



# **Dividends, Momentum and Macroeconomic Variables as Determinants of the U.S. Equity Premium Across Economic Regimes**

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## **Abstract**

The equity premium of the S&P 500 Index is explained in this paper by several variables that can be grouped into fundamental, behavioral and macroeconomic factors. We hypothesize that the statistical significance of these variables changes across economic regimes. The three regimes we consider are the low, medium and high volatility regimes in contrast to previous studies that do not differentiate across economic regimes. Using the three-state Markov switching regime econometric methodology we confirm that the statistical significance of the independent variables representing fundamentals, macroeconomic conditions and a behavioral variable changes across economic regimes. Our findings offer an improved understanding of what moves the equity premium across economic regimes than what we can learn from single-equation estimation. Our results also confirm the significance of momentum as a behavioral variable across all economic regimes.

**Key Words:** Excess stock returns, equity premium, dividends, macroeconomic variables, momentum, Markov regimes.

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## **Abstract**

The equity premium of the S&P 500 Index is explained in this paper by several variables that can be grouped into fundamental, behavioral and macroeconomic factors. We hypothesize that the statistical significance of these variables changes across economic regimes. The three regimes we consider are the low, medium and high volatility regimes in contrast to previous studies that do not differentiate across economic regimes. Using the three-state Markov switching regime econometric methodology we confirm that the statistical significance of the independent variables representing fundamentals, macroeconomic conditions and a behavioral variable changes across economic regimes. Our findings offer an improved understanding of what moves the equity premium across economic regimes than what we can learn from single-equation estimation. Our results also confirm the significance of momentum as a behavioral variable across all economic regimes.

## **1. INTRODUCTION**

In this paper we argue analytically and test empirically certain hypotheses that relate excess U.S. equity returns to certain important groups of variables across economic regimes. The review of the literature in the next section identifies three sets of variables. The three groups include fundamental factors, macroeconomic determinants, and behavioral variables. We define excess returns, also called the equity premium, in the standard way, as the difference between the index returns and the risk free interest rate. A proxy for the risk free interest rate is the Fed funds rate determined by the Federal Reserve Bank's monetary policy.

Excess U.S. equity returns are used in capital asset pricing models but when the research focus is on excess returns for an aggregate market index the concept of equity premium is more relevant. Fama and French (2002) define the equity premium as the difference between the expected return on the market portfolio of common stocks and the risk-free interest rate. The historical equity premium is usually defined as the differential return of a stock market index over the risk-free rate. Associated with the equity premium there is an academic puzzle, firstly articulated in Mehra and Prescott (1985) and recently surveyed in Mehra and Prescott (2003).

This puzzle describes the fact that the equity premium is too large to be explained by traditional asset pricing models with time-separable preferences at reasonable values of risk aversion. Using post WWII data, economists often claim that a long-run average real growth of GDP of about 3% is related to a long-run average growth of about 7% for dividends, an average rate of inflation of about 2.5% to 3%, unemployment of about 5%, a risk-free interest rate of about 5% and a long-run average increase of about 10% for the S&P 500 Index. Using these averages the historical equity premium is calculated to be 5%, as the difference between the 10% long-run average return of the S&P 500 Index and the 5% risk-free interest rate. Obviously all these averages are sample dependent. Heaton and Lucas (1999) cite several similar stylized facts. The challenge, both theoretical and empirical is to explain this risk premium of about 5%.

Connected with the puzzle of the size of the equity premium is its year by year variability. Often the equity premium variability is very large. For example, during the recent global financial crisis of 2007-2009 the S&P 500 volatility increased quite dramatically. In particular, during September and October 2008, market volatility as measure by VIX climbed to about 80%. Shiller (1989) was the first scholar to address this problem of excess volatility. In a series of papers reproduced in Shiller (1989), he and his co-authors study the sources of such volatility and argue that these include both economic fundamentals and also changes in social psychology or changes in behavioral variables.

Campbell and Cochrane (1999), using annual data from 1871-1993, revisit the equity premium and its volatility and propose a consumption based explanation. Shiller (2000) re-examines this theme with a greater emphasis on behavioral aspects by introducing the concept of irrational exuberance during the period 1996-2000. Very recently, Akerlof and Shiller (2009) introduce the Keynesian concept of “animal spirits” to illustrate the importance of human psychology as an explanatory variable of excess volatility in asset returns.

Our work makes a contribution in two critical ways: first, we propose a wider list of factors with special emphasis on momentum as a behavioral variable, and second, we trace the relative significance of these factors across three economic regimes. The three economic regimes are determined by the range of volatility of the equity premium. The statistical methodology identifies what factors determine with what significance the equity premium across three regimes of low, medium and high volatility. This contribution both generalizes and also, enriches previous results.

The theoretical hypotheses that motivate the empirical testing propose certain scenarios dependent on the level of volatility. During periods of low volatility we argue that

the low level of risk may encourage risk taking and be a factor to an above average equity premium while during periods of very high volatility associated with stock market turbulence and crashes, the equity premium could be negative. Studies that explain the equity premium without accounting for changes in the volatility of this premium only discover an average influence over the full sample of the independent factors.

In addition to formulating certain hypotheses that indicate the groups of variables explaining equity premia across three volatility regimes, we also propose that the significance of these groups of variables changes over economic regimes and proceed to test the suggested hypotheses.

In the next section, we first review the relevant literature to select groups of appropriate variables and then formulate our hypotheses. Afterwards we carry out the Markov switching regime methodology and interpret our results. Finally, we perform various diagnostic tests to confirm the appropriateness of our methodology and conclude by summarizing our main findings.

## **2. LITERATURE AND HYPOTHESES DEVELOPMENT**

To motivate the formulation of our hypotheses we selectively review several papers in three areas of research: fundamentals, macroeconomic variables and momentum. These three sets of variables are quite comprehensive, particularly if in each category one includes several variables. Keeping a clear focus on the goal of explaining the equity premium as a dependent variable by these three sets of fundamental, macroeconomic and behavioral variables we need to also address the behavior of volatility since it is used to characterize the break-up of the entire sample into three subsets.

Volatility does not enter as an independent variable in the list of factors determining the equity premium. Instead, three ranges of volatility decompose the sample set into low, medium, and high volatility to test if the role the independent variables in explaining the equity premium across these three regimes changes. Knowing the relative significance of the independent variables across regimes can offer certain insights in terms of what variables are influential during high volatility regimes. These are the regimes when markets usually crash and may be related to asset bubbles bursting, as in March 2000 or October 2008.

The literature review also includes some discussion about the role of monetary policy. Since equity premium is the difference between the historical return on the market portfolio

of common stocks and the risk-free interest rate, a brief review of how this risk-free interest rate is determined is in order.

### ***Fundamentals***

Several authors have investigated the relationship between the equity premium and the role of fundamentals. This select list of authors includes Fama and French (1988, 2002), Campbell and Shiller (1989), Blanchard (1993), Lamont (1998), and Heaton and Lucas (1999). These authors explore dividends and earnings and how they affect the equity premium. Dividend yields, dividend /price ratios, or price/earnings ratios are also used as fundamentals to explore their influence on the equity premium. Fama and French (2002) elaborate clearly the basic argument put forward by these authors. They theorize that the accepted paradigm of market efficiency claims that equity prices reflect all publicly available information about the economic fundamentals. Such fundamentals include expected earnings or dividends of firms appropriately discounted.

The classic Gordon (1962) dividend growth model and its various extensions capture this idea. From this straight-forward definition, one can obtain that changes in dividends or earnings also change the equity premium. Put differently, changes in the average return of a broad portfolio can be explained by the average dividend yield and the average rate of capital gains. Fama and French (2002) perform detailed calculations of the U.S. equity premium using very long annual data from 1872 to 2000 and found that the size of the equity premium explained by the fundamentals varies for different subsets. From 1872 to 1950, the dividend growth model explains the size of the equity premium very well but from 1951 to 2000, it explains it only partially. Also, as they check which variable among several fundamentals explains the equity premium best they conclude that it is dividends. Thus, following Fama and French (2002), we choose the S&P 500 dividend yield as an independent variable representing fundamentals to explain the equity premium. In view of the Fama and French evidence that the equity premium-dividend relationship changes across sample periods, we employ the Markov switching regime methodology that optimally selects the appropriate subsamples. Our methodology for selecting subsamples is judgment-free unlike the one followed by Fama and French.

### ***Macroeconomic Variables***

Macroeconomic variables such as inflation, GDP, industrial production, money supply, unemployment, consumption, investment, balance of payments, wealth, private and public

debt, and several others have an effect on stock market returns. The channels of influence from these macroeconomic variables to the aggregate stock market returns go through all the 500 firms included in the S&P 500 Index. These channels are very complex and the returns of each firm's stock price may be affected by macroeconomic changes in dissimilar ways.

The literature on what macroeconomic variables move the market is very large. Contributions by Bodie (1976), Chen (1991), Chen, Roll and Ross (1986), Fama (1981), Geske and Roll (1983), and Flannery and Protopapadakis (2002) are pertinent for our paper. More specifically, Bodie (1976), Fama (1981), and Geske and Roll (1983) find statistical evidence that inflation affects stock returns. Chen, Roll, and Ross (1986) and Chen (1991) consider five macroeconomic variables: the growth rate of industrial production, expected inflation, unexpected inflation, a bond default risk premium, and a term structure spread to conclude that industrial production is a strong macroeconomic variable. Since industrial production in the U.S. has been steadily declining in significance and replaced by the service sector, Cutler, Poterba, and Summers (1986) find that industrial production is significantly and positively correlated with stock returns up to the mid-1980s but not in recent sub-periods. We interpret these results to indicate that unemployment is an excellent candidate to consider as a broader macroeconomic variable capturing the growth of the economy since the impact of industrial production has decreased. Flannery and Protopapadakis (2002) conduct one of the most comprehensive studies of macroeconomic factors affecting aggregate stock market returns. They consider 17 macro series and conclude that six among them have pricing influence: the Consumer Price Index (CPI), Producer Price Index (PPI), Monetary Aggregate, Balance of Trade, Employment Report, and Housing Starts. Following Fama (1981), Chen, Roll, and Ross (1986), and more recently, Flannery and Protopapadakis (2002) we have selected inflation and unemployment as macroeconomic variables for our model.

### ***Momentum***

In a macroeconomic environment of rapid real economic growth with high employment and low inflation, stock price increases may signal further increases thus generating positive feedback. As investors observe positive fundamentals that persist, they may gradually become overconfident that the favourable macroeconomic regime will continue. Thus, they extrapolate the limited recent sample of favourable conditions into the distant future. This motivates them to buy more and increases in return attract more buyers generating a positive momentum. During periods of asset booms, momentum builds up slowly over several

quarters. However, when sufficiently negative news occurs, reversals are most often faster with sharper declines.

Prior to the emergence of behavioral finance, positive deviations of asset returns from levels justified by fundamentals were viewed as temporary. Arbitrageurs acting rationally would sell short the overvalued asset and contribute to eliminating deviations away from fundamentals. However, behavioral finance has been enriched by several papers explaining the limits to arbitrage. For example, Shleifer and Vishny (1997) have argued that arbitrageurs face both fundamental risk as well as noise trader risk and these risks may discourage them from taking a position. What if future fundamentals improve from being good to becoming even better? What if noise traders, being overconfident, continue to drive returns even higher? Shleifer and Vishny argue convincingly that under certain reasonable conditions prices may deviate from fundamentals for some time.

Chordia and Shivakumar (2002) also consider the continuation of short-term returns called momentum. They ask the question: are momentum returns due to investor irrationality or can they be explained rationally? They show that certain lagged macroeconomic variables can explain future stock returns and payoffs from momentum strategies disappear once stock returns are adjusted for their predictability.

A number of recent models show that both momentum and contrarian investor behavior may arise, be sustained in a financial market, and may also be profitable depending upon the horizon of the strategy. Barberis, Shleifer, and Vishny (1998), Daniel, Hirshleifer, and Subrahmanyam (1998), and Hong and Stein (1999) each develop models of investor behaviour that show how common psychological heuristics, if used by market participants, may lead to both mean reverting and persistent patterns in asset prices. Goetzmann and Massa (2002) carefully study both positive feedback (momentum) and negative feedback (contrarian) behavior for a large sample of individual investors with daily trading activities.

Recent work by Antoniou, Doukas, and Subrahmanyam (2010) investigates what drives momentum. The authors hypothesize that investor sentiment drives momentum and their empirical analysis confirms that momentum profits arrive only when investors are optimistic.

This selective bibliographical review supported by the integrative and perceptive survey of Barberis and Thaler (2005) suggests that momentum in the aggregate market in the form of temporary persistence of above average returns during periods of boom and its eventual reversal during asset busts can be an important behavioral variable to be included in the formulation of our hypotheses.



### ***Risk Free Interest Rate and the Role of Monetary Policy***

The equity premium as defined above is net of the risk free interest rate. This risk free interest rate is greatly influenced by monetary policy and in turn determines the size of the equity premium. The risk free interest rate fluctuates a lot; currently it is about .0025 in view of the financial crisis and high unemployment but was as high as 16.3 during May 1981. Subtracting from aggregate stock market returns a highly variable risk free interest rate can influence the equity premium substantially both its level and its volatility.

A proxy for the risk free interest rate is the Federal funds determined by monetary policy. It is well known that the Federal Reserve chooses its target Fed funds rate to achieve its central dual goals of price stability and economic growth. During the past decade the Taylor Rule has emerged as a useful tool in determining the desirable level of the Fed funds rate. This Rule computes the appropriate level of the policy Fed funds rate as the sum of a constant long-term nominal Fed funds rate and two other terms. The first term, measures the deviation of the actual current inflation from its long-run average target rate. The second, measures the deviation of the actual real current output from its long-run potential output. Each of these two terms is given a certain weight whose sum is equal to one. If an economy is growing rapidly and inflation is increasing above its long-run desirable level, Fed funds rate should be increased; if on the other hand the economy is growing slowly and inflation is below its target, Fed funds rate should be decreased. What is important in terms of our study is that using current unemployment as a proxy for deviations of current output from its potential and inflation in our empirical work below we are measuring the impact of these two macroeconomic variables on the equity premium after having netted out the conduct of monetary policy.

Monetary policy does not only determine the Fed funds rate but also influences equity returns. In terms of our theme, monetary policy affects both terms of the equity premium: aggregate returns and the risk free rate. Several papers discuss this role of monetary policy. Bordo and Wheelock (2004, 2007), Bernanke (2002), Bernanke and Gertler (1999, 2001), Bernanke and Kuttner (2005), Bordo and Jeanne (2002), Bordo, Dueker, and Wheelock (2007), and Borio and White (2004) have offered comprehensive reviews of the relationships between asset prices and the role of monetary policy. Bordo and Wheelock (2004) identify several episodes of sustained above average increases in the U.S. stock market measured by a representative index during the 19<sup>th</sup> and 20<sup>th</sup> centuries and then, evaluate the role of economic

fundamentals in each episode. Two booms stand out in terms of their length and rate of increase. These are the booms of 1923-29 and 1994-2000. The authors conclude that these booms occurred in periods of rapid real growth and labor productivity.

Bordo and Wheelock (2007) and also Bordo, Dueker, and Wheelock (2007) examine the relationship between stock market booms and monetary policy both in the U.S. and nine other developed countries during the 20<sup>th</sup> century. They find evidence that stock market booms in the U.S. and several other developed countries typically build up during periods of above average growth in real GDP and below average inflation. They find little evidence that stock market booms are driven by excessive liquidity. They also find evidence that equity booms ended within few months of an increase in inflation and consequent monetary policy tightening. Their overall conclusion suggests that stock market booms reflect both real positive macroeconomic fundamentals and monetary policies targeting price stability.

Greenspan (1999, 2002, 2003, and 2004) saw a conundrum in the use of monetary policy to defuse an asset price boom and expressed the view that stock market booms are more likely to occur when inflation is low. Greenspan has remarked that the bubble during the period 1996-2000 may have been the result of the Fed's success in reducing inflation and achieving price stability.

When monetary policy is successful in keeping price inflation low, history demonstrates that price-earnings ratios increase. What is really needed to keep stock market bubbles from occurring is some degree of uncertainty about future macroeconomic fundamentals. Such uncertainty moderates asset price booms. If there is strong consensus that economic fundamentals will remain robust and the Fed's monetary policy will succeed in achieving long-term price stability, asset prices often increase rapidly.

These ideas do not directly impact our econometric methodology and testing. However, one may need to keep these qualitative observations in mind to underscore the determinants of the Fed funds rate and the equity premium.

### ***Volatility***

In the introduction of this paper the well known fact that the stock market is very volatile is acknowledged. Numerous financial economists have researched the reasons for such volatility. In this section we selectively discuss some relevant papers and explain the role stock market volatility plays in our work. These include Schwert (1989), Shiller (1989), Akerlof and Shiller (2009), Galeotti and Schiantarelli (1994), Bekaert and Wu (2000), Wu

(2001), Stock and Watson (2003), Kim, Morley, and Nelson (2004), Campbell (2005), Zang (2006), and Ang, Hodrick, Xing, and Zang (2006).

We have discussed earlier that behavioral economists such as Shiller (1989) and Akerlof and Shiller (2009) argue that the magnitude of market volatility cannot be explained only by fundamentals and macroeconomic conditions; its size is too large and one must consider behavioral factors. Schwert (1989) uses monthly data from 1857 to 1987 and performs very detailed calculations to analyze why the stock market volatility fluctuates so much. He computes aggregate stock market volatility and its relationship to the volatility of bonds, inflation rates, money growth, and industrial production. He concludes that there is weak evidence that stock market volatility is influenced by macroeconomic volatility. Galeotti and Schiantarelli (1994) show how to obtain proxies for the fundamental and behavioral components of volatility. Bekaert and Wu (2000), Wu (2001), and Kim, Morley, and Nelson (2004) study the asymmetric behavior of volatility that describes the phenomenon that returns and conditional volatility are negatively correlated. They explain this asymmetric behavior to be the result of a leverage effect and a volatility feedback effect.

There is a large amount of literature that reviews the empirical evidence of decreased volatility in the real economy. Stock and Watson (2003) document the decrease in real volatility from around mid-1980s to 2006 and the gradual increase in asset volatility. Campbell (2005) decomposes real stock returns into fundamental news and returns news components to analyze the effects of the decreased volatility in the real economy.

In this paper, aggregate stock volatility is used to determine three regimes of a low, average, and large volatility. For each subset, we employ fundamental, macroeconomic and behavioral variables as identified by the review of the literature above to explain the size of the equity premium. Taking volatility into account adds to the contribution of our paper.

Thus, our modelling approach is different from traditional regression based analysis. We seek to explore the dynamic influence of the explanatory variables in a state-dependent framework. The environment is, therefore, subject to regime changes. Since regimes are unobserved and must be inferred from the data, it is common in regime-based approach to allow the level of the model residual variances to define the regimes. This approach addresses several issues, both economically and statistically. Accounting for volatility in our hypotheses development and methodology is a further contribution of our paper.

On the basis of this literature review, it is clear that financial economists have not yet reached a consensus on what specific fundamental and non-fundamental factors drive equity prices across diverse economic regimes. In particular, the bursting of the equity bubbles of

October 1987 with its one day decline of 20% in the S&P500 Index, the internet bubble during 2001-2002 with a 45% decline and the most recent October 2007 to March 2009 global financial crisis with a 50% correction, challenge financial economists for an explanation that is integrated with developments occurring in other phases of the economy. From the two extreme poles of perfect market efficiency to irrational market exuberance or panic, there are numerous combinations of fundamental, economic, and behavioral factors with varying weights of significance for each, all of which combined produce the observed returns.

The literature review above suggests that the equity premium is explained by fundamental factors (dividends), macroeconomic variables (inflation, unemployment), and behavioral (momentum), among other determinants. However these factors play different roles during the three states of low, medium, and high volatility. Indirectly, both the regime of volatility and the conduct of monetary policy in determining the risk-free interest rate are also involved.

Before we state the hypotheses to be tested, we review certain stylized fact about equity returns that are relevant in our analysis. First, increases in asset prices are often fueled by above average economic growth because of higher corporate profitability. Such growth can be measured monthly by decreases in unemployment. Second, the historical record also supports the observation that high equity premia occur during periods of low inflation that may also contribute to low interest rates as measured by the Fed funds rate. This is another way to say that bull markets are supported by relatively easy monetary policies since low risk of inflation allows the Fed to follow easy monetary policies. One may recall the 1996 Greenspan rhetoric that warned against “irrational exuberance” yet did not take any measures to moderate such exuberance because there appeared to be no risk of inflation during this period, nor was the Greenspan Fed interested in deflating the asset bubble by increasing Fed funds rate so high as to cause a recession. Furthermore, low interest rates allow for a more favorable discounting of future corporate profits that increase equity prices. During this regime of increasing macroeconomic stability, perceptions of risk are also reduced.

Third, economic stability as described both in terms of rapid economic growth and low inflation that fuels the early stages of an asset boom, often challenges monetary policy to consider increases in Fed funds rate to moderate the possibility of future inflation. This clearly occurred during the late 1990s and also in Japan during the late 1980s. These challenges have been addressed in detail in Bernanke and Gertler (1999, 2001), Hayford and Malliaris (2001, 2004, 2005, 2006), and Hunter, Kaufman, and Pomerleano (2003). On both

analytical and policy grounds the Fed's targeting of equity prices has been asymmetric: while asset prices increase, monetary policy remains neutral but when the stock market crashes then, monetary policy eases to moderate macroeconomic risks and to stabilize the economy. This monetary asymmetry is tied to the behavior of the stock market. As practitioners say "the market climbs a wall of worries" with slow, small and erratic increases in equity prices over long periods of time in relative contrast to periods of panic when price collapses are fast, large, and highly erratic over a much shorter period of time. The Fed's asymmetric response to equity prices may have contributed to the wide range of equity volatility. Thus, it becomes necessary to study the impact of changing volatility and we do this by considering three regimes.

Finally, certain non-fundamental characteristics appear to be present during asset booms and busts. In addition to fundamentals such as dividends, macroeconomic factors such as inflation and unemployment, momentum trading also plays an important role.

We can now formulate our hypotheses as follows:

First, we hypothesize that when economic regimes are divided according to the level of volatility of the equity premium, the time duration of low volatility will be longer than the medium volatility and it will be lower than the highest volatility. Periods of very high volatility are expected to include times when market corrections have occurred.

Second, we hypothesize that dividends are very important as an explanatory variable and are expected to be significant across all regimes with a negative coefficient since high dividends reduce net returns. This hypothesis is supported by rational theories of asset pricing.

Third, during periods of economic stability with low volatility, we expect both inflation and unemployment to play a significant role in explaining the equity premium with a negative sign. This means that low inflation contributes to higher returns and declines in unemployment contribute to economic growth, corporate profitability, and increases in the equity premium.

Fourth, we hypothesize that momentum is present across the three regimes and higher momentum contributes to higher returns. In particular, momentum works well during a low volatility regime since the associated risk of this strategy is lower. This variable represents the contribution of behavioral finance.

Fifth, we hypothesize that during periods of high volatility, momentum becomes the most significant variable among the ones considered in this model.

Finally, during periods of very low volatility for the equity premium, dividends initially drive returns but momentum also becomes important. Similarly, in periods of very high volatility both dividends and momentum explain returns but the significance of momentum increases.

The theoretical hypotheses presented above propose three economic regimes. To test empirically our hypotheses we use a 3-state regime Markov switching methodology to capture the specific fundamental, macroeconomic and behavioral factors that drive the equity premium across economic regimes. Details of this methodology are described in the next section.

### **3. DATA AND METHODOLOGY**

We use monthly data covering the period June 1965 to December 2008. The macroeconomic variables for inflation, interest rate, and unemployment are obtained from the website of the Federal Reserve Bank at St. Louis. In particular, we calculate inflation rate from the consumer price index for all urban consumers for all items (CPIAUCSL). The data item for short-term interest rate is the constant maturity three month Treasury bill (TB3MS) from the secondary market as a proxy for the Fed funds rate representing the risk-free short-term interest rate. This is used to compute the historical equity premium, defined as the differential return of the S&P 500 Index over the risk-free. We let civilian unemployment rate (UNRATE) represent the level of unemployment rate in the model. Although, some authors such as Ferrara (2003) use the inverted unemployment rate in macroeconomic analysis of business cycles, we use the direct measure of unemployment rate in our study. The aggregate equity market level is represented by the S&P 500 obtained from DataStream (S&PCOMP (PI)). DataStream also provides dividend yield (S&PCOMP (DY)) data. We use this dividend yield to compute the level of dividend and use that as a fundamental variable along with inflation and the unemployment rate as macroeconomic variables.

Since the unemployment rate and the consumer price index are subject to revisions and corrections we use the average of the past two months to coincide with the other monthly data in our analysis. We also find that the unemployment rate and the dividend data are all non-stationary. We, therefore, use the first differences of these variables in the model implementation.

Before proceeding further with our analysis, we outline the relevance of the regime based approach we adopt in this paper. Long economic time series are also subject to some

form of structural breaks as the economy moves through different phases. The concept of regime thus depends on the problem at hand. Besides, the regimes may be unobservable to the statisticians carrying out ex-post analysis. Lee and Chen (2006) show that a Markov regime-switching model for exchange rates performs very well in prediction. They justify the use of such models and the regimes appear consistent with popular known exchange rate regimes in the world. Fong and See (2002) also demonstrate the validity of using a Markov regime switching model for volatilities in oil futures price series. Raymond and Rich (1997) use regime switching to study the role of oil prices in accounting for shifts in the mean of U.S. GDP and to predict the transition between low and high growth states. Andreopoulos (2008) estimates a Markov-switching model for the interest rate, unemployment, and real oil price.

Next, we define the variables in our study before we describe the models for ease of representation. For a particular month ( $t$ ), the label used for excess return is,  $xsr_t$ , for unemployment rate is,  $uem_t$ , for inflation rate is,  $inf_t$ , and for dividend is  $div_t$ . To indicate a first differenced variable we use the common symbol  $\Delta$ .

In addition to the above we define a proxy for the behavioral variable to represent recent performance or momentum return. We follow the definition used in Kojien, Rodriguez, and Sbuely (2009). In their continuous time set up they calculate the short-term performance of the equity market as a weighted function of the past returns. Given that  $S_t$  represents the index level at time  $t$ , then the momentum return  $mmt_t$  is given by:

$$mmt_t = \int_0^t e^{-(t-u)} \frac{dS_u}{S_u}$$

where  $e^{-(t-u)}$  is the weighting scheme. Kojien et al (2009) show that there is no need to consider any more general weighting scheme since this simple approach is capable of matching the short-term and long-term autocorrelations of the stock returns. Later in this section we define a discrete version of this momentum variable for empirical investigation.

The target variable of our investigation is the equity premium ( $xsr_t$ ) defined earlier. The explanatory macroeconomic variables are inflation ( $inf_t$ ) and the civilian unemployment rate ( $uem_t$ ). The fundamental explanatory variable is the dividend yield, ( $div_t$ ) and the behavioral variable is momentum ( $mmt_t$ ).

In order to get a basic idea of the explanatory power of the selected variables we investigate the ordinary linear regression model as:

$$xsr_t = c_0 + c_1 \Delta div_t + c_2 inf_t + c_3 \Delta em_t + c_4 xsr_{t-1} + \varepsilon_t \quad (1)$$

The lagged excess return helps to take care of residual serial correlation. The parameter estimates of this linear regression are given in the table below, with t-statistics below the parameters. In the first instance we let the residual variance to be constant.

| $c_0$   | $c_1$    | $c_2$   | $c_3$   | $c_4$   |
|---------|----------|---------|---------|---------|
| 0.00226 | -0.05491 | 0.38394 | 0.00318 | 0.61625 |
| 1.90    | -44.57   | 1.30    | 0.37    | 21.24   |

In order to understand how well such a linear regression relation performs, we carried out the CUSUM of squares test with the residuals in EViews™. The details are not included here (but available on request). This test clearly shows that this linear model is incapable of addressing either the parameter instability and/or variance instability over the sample period. As a further step we estimate the same model but this time with a GARCH specification of the residual variance. In this instance also, the CUSUM of squares test of residuals indicate parameter and/or variance instability. Although the GARCH specification addresses time varying conditional variance, the unconditional variance is constant. If there is indeed structural change in the unconditional variance, a GARCH specification is inadequate to demonstrate it. Besides, structural change may imply different coefficients of the regression relation.

A natural alternative to the model in equation (1) is to allow such a relationship to be dependent on the regime prevailing at a given date. Using a monthly data set, Guidolin and Ono (2006) find overwhelming evidence of regime switching in the joint process for asset prices and macroeconomic variables. They also find that modeling explicitly the presence of such regimes improves considerably the out-of-sample performance of a model of the linkages between asset prices and the macro-economy.

Once the regime breakdown is achieved, then we can disentangle the relationships among the variables depending on the regime. Since it is difficult to stipulate where regime changes may have occurred, we rely on the data to decide on this. In addition, if the different regimes are allowed to have different variances or volatilities, then it also caters for heteroscedasticity in the data, which is a common occurrence in financial and economic time



series. In this context, the best applicable methodology is to allow an unobserved Markov chain to drive the regimes under a time homogeneous transition probability.

The most intuitively appealing way to classify the regimes is based on the level of the residual variance or in other words the surrounding level of uncertainty. If there are indeed different levels of uncertainties, then not allowing for regime differences will lead to misspecified models and may not allow full understanding of the relationships among the variables of interest to us.

The adoption of a regime dependent strategy is not only confined to macro-economic analysis. Alexander and Dimitriu (2005) adopted a similar regime-dependent strategy to investigate complex hedge fund investment styles where the traditional approach fails to uncover the underlying dynamics. Our study thus follows a similar regime-dependent strategy.

We have already pointed out that a particular regime at any given date is to be determined by an unobserved state variable whose evolution is governed by a probability law. This approach also addresses the structural breaks in the relationship in a straightforward manner. In addition, this is a different approach to address heteroscedasticity than the GARCH modeling. In a GARCH set up the conditional variance changes but the unconditional variance is fixed whereas with regime dependent variance specification the unconditional variance itself is changing.

There is another advantage of the regime dependent approach to our analysis. In the table above not all the estimated parameters of the linear regression model in equation (1) are significant. Without any regime structure the results may simply be indicating the average effect. With a regime dependent model it is likely that we will find a particular parameter is significant in one regime but not in another one. If this does occur, it then provides additional insight into the background economic dynamics. In fact, we document evidence of this occurring later in the discussion of our results.

Based upon the above analysis and as we have hypothesized earlier, we would expect to detect varying degrees of influence of these explanatory variables across different regimes in the market. We, therefore, propose the following model representation. The lagged value of ( $xsr_t$ ) is not used here since we do not find this important when regimes are allowed.

$$xsr_t = c_{0,S_t} + c_{1,S_t} \Delta div_t + c_{2,S_t} inf_t + c_{3,S_t} \Delta em_t + \varepsilon_{t,S_t} \quad (2)$$

The main task now is to decide how many different regimes might be there. In order to explore this issue we examine certain influential papers relevant to our topic that also employ multi-state regime switching models.

First, Bansal, Tauchen, and Zhou (2004) find a two-regime description of the U.S. economy adequate in the context of a varying risk premium in the term structure of interest rates. They also assume the transition probability of the Markov chain to be time homogeneous. Second, Guidolin and Timmermann (2006) find that a three-regime description fits well for the U.S. bond and equity returns when modelled separately. But they needed a four-regime description to fit the joint distribution of bond and stock returns. The transition probability in this case is also time homogeneous. It is also apparent from their paper that the numerical difficulty of estimation increases as the dimension of the model increases.

Thus, approaching the issue of the number of regimes purely on statistical grounds is not the best course since efficiency of estimation becomes a problem with each increase in the number of states as the number of parameters rapidly increases. Since we are modelling univariate time series we follow Ferrara (2003) to capture such regimes with a Markov switching framework with pre-specified number of states. Similar to Ferrara (2003) we also allow a three-state unobserved Markov chain to drive the parameters of the model in equation (2). Our dataset covers the period analysed in Ferrara (2003). In our analysis the regimes are classified by the level of variance of the model residual. The Markov switching model is a dynamic model of the equity premium that allows for endogenous structural breaks and thus, allows the data to formalize the beginning and ending of each regime. A similar approach is adopted by Boyer, Kumagai, and Yuan (2006). They find an increased level of co-movement among emerging market stock index returns during high volatility periods.

Regarding the parameter estimation issue from the three-state unobserved sample paths we use maximum likelihood method as in Kim and Nelson (1999), together with the expectation maximization (EM) algorithm. The EM algorithm has proven to be robust with respect to initial parameter values. The number of parameters for a three-regime model is 21 and may be considered large for most econometric analyses.

In the second stage of our analysis we include the behavioral variable, momentum return, as an additional explanatory variable in equation (2) above and estimate the three-state Markov switching model. The behavioral element, in addition to the other macro-economic and fundamental variables, may have incremental explanatory power. In fact we demonstrate this incremental explanatory power later in the results section. Connolly and Stivers (2003)

report the existence of momentum in weekly equity returns in a number of markets and this appears to be related to the turnover. They also point out that any theoretical reasoning of this behavior is still an open question. Nevertheless, such observations have taken hold in behavioral finance. Although a workable definition of momentum return is being used by various market participants, such as for example, technical traders, we need a proxy for our aggregate equity market based upon the index itself. Chordia and Shivakumar (2002) utilize past six months' return to define this concept. Barberis and Thaler (2005) use the notion of short-term persistence as a proxy for the momentum return. Earlier in this section we have already defined the performance variable (momentum return) in a continuous time setting. In equation (4) below we use the equivalent discrete time version of the same notion.

The modified model, with the inclusion of the proxy for the behavioral variable, now looks like:

$$xsr_t = c_{0,S_t} + c_{1,S_t} \Delta div_t + c_{2,S_t} inf_t + c_{3,S_t} \Delta uem_t + c_{4,S_t} mmt_t + \varepsilon_{t,S_t} \quad (3)$$

The discrete version of the new explanatory performance variable  $mmt_t$  captures the momentum return defined as,

$$mmt_t \approx \sum_{i=1}^t e^{-i} r_{t-i+1}, \quad (4)$$

where  $r_t$  is S&P 500 price level based return for the month  $t$ . The estimation methodology is still based on EM approach and the number of parameters in this case is 24.

#### 4. RESULTS

This section interprets the results in Tables 1 and 2. As we interpret the results it is important to point out that the models with regimes clearly dominate the non-regime model in increasing the explanatory power of the variables.

Good place for Table 1 and Figure 1

Table 1 summarizes the parameter estimates, the transition probability matrix, and average duration in months for the regimes identified for model equation (2). Regimes are classified based on residual variances and there is an order of magnitude difference between

the lowest and the highest estimated variances. As would be expected, the diagonal elements of the transition probability matrix show that the highest variance state is least likely to persist. The expected duration of the highest variance state is only 4.6 months whereas the lowest one has an expected duration of 40.7 months. Economists such as Mishkin (2007) have argued that high volatility periods are often related to turning points in business cycles. Such periods are often brief and it is hard to find consistent economic factors explaining these turning points. Worth pointing out is the magnitude of the variance in the highest state: 4.037 vs. 0.556 and 0.539 in the medium and low variance states. In other words, when markets correct during turning points, the volatility of the equity premium is very large compared to the volatility during normal times.

Although, we find the average realized equity premium is negative in the highest variance state, it is positive in the low and medium variance states. All these average returns are statistically significant. Similarly, all the coefficients of the change in dividend are negative and statistically significant. We are using price level based returns and increases in dividends are likely to lead to price reductions. This result is intuitive.

Focusing on the inflation variable, the impact of increased inflation on the equity premium is negative in both the low and medium variance states. This is what we would normally expect, possibly because higher inflation leads to higher prices and lowers demands for goods and services. This is likely to reflect in lower earnings by firms and ultimately lower stock prices. Higher inflation may also lead to higher costs for firms as well, whereas they may not be able to raise prices soon due to price stickiness. Furthermore, higher inflation also increases the risk-free interest rate and reduces the equity risk premium. The behavior in the high variance state is quite different and the coefficient of inflation is positive and significant. This suggests that in the high volatility regime stocks are a good hedge for inflation. However, this may be a short-lived phenomenon and is reflected by the shortest expected duration of this state.

The other macroeconomic variable, unemployment, has differing impact on the equity premium in the medium and the low variance regimes. Unemployment has no significant effect during the short-lived high variance state. In the most stable state, i.e. the low variance one, a rise in unemployment leads to a fall in the equity premium, probably indicating an expected drop in overall consumption demand. However, in the medium variance state, unemployment affects the equity premium positively, although at about half the magnitude of that of the low variance state. One explanation of this finding is that during periods of increasing unemployment, the Fed adopts an easier monetary policy that lowers the risk-free

interest rate. Such an easy monetary policy is usually favourable to equity returns. Thus, higher equity returns and a lower risk-free interest rate result in a higher equity premium. The average duration of the medium variance state is nearly half of that of the most stable state.

Figure 1 depicts the probability of the respective states occurring. The second half of the sample period (from mid 1980's onward) is dominated by the medium variance level with occasional emergence of the high variance state. The intercept term representing the average excess return for the medium variance regime is positive and significant. From the data we could easily verify that the sample average excess return for the period of March 1991 to March 1998 is 0.010 and for the period August 2003 to August 2007 is 0.006. This is an indirect verification of the success of the regime separation by the model we employed in this study.

#### Good place for Table 2 and Figure 2

The parameter estimates of the model including the performance variable, momentum return, are given in Table 2. The average duration of the most stable state in this scenario is almost the same as that of the previous case given in Table 1. The most volatile state, however, is reduced to about half the duration of that of the previous case. This is possibly due to the momentum factor changing the persistence of a high volatility regime. Figure 2 captures the probability of different regimes occurring in the case when momentum return is included. The sharper nature of the most volatile state (regime 1) supports the observation of reduced average duration in a regime. However, the probability of the highest volatility state occurring spans the similar duration as in Figure 1. Thus, it appears that the inclusion of the behavioral variable in the model reduces the 'stay' in the high volatility regime.

The introduction of momentum as an additional explanatory variable, does not impact the significance of dividends. Observe that Table 2 indicates that dividends are significant in all three states. In fact, their significance increases when compared to the corresponding numbers in Table 1. However, the significance of the two macroeconomic variables, inflation and unemployment, is reduced with the introduction of momentum. Specifically, inflation is now only significant in the medium variance state, with a positive coefficient and with lower strength. The effect of the unemployment rate is very small but significant in the most stable state. In the least stable state the unemployment rate affects excess returns positively. Most importantly, the coefficients of momentum are statistically significant in all states. In the least

stable state, momentum has the maximum positive impact on the equity premium. Thus, it is possible that this behavioral variable subsumes many of the effects of other explanatory variables in the model. It makes it difficult to comment on the magnitudes of the other coefficients.

The results of Tables 1 and 2 confirm the importance of macroeconomic factors such as unemployment and inflation in addition to the fundamental factor, dividend yield, in explaining the equity premium. Also, when momentum is introduced as an explanatory variable of the equity premium, it is found to be significant across all three regimes.

The results of Tables 1 and 2 and the preceding analysis allow us to draw the following conclusions about the hypotheses proposed.

First, the time duration of the low volatility regime is indeed longer than that of the medium regime and both are longer than the high volatility regime. From Table 1 we read durations of an average 40.63, 20.08 and 4.63 months respectively. From Table 2, the corresponding average monthly durations are 40, 28.16 and 2.08.

Second, dividends emerge as a significant explanatory variable in both models presented in Tables 1 and 2 and in all regimes; they also have the expected negative sign. This confirms our second hypothesis and the numerous findings of previously published research cited in the bibliographical review.

Third, the two macroeconomic variables we selected, inflation and unemployment, give us conflicting results. In Table 1, both variables are significant in all three regimes but the signs alternate. In Table 2, the significance declines. We conclude that Table 1 gives partial support to our hypothesis that during periods of low volatility, inflation and unemployment are significant but Table 2 indicates that only unemployment is significant when momentum also enters as an explanatory variable. Thus, our third hypothesis receives only partial confirmation.

Fourth, momentum is significant and has the correct sign indicating that high momentum increases net returns. Tables 1 and 2 clearly support this hypothesis and confirm the importance of momentum in explaining the equity premium in all regimes. These results support our fourth hypothesis.

Finally, dividends and momentum emerge as the two most significant variables in Table 2 for all three regimes. In the low volatility regime returns are driven by dividends but momentum adds to net returns. When volatility is the highest, dividends are still significant but momentum becomes the most significant variable. This confirms the fifth hypothesis.

## 5. RESIDUAL DIAGNOSTICS OF THE MARKOV SWITCHING MODEL

It is a common practice for assessing adequacy of Markov switching models to apply the test of independence to the residual series. A powerful test used for independence and, under certain circumstances, for nonlinear dependencies, was developed by Brock, Dechert, Scheinkman, and LeBaron (1996) and is based on the correlation integral. The BDS statistic tests the null hypothesis that the elements of a time series are independently and identically distributed (IID). For a time series which is IID, the distribution of the statistic is asymptotically standard normal under the null of whiteness. The null is rejected if the test statistic is absolutely large, (say greater than 1.96). If the null hypothesis of IID cannot be accepted this implies that the residuals contain some kind of hidden structure. We have carried out the BDS test for the model residuals in Eviews and are given in Table 3. The test requires the choice of two parameters, commonly referred to as the dimension and epsilon, the distance for testing proximity of the data points. In all our tests we set epsilon as a fraction of the range of the residual data series.

Good place for Table 3

The BDS test statistics in Table 3 show that the hypothesis of IID nature of the residual series is well supported for both models and for all the dimensions chosen. Thus, we find statistical support for the Markov switching models applied to the analyses of the excess stock return in terms of other macro-economic and fundamental variables.

### *Model Diagnostics*

In this section we consider the diagnostics of the fitted Markov switching model. We first analyze the probability series generated by using the Regime Classification Measure (RCM) of Ang and Bekaert (2002).

A source of uncertainty, idiosyncratic to regime switching models is the ex post determination of regimes. In switching models it is assumed that the occurrence of a regime is observed by the market but not by the econometrician who must *infer* it from the model. Until recently, the quality of regime classification was determined by focusing on the

smoothed ex-post regime probabilities. An innovation in this area is the Regime Classification Measure (RCM) proposed by Ang and Bekaert (2002). This measure is essentially a sample estimate of the variance of the probability series. It is based on the idea that perfect classification of regime would infer a value of 0 or 1 for the probability series and would be a Bernoulli random Variable. The formula given to calculate this is

$$400 \times \frac{1}{T} \times \sum p_t \times (1 - p_t) \quad (5)$$

where  $p_t$  is the probability of being in a certain regime at time  $t$ . Good regime classification is associated with low RCM statistic values. A value of 0 means perfect regime classification and a value of 100 implies that no information about the regimes is revealed. Weak regime inference implies that the model cannot successfully distinguish between regimes from the behavior of the data and may indicate misspecification.

With the data for probability series for three different states in our model (equation (2)) the RCM measure for  $S_t = 1$  is 15.87,  $S_t = 2$  is 17.03 and for  $S_t = 3$  is 5.18. Similarly, for equation (3) these values are,  $S_t = 1$  is 6.84,  $S_t = 2$  is 5.45 and for  $S_t = 3$  is 10.62. We can see that the RCM values for all the series are reasonably low, especially when compared to those reported in Ang and Bekaert (2002). This shows that the model is able to confidently distinguish which regimes are occurring at each point in time. The values of 5.18, 6.84 and 5.45 are particularly pleasing which indicate that the model has successfully captured the important but turbulent economic events in the 34 year sample analyzed in this paper. Although the RCM values for the three states are good indications for the switching model used in this study, we focus on the incremental power of the behavioral variable in the next section.

### ***Model Comparison***

In order to understand the efficacy of our regime based approach we carry out several pair wise model comparisons in a consistent framework. It may be argued that once we allow regime breaks based on variance and intercept terms there is no further advantage in allowing the coefficients of the explanatory variables to be regime dependent. We prove below that this is not the case and establish the central theme of our paper that the importance of the



explanatory variables depends on the regime. To this end, we carry out separate model estimation as in equation (2) but only allow the intercepts and variance terms to be regime dependent. We do not include those results in a table (but the figures are available upon request). However, before discussing the model comparison results we give a brief review of the consistent methodology we employ.

The issue of comparing models has been a long standing one in econometrics and statistical science. Dealing with nested models is now almost trivial as the log-likelihood can easily be compared using a simple likelihood ratio test. However, comparing non-nested models as well as models incorporating regimes is a different matter. Various measures of in sample fit, mostly non-parametric, have been advocated. These measures, designed for comparing predictions, are inconsistent and unreliable at best. The most satisfactory gauge of model fit is the objective function. Computing the log-likelihood and comparing the likelihood functions of two competing models will provide a definitive statement regarding the superiority of one model over the other. Vuong (1989) develops such a measure. The test proposed by Vuong is simple in its approach and its estimation only requires that all the conditional densities computed at the point of convergence during the optimization process be stored. The basic idea of constructing this test is given in the appendix.

The classical likelihood ratio based test deals with models that are nested where, by constraining some of the parameters of one model the second model is obtained. In our case, the regime based models and the basic regression model are clearly non-nested. The comparison between different regime based models can, however, still be considered in a classical setting of nested models. Vuong (1989) defines these concepts of nesting in term of spanning the conditional densities and developing the asymptotic distribution of the test statistics.

Although, the use of Vuong's non-nested likelihood ratio test is a relatively recent development in financial economics, it has been successfully adopted by Danielsson (1998), Ball and Torous (1999), and Smith (2002). This test statistic has a well-defined limiting distribution i.e.  $N(0, 1)$ . If the statistic is greater than the critical value at the 5% level then the Markov switching model captures the data generating process better than the other model. Similarly, Vuong demonstrates that the nested model test using his approach turns out to be the same as the classical test and has the Chi-square limiting distribution.

Good place for Table 4

We have shown the results of these tests in Table 4. The tests show that our regime based models are much better than the simple regression model of equation (1) using the non-nested tests of Vuong. Also, the regime based model that includes the momentum variable, equation (3), is much better than both the simple regime based model (with only intercepts and variance depending on regime), and the more complex regime based model which does not include the momentum variable. This proves the central hypothesis of our study that the importance of the explanatory variables depends on the regime, which a simple regression model cannot capture. Finally, the performance of the model of equation (3) exhibits the importance of the behavioral characteristic in explaining the equity premium. The behavioral variable as defined in this paper adds to the explanatory power of the macroeconomic phenomenon studied here.

### ***Evaluation***

We find that the explanatory pattern for the movement of the equity premium is dependent on the state of the economy as determined by the level of the variance of the equity premium. A Markov regime switching model is able to bring out better understanding of the nature of interaction between the selected independent variables and the equity premium. In addition to the fundamental and macroeconomic factors, we find a common proxy for the behavioral variable, momentum return, also has substantial explanatory power in all three regimes. The statistical tests carried out clearly support the modelling approach adopted in this paper. The model's classified states can identify periods of very high market volatility as well as periods that may be termed 'irrational exuberance'. In particular we confirm the importance and statistical significance of macroeconomic factors (unemployment and inflation), fundamentals (dividends), and behavioral (momentum) as explanatory variables of the U.S. equity premium.

### ***What Drives the Regime Transitions?***

We have already noticed that the volatility of the Markov switching model residuals is instrumental to the regime classification of the data and demonstrate the importance of regimes how the explanatory variables react. Regime 1 has much greater variance compared to other regimes. The probability plots of different regimes in Figures 1 and 2 do correspond to some of the known historical events. Thus, it is, reasonable to ask whether realized equity

premia have the power to influence the change in regimes. In order to quantify this we estimate a Logit regression model of the form:

$$p_t = \frac{1}{1 + \exp(-\alpha_0 - \alpha_1 x_{t-1})},$$

where  $p_t$  denotes the filtered probability of being in the high volatility regime at time  $t$ ,  $\alpha_0$  and  $\alpha_1$  are regression coefficients and  $x_t$  is the squared equity premium,  $xsr_t$ .

Good place for Table 5

Table 5 gives the results of estimating the Logit model as described above. The sign and significance of the coefficients representing the lagged squared equity premium for both models (with and without momentum return) indicate that a large jump in the equity premium up or down may indeed be followed by a regime shift.

Examining Figure 2 we observe that the model correctly selects the oil embargo of 1974, the crash of October 1987, the Long Term Capital Management crisis of 1998, the Russian Default, the 9/11 terrorist attacks, and the recent Financial Crisis as the highest volatility events.

## 6. CONCLUSIONS

The behavior of the stock market across various economic regimes has been a central topic of research. In this paper we augment the list of important fundamental and macroeconomic variables by adding trading momentum as a behavioral variable. Our goal is to use fundamental, macroeconomic, and behavioral variables to explain U.S. equity returns during the 1965-2008 period, across three economic regimes.

We do an extensive literature review to identify three broad categories of factors that can influence the U.S. equity premium. The first fundamental variable is dividends. Next, we identify certain macroeconomic variables such as inflation and unemployment. Finally, we also introduce a behavioral variable called momentum to explore its influence on the equity premium. We also review the role of monetary policy that is charged to maintain economic and financial stability by promoting economic growth and controlling for inflation. The main tool of monetary policy is the Fed funds rate. We use this Fed funds rate to define the risk free interest rate that is subtracted from the index returns to define the equity premium.

The theoretical hypotheses propose three regimes of economic conditions. The ever changing dynamic pattern of the equity premium is explained by placing different weights and significance between fundamental, macroeconomic and behavioral variables across the various phases of an economic cycle. To capture the most important phases we propose three regimes of market volatility: low volatility, average volatility and above average volatility.

We formulate and test six hypotheses about the equity premium: First, we hypothesize that when economic regimes are divided according to the level of volatility of the equity premium, the time duration of low volatility will be longer than the duration of the medium volatility regime and both will be longer than the duration of the highest volatility regime. Empirical evidence supports this hypothesis. In Table 1 the average durations for high, medium and low volatility regimes are 4.63, 20.08 and 40.74 months respectively and for Table 2 the durations are 2.08, 28.16 and 40.

Second, we hypothesize that dividends are very important as an explanatory variable and are expected to be significant across all regimes with a negative coefficient since high dividends reduce net returns. Evidence in Tables 1 and 2 supports this hypothesis.

Third, during periods of economic stability with low volatility, we expect macroeconomic variables such as inflation and unemployment to play a significant role in explaining the equity premium. This hypothesis is partially confirmed because the

significance of macroeconomic variables changes across the three volatility regimes for both models as reported in Tables 1 and 2.

Fourth, we hypothesize that momentum is present across the three regimes and higher momentum contributes to higher returns. This is confirmed with very high significance in Table 2. Next, we hypothesize that during periods of high volatility, momentum becomes the most significant variable among the ones considered in this model. This is partially confirmed. Table 2 presents evidence that momentum along with dividends and unemployment determine the equity premium in the high volatility regime.

Finally, during periods of very low volatility for the equity premium, dividends initially drive returns but momentum also becomes important. Similarly in periods of very high volatility both dividends and momentum explain returns but the significance of momentum increases. This hypothesis is also partially confirmed. Momentum, dividends and unemployment are significant explanatory variables for the equity premium both in the low and high volatility regimes but the significance of momentum does not increase during the high volatility regime as hypothesized.

In conclusion, we empirically test two models that differ in the number of independent variables that explain the equity premium. The first model includes dividends, inflation and unemployment while the second considers these three independent variables and also momentum. Empirical evidence demonstrates that fundamental variables represented by dividends are significant across all three regimes and in both models. Momentum also is highly significant across all three regimes. Inflation and unemployment fluctuate in their significance across the three regimes and the two models. In particular during the long periods of low volatility that last on average about 40 months each, the equity premium is influenced by dividends and momentum each offsetting the other. Dividends have a coefficient of -2.0427 while momentum has a coefficient of 2.088. During the very short periods of above average volatility that last on average only 2 months, momentum dominates as an explanatory variable. Finally, during periods of average volatility that last about 28 months both dividends and momentum are significant along with inflation. These results support our hypotheses that both fundamentals and behavioral variables explain the equity premium with different significance across volatility regimes.

## Appendix:

Vuong's (1989) test for selection of non-nested models is related to the classical likelihood ratio based test and uses Kullback-Leibler Information criterion to measure the closeness of the model to the true data generating process. The test is directional and may be used to decide which model is performing better than the other one in explaining the data under consideration.

Consider two competing models with the conditional densities for the observations,  $y$ , with the explanatory variables,  $z$ , are given by,  $f(y|z;\Theta)$ , and  $g(y|z;\Psi)$ , where  $\Theta$  and  $\Psi$  are the parameter vectors for the first and second model respectively. For non-nested models, under certain regulatory conditions, Vuong showed that the following test statistic,

$$\frac{\sum_{i=1}^n \ln f(y_i) - \ln g(y_i)}{\sqrt{n\hat{\omega}_n}} \xrightarrow{D} N(0,1),$$

where  $n$  is the number of observations and  $\hat{\omega}_n$  is given by,

$$\hat{\omega}_n^2 = \frac{1}{n} \sum_{i=1}^n [\ln f(y_i) - \ln g(y_i)]^2 - \left[ \frac{1}{n} \sum_{i=1}^n [\ln f(y_i) - \ln g(y_i)] \right]^2$$

is the variance of the test statistic.

This statistic is easy to compute once the maximum likelihood estimation of the parameters has been carried out. The procedure needs to store all the conditional densities computed at the point of convergence. If the computed test statistic is higher than the chosen critical value, we reject the hypothesis that the models are equivalent in favour of the model represented by the conditional densities,  $f(y|z;\Theta)$

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Table 1  
Parameter Estimates Determining the Equity Premium (Equation 2)  
Three State Markov Switching Model

|   | $S_t = 1$             | $S_t = 2$              | $S_t = 3$              |
|---|-----------------------|------------------------|------------------------|
| $c_0$ (Intercept)   | -0.036830*<br>(-2.93) | 0.017667*<br>(7.89)    | 0.007656***<br>(1.94)  |
| $c_1$ ( $\Delta$ Dividend)                                | -0.247037*<br>(-3.63) | -0.414413*<br>(-15.03) | -1.654876*<br>(-12.37) |
| $c_2$ (Inflation)   | 5.015457*<br>(2.74)   | -1.454474**<br>(-2.48) | -2.771233*<br>(-3.72)  |
| $c_3$ ( $\Delta$ Unemp. Rate)                             | -0.028334<br>(-0.59)  | 0.045672*<br>(2.92)    | -0.085522*<br>(-4.79)  |
| $\sigma^2 \times 10^{-3}$                                 | 4.037*<br>(4.90)      | 0.556*<br>(10.13)      | 0.539*<br>(7.72)       |
| Transition probability matrix $p_{i,j} : j \rightarrow i$ |                       |                        |                        |
|   | $j=1$                 | $j=2$                  | $j=3$                  |
| $i=1$   | 0.783918*<br>(9.75)   | 0.036780**<br>(2.49)   | 0.019468<br>(1.56)     |
| $i=2$   | 0.216082*<br>(2.69)   | 0.950202*<br>(60.06)   | 0.005075<br>(0.71)     |
| $i=3$   | 1.00E-08              | 0.013018               | 0.975456               |
| Average duration in a particular state (months)           |                       |                        |                        |
|   | 4.63                  | 20.08                  | 40.74                  |

The numbers in parentheses are t-statistics computed from the information matrix. Single \* indicates significance at 1% level and double \* indicates significance at 5% level and triple \* indicates 10% level.

Ljung-Box statistic for model squared residual with lag 36 gives a p-value of 0.410 indicating no residual heteroscedasticity. Additional diagnostics are given in the text.

Table 2  
Parameter Estimates Determining the Equity Premium (Equation 3)  
Three State Markov Switching Model

|   | $S_t = 1$             | $S_t = 2$              | $S_t = 3$              |
|---|-----------------------|------------------------|------------------------|
| $c_0$ (Intercept)   | 0.002602<br>(0.51)    | -0.001939<br>(-1.77)   | -0.000400<br>(-0.60)   |
| $c_1$ ( $\Delta$ Dividend)                                | -0.575593*<br>(-3.64) | -7.897492*<br>(-22.25) | -2.042740*<br>(-27.63) |
| $c_2$ (Inflation)   | 0.572984<br>(1.23)    | 0.709286*<br>(3.13)    | 0.136024<br>(0.87)     |
| $c_3$ ( $\Delta$ Unemp. Rate)                             | 0.132181*<br>(6.27)   | -0.002867<br>(-0.81)   | 0.007629**<br>(2.07)   |
| $c_4$ (Momentum)  | 2.597215*<br>(24.95)  | 2.004013*<br>(59.73)   | 2.087992*<br>(73.32)   |
| $\sigma^2 \times 10^{-3}$                                 | 0.092**<br>(2.27)     | 0.051*<br>(9.05)       | 0.047*<br>(9.64)       |
| Transition probability matrix $p_{i,j} : j \rightarrow i$ |                       |                        |                        |
|   | j=1                   | j=2                    | j=3                    |
| i = 1   | 0.519984*<br>(83.66)  | 0.027659<br>(1.34)     | 0.008635<br>(1.43)     |
| i = 2   | 0.338973<br>(1.48)    | 0.964489*<br>(51.52)   | 0.016363<br>(1.79)     |
| i = 3   | 0.141044              | 0.007852               | 0.975002               |
| Average duration in a particular state (months)           |                       |                        |                        |
|   | 2.08                  | 28.16                  | 40.00                  |

The numbers in parentheses are t-statistics computed from the information matrix. Single \* indicates significance at 1% level and double \* indicates significance at 5% level, and triple \* indicates 10% level.

Ljung-Box statistic for model squared residual with lag 36 gives a p-value of 0.933 indicating no residual heteroscedasticity. Additional diagnostics are given in the text.

Table 3  
BDS Test Statistics for Different Dimensions

| Dimension | Model (Equation 2) | Model (Equation 3) |
|-----------|--------------------|--------------------|
| 2         | 0.014637           | 0.004334           |
| 3         | 0.030291           | 0.008035           |
| 4         | 0.041476           | 0.012593           |
| 5         | 0.046601           | 0.014279           |
| 6         | 0.045267           | 0.016128           |

Epsilon chosen for this test is 70% of the range of the fraction of the pairs (carried out in EViews).

Table 4  
Model Comparisons Using Vuong (1989) Likelihood Ratio Test  
Test Statistics and Critical Values at 0.05 Level of Significance\*

|                  | Model 1 vs. Model 0 | Model 2 vs. Model 0 | Model 3 vs. Model 0 |
|------------------|---------------------|---------------------|---------------------|
| Non-nested Tests | 20.24               | 17.96               | 31.66               |
|                  | 1.64                | 1.64                | 1.64                |
|                  | Model 2 vs. Model 1 | Model 3 vs. Model 1 | Model 3 vs. Model 2 |
| Nested Tests     | 2.88                | 28.77               | 27.51               |
| Critical Values  | 12.59               | 16.92               | 7.81                |

Model 0 refers to the regression model of equation 1 with no Markov switching regimes. Model 1 refers to the three state Markov switching regimes only in intercepts and variances and explanatory variables as in equation 2. Model 2 refers to the three state Markov switching regimes given by equation 1 where all parameters are regime dependent. Model 3 is similar to model 2 with the addition of state dependent momentum return as an extra explanatory variable.

\*The properties of the critical values and the tests are discussed in the text. In the upper panel the comparisons with model 0 are non-nested and as such the critical values refer to the limiting distribution  $N(0,1)$ . The nested model tests in the lower panel have critical values obtained from Chi-square distributions with degrees of freedom being the differences in number of parameters.

Table 5  
Logit Model Results

|                        | Without Momentum Return | With Momentum Return |
|------------------------|-------------------------|----------------------|
| Coefficient $\alpha_1$ | 297.23                  | 98.65                |
| t-Stat.                | (5.15)                  | (4.06)               |
| Pseudo R-Square        | [0.17]                  | [0.06]               |

These results are obtained from EViews using Binary estimation method.

Figure 1  
 Smoothed State Probabilities Inferred by the Model  
 Three State Model for the Equity Premium

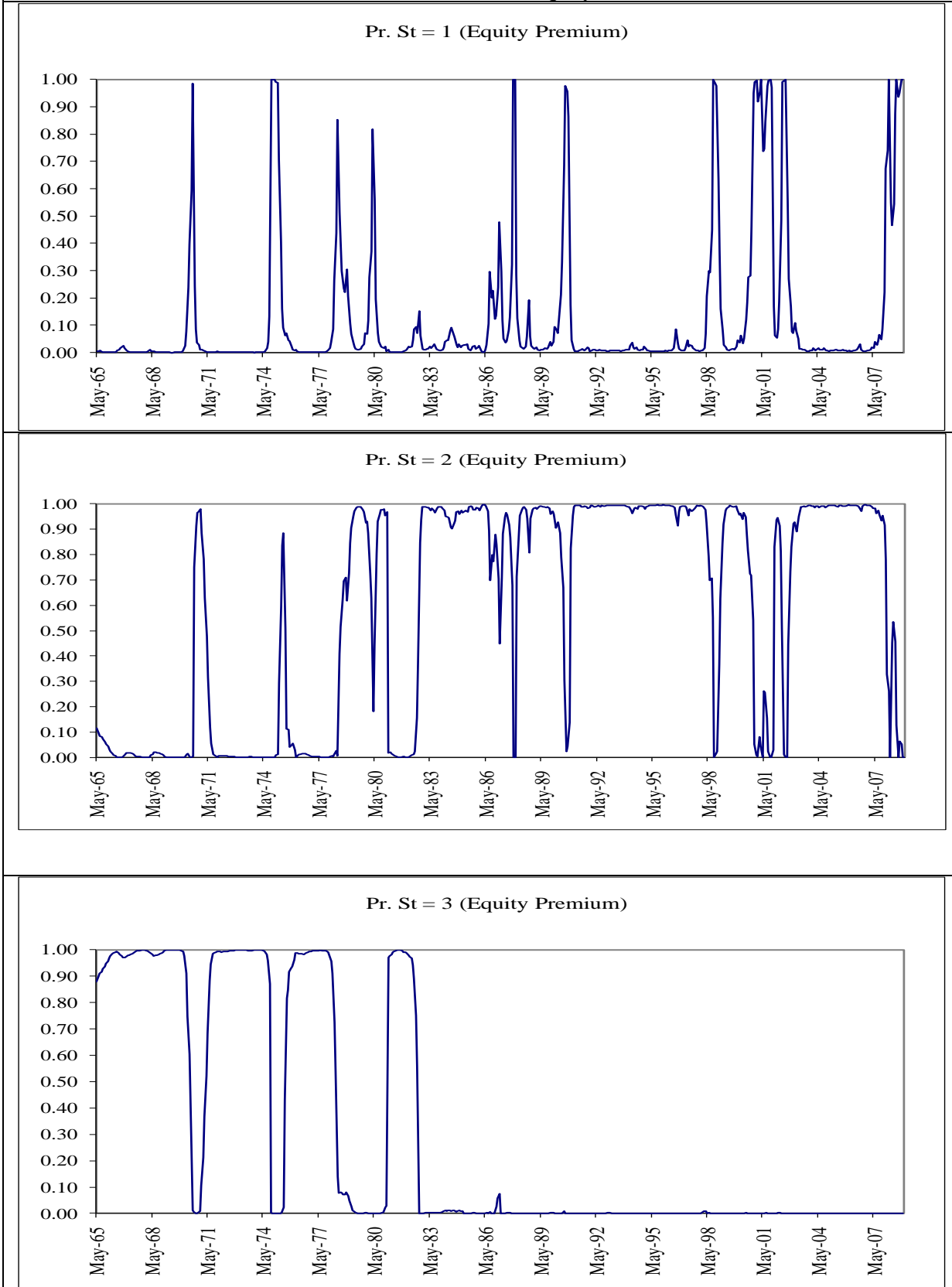




Figure 2  
Smoothed State Probabilities Inferred by the Model and Momentum Return  
Three State Model for the Equity Premium

