, we see negative predictive power for consumption growth from REIT (both horizons) and from commodities (four-quarter horizon). The default return exhibits positive predictive power for one-quarter output growth. In the post-crisis period, the default return exhibits negative predictive power for output growth over both horizons and positive predictive power for consumption growth over both horizons and four-quarter investment growth. The default yield exhibits negative predictive power for output and consumption growth over both horizons. The REIT returns exhibit positive predictive power for one-quarter output growth but negative predictive power for one-quarter consumption growth. There is also evidence that commodities exhibit negative predictive power for consumption growth.

These results reveal that the nature of the relations vary over time, not only in terms of statistical significance but also in terms of the sign of the predictive coefficient. Notably, we see the REIT return exhibit a positive predictive relation for output growth in the 1970s and 1980s, a negative relation in the 1990s and a positive relation again post-crisis. We see similar sign changes in coefficient sign for the default return for output and investment growth and REIT returns for consumption growth. Of further interest, we also see that commodities only exhibit predictive power for consumption growth.

Plots for the rolling coefficient and significance values for four-quarter output growth are reported in Figure 3. Taking the plots by each predictive series, we can see that for stock returns, the coefficient is positive and borderline significant for most of the sample period. Notably, however, around the financial crisis period, we can see that the coefficient turns negative and becomes statistically insignificant. For the term structure, the coefficient is positive and significant throughout the sample period, with the exception of the period from the late 1990s to the early 2000s and associated with the dotcom bubble. This is also the period where stock returns exhibit a higher coefficient value and greater statistical significance. The change in the short-term interest rate exhibits a positive and significant value during the 1980s and 1990s before turning negative and insignificant during the dotcom period. From the financial crisis period onwards, we see the coefficient increase both in value and statistical significance. These results for stock returns, the term structure and the change in the short-term interest rates confirm those above that the nature of the predictive power varies, with stock returns exhibiting most predictive power during the great moderation period, the term structure showing more consistent predictive ability and short-term interest rates increasing predictive power in the post-crisis period.

Considering the additional variables, we can observe that the coefficient on commodity returns switches from being positive to negative at the start of the dotcom bubble period and reflects the changing nature of commodities within a portfolio setting. Nonetheless, throughout the period, the rolling coefficient is statistically insignificant except for a small window at the start of the dotcom crash and again during the financial crisis. This suggests that a significant commodity return effect occurs only with a crisis period. For the REIT returns, similar to commodities, these exhibit a positive coefficient prior to the dotcom period and a negative coefficient afterwards. In contrast to commodities, the predictive coefficient is largely significant (albeit perhaps marginally), except for the dotcom crash and the recovery period. For the two series that capture the corporate bond market, again, we see changes in the nature of the coefficients over time. From the beginning of the sample, both the default yield and default return exhibit a positive coefficient value, which is insignificant for the former and marginally significant for the latter. During the second half of the 1990s, at the start of the dotcom bubble, both coefficients turn negative, now being significant for the yield (although turning insignificant during the crash period) and insignificant for the return series. For the remainder of the sample, the default yield remains negative, while the default return becomes positive (from around 2000), with both coefficients statistically significant after the start of the financial crisis period.

For the four additional series, we can observe some commonality in the behaviour of the coefficients. Each of the series exhibits a positive coefficient value at the start of the sample period and this changes to negative during the second half of the 1990s (in 2000 for REIT returns). This is a period associated with the start of the dotcom bubble and as well as one of extended economic growth with the economy growing at around 4% per year. This period also saw the coefficient on both government bond interest rate series decline in magnitude and significance, while that on stock returns increased. Following the bursting of the dotcom bubble each of these coefficients remains negative and are borderline statistically significant (after the financial crisis for REIT returns), except for the default return, which is positive and significant. Across all series we can see that the dotcom and financial crisis events perturb the nature of the predictive relation between financial markets and output growth. For stock returns, bond returns (default return) and government bond yields the relation is positive. For the commodity, housing and corporate bond yields, the relation switches from a positive predictive one to a negative one, highlighting a change in investor perceptions of these assets and their relation with the macroeconomy.[17]

7. Summary and Conclusion.

This paper has two broad aims, to consider if and when major financial variables predict key macroeconomic series and to see whether the predictive power for output growth is also seen in consumption or investment growth. The importance of this is in using financial markets as

[17] Similar plots for consumption and investment growth are available upon request.

a leading indicator for subsequent macroeconomic performance. Several leading indicator measures incorporate some financial variables; thus, the results of this research will inform on their usefulness. Furthermore, our understanding of asset price movement is predicated on interrelations with movements in macroeconomic variables, with prices changing according to expectations of future cash flows and risk.

Full sample results suggest that stock returns and the 10-year minus 3-month government debt term structure exhibit a positive and significant predictive effect on subsequent output, consumption and investment growth. In addition, the change in the 3-month Treasury bill also has predictive power for output and investment growth. Sub-sample analysis reveals key distinctions in the nature of the predictive power arising from these three variables. While the term structure exhibits relatively constant predictive power throughout the sample period (except around the peak and bursting of the dotcom bubble), the predictive power arising from stock market returns largely only occurs during the great moderation period of relatively consistent economic growth, whereas for the change in the short-term rate, predictive power largely arises in the period following the financial crisis. The results also reveal commonality in the predictive relations for output growth and investment growth, indicating that the same factors that influence investor expectations and behaviour apply to both these macroeconomic series as opposed to consumption growth.

In extending the analysis, we include alternative predictor variables from financial markets that have grown in importance over the sample period and may now exhibit greater predictive power than the more established series. Full sample results incorporating commodity and REIT returns as well as the default yield and return reveal little additional predictive power. Of note, REIT returns do provide positive predictive power for output and investment growth over a one-quarter horizon, with the default return doing likewise at the four-quarter horizon. Again, sub-sample results reveal differences and notably a change in the nature of the predictive coefficient around the dotcom bubble and crash period.

The results reveal key information that is helpful to policy-makers in using financial markets as a leading indicator for subsequent economic activity. The government debt term structure provides consistent predictive power such that an increase in the yield spread is consistent with a growing economy, while a shrinking spread indicates poorer future economic conditions. Stock market returns suggest that higher returns indicate an expanding economy, although in times of crisis, it is less clear that stock returns provide much helpful information. In contrast, the change in the short-term interest rate does provide such information but less so during more benign economic conditions. Additional variables reveal that a rise in commodity and REIT returns, the corporate default yield and a fall in the corporate default return indicate weakening future economic conditions. However, the nature of these relations is more unstable and requires further work to ensure they provide reliable signals for economic conditions.

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Table 1. Summary Statistics

	Mean	Std Dev	Min	Max	Skew	Kurt
GDP Growth	2.751	2.052	-4.147	8.204	-0.640	4.426
Cons Growth	2.962	1.691	-2.319	6.513	-0.587	3.450
Inv Growth	3.940	9.364	-30.385	33.067	-0.596	5.215
Stock Returns	0.054	0.952	-3.566	2.442	-0.739	4.185
Term Structure	0.223	1.006	-3.766	2.881	-0.869	4.646
Interest Rate Ch.	-0.037	1.171	-8.627	5.538	-2.110	23.875
Commod Returns	-0.001	1.000	-5.676	3.778	-1.126	9.465
REIT	0.001	1.000	-5.536	2.280	-1.480	10.656
Default Yield	0.197	1.038	-1.041	5.268	1.763	7.270
Default Return	0.004	1.069	-4.914	6.696	0.432	14.373
Notes: The macroeconomic series are presented as annual growth values.						

Table 2. Predictive Regression Results

	Output Growth		Consumption Growth		Investment Growth	
	One-Period	Four-Period	One-Period	Four-Period	One-Period	Four-Period
Stock Returns	0.198 (2.75)	0.465 (2.65)	0.165 (3.22)	0.310 (1.94)	0.999 (2.29)	2.691 (3.12)
Term Structure	0.230 (3.72)	0.918 (4.27)	0.175 (2.68)	0.690 (3.37)	1.221 (4.62)	4.652 (5.77)
Interest Rate Ch.	0.214 (3.33)	0.334 (2.24)	-0.051 (-1.21)	0.035 (0.30)	1.660 (5.36)	2.124 (3.18)
Adj R-sq.	0.189	0.219	0.172	0.189	0.303	0.290

Notes: Entries are the coefficient values (and Newey-West *t*-statistics) from equation (1) where the dependent variables are given by the first row (GDP, consumption and investment growth) and the explanatory variables are given by the first column (stock returns, the 10-year minus 3-month Treasury term structure and the change in the 3-month Treasury bill rate). The final row contains the Adjusted R-squared value.

Table 3. Predictive Regression Results – Monetary Policy Break Dates

	Output Growth		Consumption Growth		Investment Growth	
	One-Period	Four-Period	One-Period	Four-Period	One-Period	Four-Period
	Sample: 1973:1-1979:3					
Stock Returns	0.036 (0.20)	-0.130 (-0.69)	-0.004 (-0.04)	-0.310 (-1.15)	0.827 (0.64)	1.788 (2.10)
Term Structure	0.652 (5.12)	2.488 (8.25)	0.487 (3.61)	1.877 (6.22)	2.838 (5.14)	11.048 (8.77)
Interest Rate Ch.	0.361 (2.38)	0.494 (1.05)	0.006 (0.04)	-0.020 (-0.04)	2.435 (2.16)	1.899 (1.39)
	Sample: 1979:4-1982:3					
Stock Returns	1.347 (3.81)	0.425 (0.33)	0.816 (4.25)	-0.777 (-1.49)	5.332 (2.87)	5.589 (1.01)
Term Structure	0.350 (2.55)	1.169 (1.81)	0.535 (5.50)	1.282 (7.66)	0.950 (1.29)	2.971 (1.06)
Interest Rate Ch.	0.128 (1.00)	0.365 (1.18)	0.016 (0.31)	0.332 (3.76)	0.918 (2.08)	0.966 (0.66)
	Sample: 1982:4-2008:4					
Stock Returns	0.207 (2.32)	0.608 (2.20)	0.219 (3.80)	0.491 (2.52)	0.637 (1.41)	2.775 (1.91)
Term Structure	0.118 (1.77)	0.635 (2.33)	0.078 (1.24)	0.513 (1.85)	0.654 (2.09)	3.076 (2.76)
Interest Rate Ch.	0.272 (2.41)	0.877 (2.17)	0.002 (0.02)	0.591 (1.65)	2.381 (5.11)	3.931 (2.39)
	Sample: 2009:1-2015:4					
Stock Returns	-0.019 (-0.31)	0.068 (0.78)	-0.037 (-0.60)	0.164 (0.99)	0.651 (1.36)	0.112 (0.15)
Term Structure	0.135 (1.05)	0.510 (1.76)	-0.010 (-0.06)	0.087 (0.19)	1.080 (1.01)	5.550 (2.00)
Interest Rate Ch.	-2.112 (-1.83)	-2.99 (-1.70)	-1.362 (-0.99)	-0.459 (-0.21)	-13.795 (-1.62)	-22.308 (-2.17)

Notes: Entries are the coefficient values (and Newey-West *t*-statistics) from equation (1). The full sample is divided into sub-samples defined as different monetary policy regimes as discussed in Section 3.

Table 4. Predictive Regression Results – Bai-Perron Break Dates

	Output Growth		Consumption Growth		Investment Growth	
	One-Period	Four-Period	One-Period	Four-Period	One-Period	Four-Period
	1973:1 – 1980:2	1973:1 – 1984:1	1973:1 – 1985:2	1973:1 – 1984:3	1973:1 – 1980:2	1973:1 – 1983:4
Stock Returns	0.064 (0.42)	0.323 (1.10)	0.129 (1.30)	-0.089 (-0.38)	0.954 (0.86)	4.403 (2.90)
Term Structure	0.685 (7.15)	2.125 (7.36)	0.467 (7.52)	1.647 (9.75)	2.901 (7.10)	8.309 (5.45)
Interest Rate Ch.	0.235 (5.64)	0.733 (3.91)	0.057 (1.54)	0.358 (4.64)	1.502 (8.87)	3.020 (3.32)
	1980:3 - 2008:2	1984:2 – 2006:4	1985:3 – 2006:3	1984:4 – 1991:3	1980:3 – 2008:2	1984:1 – 1991:1
Stock Returns	0.176 (2.53)	0.233 (1.98)	0.142 (3.70)	0.242 (2.06)	0.417 (1.28)	-0.606 (-1.25)
Term Structure	0.187 (2.99)	0.438 (1.58)	0.011 (0.18)	1.274 (3.87)	0.778 (3.23)	2.736 (2.11)
Interest Rate Ch.	0.304 (4.76)	0.155 (0.77)	-0.092 (-0.81)	0.358 (1.32)	2.091 (12.96)	0.806 (1.07)
	2008:3 – 2017:4	2007:1 – 2017:4	2006:4 – 2017:4	1991:4 – 1999:4	2008:3 – 2017:4	1991:2 – 1999:4
Stock Returns	0.095 (0.91)	0.456 (1.71)	0.078 (0.67)	0.108 (1.11)	1.310 (1.66)	0.596 (1.10)
Term Structure	0.160 (2.26)	0.579 (2.95)	-0.012 (-0.18)	-0.586 (-3.15)	1.593 (2.5)	-0.558 (-0.99)
Interest Rate Ch.	1.789 (5.46)	2.163 (4.59)	0.281 (2.15)	-0.764 (-3.72)	9.542 (6.92)	-2.571 (-1.24)
				2000:1- 2006:3		2000:1 – 2007:2
Stock Returns				0.005 (0.06)		-0.361 (-0.81)
Term Structure				0.401 (3.54)		4.553 (6.20)
Interest Rate Ch.				0.348 (2.45)		3.379 (3.98)
				2006:4 – 2017:4		2007:3 – 2017:4
Stock Returns				0.339 (1.28)		2.859 (1.76)
Term Structure				0.470 (2.06)		5.533 (2.64)
Interest Rate Ch.				1.767 (3.55)		12.162 (4.77)
Adj R-sq.	0.368	0.509	0.363	0.642	0.433	0.528

Notes: Entries are the coefficient values (and Newey-West *t*-statistics) from equation (1) and using the Bai-Perron methodology to define breaks in the estimated coefficients. The final row contains the Adjusted R-squared value.

Table 5. Predictive Regression Results - Extended Variables

	Output Growth		Consumption Growth		Investment Growth	
	One-Period	Four-Period	One-Period	Four-Period	One-Period	Four-Period
Stock Returns	0.156 (2.47)	0.466 (2.15)	0.163 (2.88)	0.351 (2.24)	0.585 (2.05)	2.311 (2.27)
Term Structure	0.180 (2.77)	0.729 (3.35)	0.139 (2.07)	0.592 (2.91)	0.984 (3.36)	3.559 (4.50)
Interest Rate Ch.	0.191 (2.94)	0.265 (1.97)	-0.065 (-1.38)	0.011 (0.09)	1.546 (5.77)	1.870 (2.77)
Commodities	0.028 (0.47)	-0.118 (-0.56)	-0.036 (-0.69)	-0.169 (-0.90)	0.096 (0.36)	-0.769 (-0.93)
REIT	0.139 (2.22)	0.202 (1.11)	0.098 (1.78)	0.179 (1.11)	0.900 (3.90)	1.356 (1.77)
Default Yield	-0.109 (-1.96)	-0.199 (-0.65)	-0.091 (-1.53)	-0.212 (-0.74)	-0.603 (-2.01)	-0.513 (-0.41)
Default Return	0.019 (0.07)	0.300 (2.19)	0.007 (0.12)	0.113 (0.64)	0.121 (0.42)	2.198 (2.47)
Adj R-sq.	0.266	0.267	0.251	0.303	0.396	0.301

Notes: Entries are the coefficient values (and Newey-West *t*-statistics) from equation (1), now including the additional explanatory variables for commodity returns, real estate investment trust returns, the default yield and the default return. The final row contains the Adjusted R-squared value.

Table 6. Predictive Regression Results - Extended Variables with Bai-Perron Break Dates

Output Growth		Consumption Growth		Investment Growth	
One-Period	Four-Period	One-Period	Four-Period	One-Period	Four-Period
1975:1 – 1990:4	1975:1 – 1983:4	1975:1 – 1990:1	1975:1 – 1989:1	1975:1 – 1984:2	1975:1 – 1983:4
SR + 1%	TS + 1%	SR + 1%	TS + 1%	SR + 1%	SR + 5%
TS + 1%	DTB3 + 5%	TS + 1%	DTB3 + 1%	TS + 1%	TS + 1%
DTB3 + 1%	Def Ret + 1%	REIT + 5%	Def Yd + 1%	DTB3 + 1%	Def Ret + 1%
REIT + 1%				REIT + 5%	
Def Yd – 10%					
1991:1 - 2001:1	1984:1 – 1990:4	1990:2 – 1998:3	1989:2 – 1995:3	1984:3 – 2010:1	1984:1 – 1991:1
TS – 1%	SR + 1%	DTB3 – 1%	SR + 5%	TS + 1%	TS + 5%
REIT – 10%	TS + 1%	GSCI – 1%	TS + 1%	DTB3 + 1%	DTB3 + 5%
	DTB3 + 1%	Def Yd – 1%	DTB3 – 5%	REIT + 5%	REIT + 5%
	REIT + 1%		GSCI – 10%	Def Yd – 1%	
			Def Yd – 1%	Def Ret + 5%	
2000:2 – 2008:3	1991:1 – 1999:3	1998:4 – 2005:2	1995:4 – 2005:3	2010:2 2017:4	1991:2 – 2000:1
TS + 1%	TS – 1%	SR + 5%	SR + 10%	TS + 5%	
Def Ret + 1%		DTB3 + 10%	GSCI – 5%	DTB3 + 10%	
		REIT – 5%	REIT – 5%	Def Yd – 5%	
				Def Ret – 1%	
2008:4 – 2017:4	1999:4 – 2006:2	2005:3 – 2011:3	2005:4- 2017:4		2000:2 – 2007:4
REIT + 1%	TS + 1%	ST – 5%	SR – 5%		TS + 1%
Def Yd – 5%	DTB3 + 1%	GSCI – 5%	TS + 1%		DTB3 + 5%
Def Ret – 1%		REIT – 10%	DTB3 + 1%		
		Def Yd – 1%	GSCI – 1%		
		Def Ret + 1%	Def Yd – 1%		
			Def Ret + 1%		

	2006:3 – 2017:4	2011:4 – 2017:4			2008:1 – 2017:4
	TS + 1%	SR – 1%			SR + 10%
	DTB3 + 1%	TS + 10%			TS + 5%
	GSCI – 10%	Def Yd – 1%			DTB3 + 5%
	REIT – 10%				Def Ret + 5%
	Def Yd – 5%				
	Def Ret – 1%				
0.499	0.612	0.565	0.697	0.526	0.604

Notes: Entries denote the significant variables, the coefficient sign and the significance level from equation (1) and using the Bai-Perron methodology to define breaks. For example, under the one-quarter output growth column, ‘SR + 1%’ refers to that stock returns are significant at the 1% level and with a positive coefficient. The final row contains the Adjusted R-squared value.

Figure 1. Data Plots

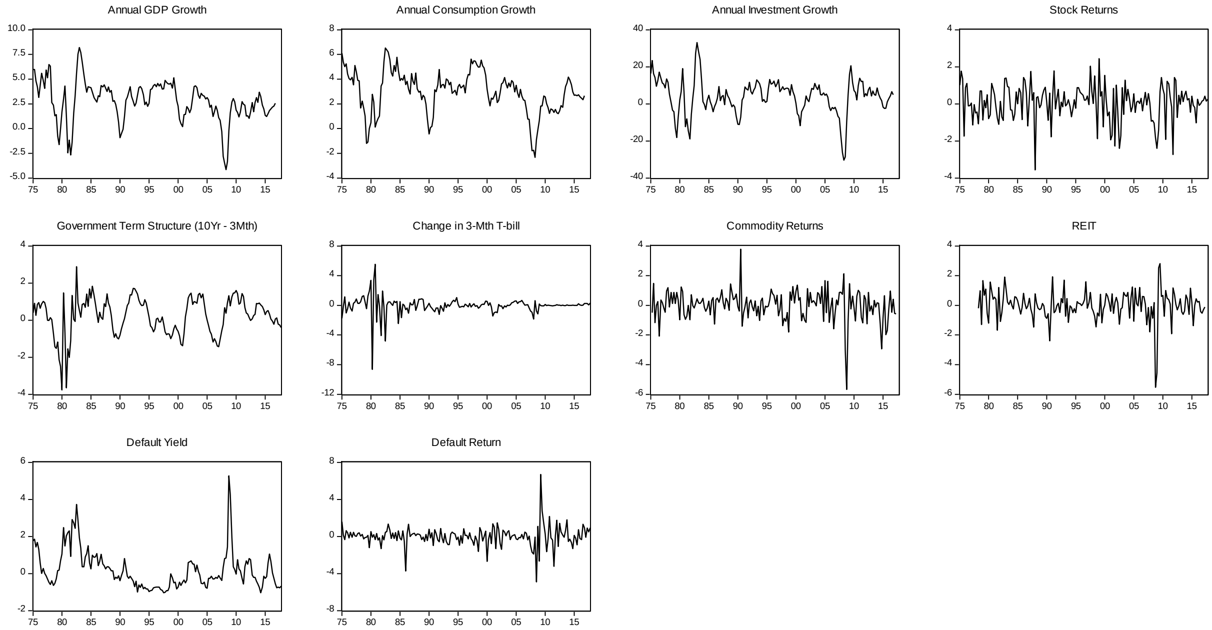
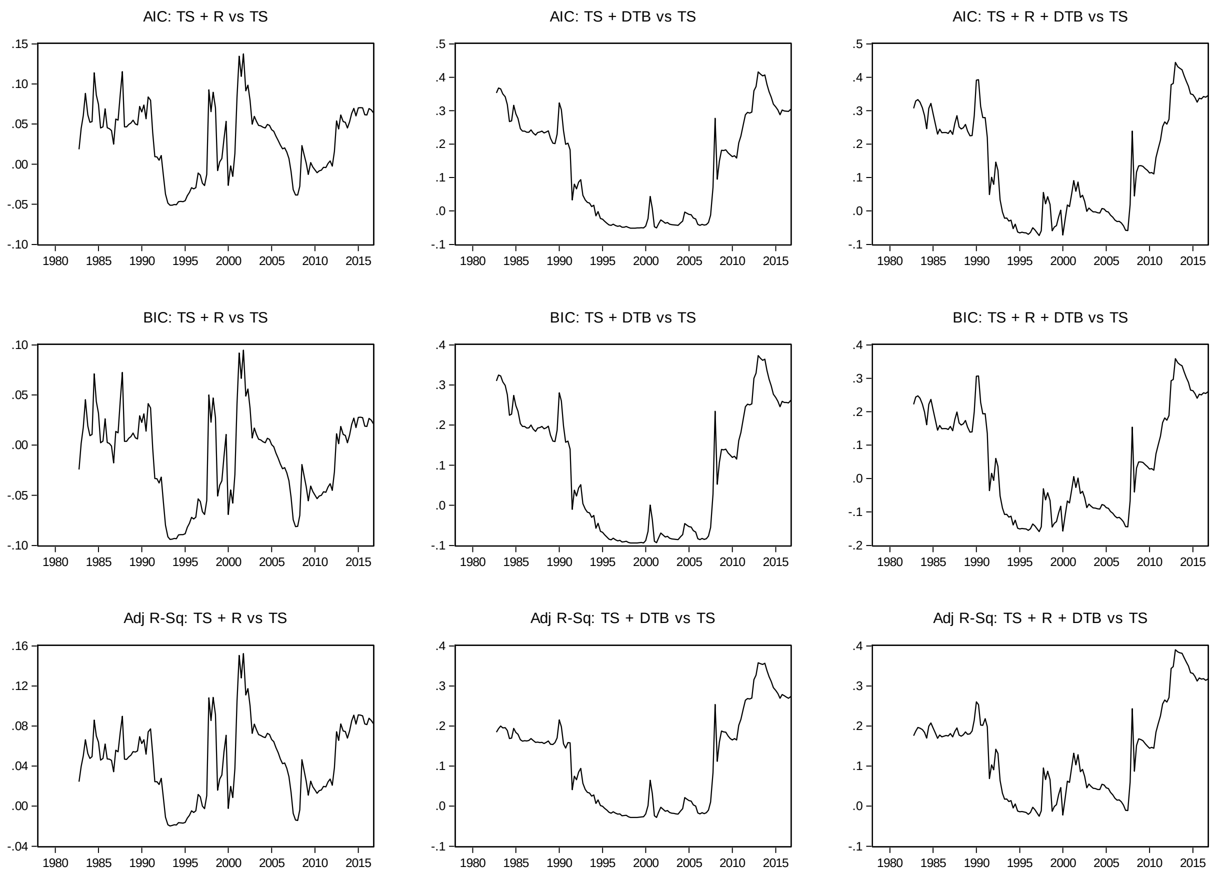


Figure 2. Comparing Model Specification Tests:
Annual GDP Growth



Notes: The plots show the AIC, BIC and Adjusted R-squared values of equation (1) that contains just the term structure (TS) as the explanatory variable against a regression that contains combination including stock returns (R) and the change in the 3-month Treasury bill (DTB). The plots are constructed such that a positive value indicates preference for the multiple regression model against the TS only model.

Figure 3. Rolling Coefficients and 95% Confidence Interval