

Value versus Growth: Time-Varying Expected Stock Returns

Huseyin Gulen*
Krannert Graduate School of Management
Purdue University

Yuhang Xing†
Jones Graduate School of Management
Rice University

Lu Zhang‡
Stephen M. Ross School of Business
University of Michigan
and NBER

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Abstract

Using a Markov switching model, we document that the expected value-minus-growth return displays strong countercyclical variations. Under a variety of flexibility proxies such as the ratio of fixed assets to total assets, the frequency of disinvestment, financial leverage, and operating leverage, we show that value firms are less flexible in adjusting to worsening economic conditions than growth firms, and that inflexibility increases the costs of equity in the cross section. The time-variations in the expected value premium highlight the importance of conditioning information in understanding the cross section of average returns.

*Krannert Graduate School of Management, Purdue University, 403 West State Street, West Lafayette, IN 47907. Tel: (765) 496-2689, fax: (765) 494-9658, and e-mail: hgulen@purdue.edu.

†Jesse H. Jones Graduate School of Management, MS 531, Rice University, 6100 Main Street, Houston TX 77005. Tel: (713) 348-4167, fax: (713) 348-5251, and e-mail: yxing@rice.edu.

‡Finance Department, Stephen M. Ross School of Business, University of Michigan, 701 Tappan Street R 4336, Ann Arbor MI 48109-1234; and NBER. Tel: (734) 615-4854, fax: (734) 936-0282, and e-mail: zhanglu@bus.umich.edu.

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1 Introduction

Value stocks earn higher average returns than growth stocks (e.g., Rosenberg, Reid, and Lanstein 1985, Fama and French 1992, 1993, and Lakonishok, Shleifer, and Vishny 1994). But the economic sources of the value premium (the average return difference between value and growth stocks) have been a source of heated debate. DeBondt and Thaler (1985), Lakonishok et al., and Daniel, Hirshleifer, and Subrahmanyam (1998) argue that the value premium is driven by investor overreaction. The investment-based asset pricing literature has responded by linking risk and expected returns to firm characteristics and resurrected the view that fundamentals are important drivers for cross-sectional expected returns (e.g., Cochrane 1991, Berk, Green, and Naik 1999, Carlson, Fisher, and Giammarino 2004, and Zhang 2005). Although the underlying model structures are diverse, a central prediction in this literature is that firms should differ in cyclical behavior of expected returns, depending on their respective book-to-market ratios (see Section 2 for detailed explanations).

Consistent with theory, we find strong evidence of countercyclical movements in the expected value-minus-growth return. Using the two-state Markov switching framework of Perez-Quiros and Timmermann (2000), we find that in recessions, the expected excess returns of value stocks are most strongly affected, and the expected excess returns of growth stocks are least affected, by worsening aggregate economic conditions as measured by higher short-term interest rate and higher default spread. By way of contrast, in expansions the expected excess returns of both value and growth stocks have insignificant loadings on the short-term interest rate and the default spread. Because of the asymmetric response across the states of the economy, the expected value-minus-growth return displays strong cyclical variations. The expected return tends to spike upwards rapidly during recessions only to decline more gradually in the ensuing expansions. We also document similar time-variations in the conditional volatility and the conditional Sharpe ratio of the value strategy.

Guided by theory, we also examine the potential sources of the time-varying expected value premium. Using a variety of proxies for real flexibility, we test the theoretical prediction that value firms are less flexible than growth firms in adjusting to worsening economic conditions. The answer is strongly affirmative. We document that value firms have higher ratios of fixed assets to total assets, higher frequency of disinvestment, higher financial leverage, and higher operating leverage than growth firms. Moreover, constructing a composite inflexibility index that aggregates the information contained in the four individual proxies, we show that firms with less real flexibility incur higher costs of equity on average than firms with more real flexibility.

Time series predictability of the stock market returns has received much attention in empirical finance. In contrast, the literature on predicting returns to anomalies-based trading strategies such as the value strategy seems underdeveloped. Despite some affirmative evidence, the question whether the value premium is predictable remains controversial.¹ Summarizing a large empirical literature in behavioral finance, Barberis and Thaler (2003, pp. 1091–1092) argue that: “Stocks are risky if they fail to pay out at times of high marginal utility—in ‘bad’ times—and instead pay out when marginal utility is low—in good times. The problem is that . . . there is little evidence that the portfolios with anomalously high average returns do poorly in bad times, whatever plausible measure of bad times is used. For example, Lakonishok et al. (1994) show that in their 1968 to 1989 sample period, value stocks do well relative to growth stocks even when the economy is in recession. Similarly, DeBondt and Thaler (1987) find that their loser stocks have higher betas than winners in up markets and lower betas in down markets an attractive combination that no one would label ‘risky.’ ” Lewellen and Nagel (2006) also argue that the covariance between the value-minus-growth betas and the expected market risk premium is too small. Chen, Petkova, and Zhang (2008) show that the expected value premium estimated from predictive regressions is only weakly responsive to negative shocks to aggregate economic conditions. We contribute to the literature by documenting strong evidence that the expected value premium estimated from a Markov switching framework is countercyclical.

Our Markov switching framework follows that of Perez-Quiros and Timmermann (2000).² Our work differs in both economic question and theoretical motivation. Perez-Quiros and Timmermann ask whether there exists a differential response in expected returns to negative monetary policy shocks between small and large firms. Their study is motivated by imperfect capital markets theories (e.g., Bernanke and Gertler 1989, Gertler and Gilchrist 1994, and Kiyotaki and Moore 1997). In contrast, we ask whether there exists a differential response in expected returns to negative aggregate shocks between value and growth firms, an inquiry motivated by investment-based asset pricing theories (e.g., Carlson, Fisher, and Giammarino 2004 and Zhang 2005).

Section 2 motivates our empirical analysis. Section 3 estimates a univariate Markov switching model for each individual book-to-market deciles. Section 4 estimates a joint switching model for the value and growth deciles simultaneously. Section 5 examines the sources of the time-variations

¹The affirmative evidence is documented by, for example, Jagannathan and Wang (1996), Pontiff and Schall (1999), Lettau and Ludvigson (2001), Cohen, Polk, and Vuolteenaho (2003), and Ang and Chen (2007).

²Similar regime switching models have been extensively used in empirical finance to address diverse issues such as international asset allocation (e.g., Ang and Bekaert 2002a and Guidolin and Timmermann 2008a), interest rate dynamics (e.g., Ang and Bekaert 2002b), capital markets integration (e.g., Bekaert and Harvey 1995), and the joint distribution of stock and bond returns (e.g., Guidolin and Timmermann 2006 and Guidolin and Timmermann 2008b).

in expected returns related to the real flexibility of firms. Section 6 concludes.

2 Sources of the Time-Variations in the Expected Value Premium

Why should the expected returns of value firms covary more with recessions than the expected returns of growth firms? Equivalently, why should the expected value premium display countercyclical variations? The investment-based asset pricing theories have recently provided some clues. The key word is inflexibility. The basic idea is that due to a variety of sources, value firms are less flexible than growth firms in adjusting to recessionary shocks. As a result, the risk and the expected return of value firms are highest in recessions relative to those of growth firms. The theories have suggested three distinct but related sources that can give rise to the relative inflexibility of value firms: costly reversibility, operating leverage, and financial leverage.

Zhang (2005) argues that because of costly reversibility and time-varying price of risk, value firms are less flexible than growth firms in scaling down to mitigate the impact of negative shocks. As a result, value firms are riskier than growth firms in recessions when the price of risk is high. Specifically, costly reversibility means that firms face higher costs in scraping than in expanding the scale of productive assets (e.g., Ramey and Shapiro 2001). Because the assets of value firms are less profitable than growth firms, value firms want to disinvest more in recessions. In contrast, disinvesting is not as important for growth firms with more productive assets. Because disinvesting is restricted by costly reversibility, the fundamentals of value firms are more adversely affected by worsening economic conditions than the fundamentals of growth firms.

Time-varying price of risk reinforces the effect of costly reversibility. When the aggregate price of risk is countercyclical (e.g., Campbell and Cochrane 1999), the discount rates of firms will be in general higher in recessions than in expansions. Consequently, the expected net present values of assets in place are even lower than they would be if the price of risk is constant, meaning that value firms want to disinvest even more. Because scaling down is difficult, the fundamentals of value firms are even more exposed to negative aggregate shocks than they would be with constant price of risk.

Because costly reversibility and time-varying price of risk deprive value firms of flexibility in scaling down, value firms are riskier than growth firms in bad times. Combined with time-varying price of risk, the countercyclical risk dynamics of the value-minus-growth strategy give rise to the countercyclical variations in the expected value premium. Gala (2007) extends the economic mechanism of costly reversibility on risk and expected returns proposed by Zhang (2005) in the context

of an industry equilibrium model into a general equilibrium framework.

The effect of costly reversibility on risk and expected returns is also studied by Kogan (2004) and Cooper (2006). Kogan assumes that the rate of investment must be between zero and an upper limit. The lower constraint is due to irreversibility, and the upper constraint is due to adjustment costs. He finds that when the lower constraint is binding, the relation between book-to-market and expected returns is positive. Using a dynamic investment model with fixed costs of investment, Cooper finds that book-to-market is informative of the deviation of the actual capital stock from the target level. This deviation in turn measures the sensitivity of stock returns to aggregate economic conditions. Although the underlying model structures are diverse, the central prediction is largely in line with that from Zhang (2005) and Gala (2007).

Operating leverage also drives the time-variations in the expected value premium. Building on Berk, Green, and Naik (1999), Carlson, Fisher, and Giammarino (2004) use a real options model to study the dynamic behavior of monopolistic firms. When demand for the product of the firms in the economy decreases, equity values fall relative to book values and revenues fall relative to the average level. For value firms, equity values fall more relative to book values and revenues fall more relative to the average, meaning that value firms should have higher operating leverage than growth firms. Further, the fixed costs of production are fixed and do not decrease proportionally with revenues in recessions, meaning that earnings (revenues minus variable and fixed costs) will decrease more than proportionally relative to revenues. This operating leverage mechanism causes value firms to be more affected by negative aggregate shocks than growth firms. As a result, the risk and expected returns of value firms increase more than the risk and expected returns of growth firms in recessions.

The theories that we have discussed so far study firms that are all equity financed and ignore the effect of financial leverage on risk and expected returns. Livdan, Sapriza, and Zhang (2008) incorporate retained earnings, debt, costly external equity, and collateral constraints on debt capacity in the spirit of Hennessy and Whited (2005) into the investment-based asset pricing framework. Livdan et al. find that leverage ratios increase risk and expected returns, and that this effect is even more dramatic for the less profitable value firms than for the more profitable growth firms.

Livdan, Sapriza, and Zhang (2008) discuss two channels through which leverage affects risk and expected returns. First, according to the standard leverage hypothesis in corporate finance, higher leverage means that shareholders must bear a higher proportion of the asset risk and require a higher risk premium to hold the stocks. Second, the inflexibility mechanism allows the underlying

asset risk to increase with leverage. Intuitively, more leveraged firms are burdened with more debt and must pay more interests and retire a higher amount of the existing debt before financing new investments. Thus, these firms are more likely to face binding collateral constraints, less flexible in using investment to smooth dividends, riskier, and earn higher expected returns than less leveraged firms. Finally, the leverage effect on risk and expected returns should be even more important for the less profitable value firms than for the more profitable growth firms. The idea is that the inflexibility due to high leverage ratios interacts with other sources of inflexibility such as costly reversibility and operating leverage, both of which are more severe for less profitable firms.

3 A Univariate Model of Time-Varying Expected Stock Returns

Section 3.1 describes the econometric framework that we use. Section 3.2 describes our data and model specifications. Section 3.3 presents and discusses our estimation results.

3.1 The Econometric Framework

We adopt the Markov switching framework that explicitly allows for state dependence in expected stock returns. To facilitate economic interpretation in lines of recessions and expansions, we allow for only two possible states to be determined by the data.

Specifically, we use the Perez-Quiros and Timmermann (2000) Markov switching framework with time-varying transition probabilities based on prior work of Hamilton (1989) and Gray (1996). Let r_t denote the excess return of a testing portfolio over period t and \mathbf{X}_{t-1} be a vector of conditioning variables. The Markov switching framework allows the intercept term, slope coefficients, and volatility of excess returns to depend on a single, latent state variable, S_t :

$$r_t = \beta_{0,S_t} + \beta'_{S_t} \mathbf{X}_{t-1} + \epsilon_t, \quad \epsilon \sim \mathcal{N}(0, \sigma_{S_t}^2) \quad (1)$$

in which $\mathcal{N}(0, \sigma_{S_t}^2)$ denotes a normal distribution with mean zero and variance, $\sigma_{S_t}^2$. Two states, $S_t = 1$ or $S_t = 2$, mean that the slopes and variance are either $(\beta_{0,1}, \beta'_1, \sigma_1^2)$ or $(\beta_{0,2}, \beta'_2, \sigma_2^2)$.

To specify how the underlying state evolves through time, we assume that the state transition

probabilities follow a first-order Markov chain:

$$p_t = P(S_t = 1|S_{t-1} = 1, \mathbf{Y}_{t-1}) = p(\mathbf{Y}_{t-1}) \quad (2)$$

$$1 - p_t = P(S_t = 2|S_{t-1} = 1, \mathbf{Y}_{t-1}) = 1 - p(\mathbf{Y}_{t-1}) \quad (3)$$

$$q_t = P(S_t = 2|S_{t-1} = 2, \mathbf{Y}_{t-1}) = q(\mathbf{Y}_{t-1}) \quad (4)$$

$$1 - q_t = P(S_t = 1|S_{t-1} = 2, \mathbf{Y}_{t-1}) = 1 - q(\mathbf{Y}_{t-1}) \quad (5)$$

in which \mathbf{Y}_{t-1} is a vector of variables publicly known at time $t - 1$ and affect the state transition probabilities between time $t - 1$ and t . Prior studies have shown that the state transition probabilities are time-varying and depend on prior conditioning information such as the economic leading indicator (e.g., Filardo 1994 and Perez-Quiros and Timmermann 2000) or interest rates (e.g., Gray 1996). Intuitively, investors are likely to possess superior information on the state transition probabilities than that implied by the model with constant transition probabilities.

We estimate the parameters of the econometric model using maximum likelihood methods. Let $\boldsymbol{\theta}$ denote the vector of parameters entering the likelihood function for the data. Suppose the density of the innovations, ϵ_t , conditional on being in state j , $f(r_t|S_t = j, \mathbf{X}_{t-1}; \boldsymbol{\theta})$, is Gaussian:

$$f(r_t|\Omega_{t-1}, S_t = j; \boldsymbol{\theta}) = \frac{1}{\sqrt{2\pi\sigma_j}} \exp\left(\frac{-(r_t - \beta_{0,j} - \beta'_j \mathbf{X}_{t-1})^2}{2\sigma_j}\right) \quad (6)$$

for $j = 1, 2$. Ω_{t-1} denotes the information set that contains $\mathbf{X}_{t-1}, r_{t-1}, \mathbf{Y}_{t-1}$, and lagged values of these variables. The log-likelihood function is given by:

$$\mathcal{L}(r_t|\Omega_{t-1}; \boldsymbol{\theta}) = \sum_{t=1}^T \log(\phi(r_t|\Omega_{t-1}; \boldsymbol{\theta})) \quad (7)$$

in which the density, $\phi(r_t|\Omega_{t-1}; \boldsymbol{\theta})$, is obtained by summing the probability-weighted state densities, $f(\cdot)$, across the two possible states:

$$\phi(r_t|\Omega_{t-1}; \boldsymbol{\theta}) = \sum_{j=1}^2 f(r_t|\Omega_{t-1}, S_t = j; \boldsymbol{\theta}) P(S_t = j|\Omega_{t-1}; \boldsymbol{\theta}) \quad (8)$$

and $P(S_t = j|\Omega_{t-1}; \boldsymbol{\theta})$ is the conditional probability of state j at time t given information at $t - 1$.

The conditional state probabilities can be obtained recursively:

$$P(S_t = i|\Omega_{t-1}; \boldsymbol{\theta}) = \sum_{j=1}^2 P(S_t = i|S_{t-1} = j, \Omega_{t-1}; \boldsymbol{\theta}) P(S_{t-1} = j|\Omega_{t-1}; \boldsymbol{\theta}) \quad (9)$$

in which the conditional state probabilities, by Bayes's rule, can be obtained as:

$$P(S_{t-1} = j | \Omega_{t-1}; \theta) = \frac{f(r_{t-1} | S_{t-1} = j, \mathbf{X}_{t-1}, \mathbf{Y}_{t-1}, \Omega_{t-2}; \theta) P(S_{t-1} = j | \mathbf{X}_{t-1}, \mathbf{Y}_{t-1}, \Omega_{t-2}; \theta)}{\sum_{j=1}^2 f(r_{t-1} | S_{t-1} = j, \mathbf{X}_{t-1}, \mathbf{Y}_{t-1}, \Omega_{t-2}; \theta) P(S_{t-1} = j | \mathbf{X}_{t-1}, \mathbf{Y}_{t-1}, \Omega_{t-2}; \theta)} \quad (10)$$

Following Gray (1996) and Perez-Quiros and Timmermann (2000), we iterate on equations (9) and (10) to derive the state probabilities, $P(S_t = j | \Omega_{t-1}; \theta)$, and obtain the parameter estimates of the likelihood function. Variations in the state probabilities can be interpreted as evidence supporting the notion of time-variations in expected stock returns.

3.2 Data and Model Specifications

We use as testing assets the excess returns of the decile portfolios formed on book-to-market equity. Excess returns are defined in excess of the one-month Treasury bill rate. The data for the decile returns and Treasury bill rates are from Kenneth French's Web site. The sample period is from January 1954 to December 2007 with a total of 648 monthly observations. Following Perez-Quiros and Timmermann (2000), we start the sample from January 1954 to conform with the period after the Treasury-Federal Reserve Accord that allows the Treasury bill rates to vary freely.

Table 1 reports the moments of monthly excess returns for ten book-to-market deciles. The mean excess return increases virtually monotonically from 0.48% per month for the growth decile to 0.97% for the value decile. The value-minus-growth portfolio earns an average return of 0.48% with a volatility of 4.28% per month, meaning that the average return is more than 2.8 standard errors from zero. Most of the deciles are negatively skewed, but the value-minus-growth portfolio is positively skewed. Finally, all portfolios are fat-tailed with kurtosis coefficients larger than three.

To provide some initial sense on the time-variations in the expected value premium, Figure 1 provides a bar graph for the annual value-weighted value-minus-growth returns. The value portfolio is the decile with the highest book-to-market equity, and the growth portfolio is the decile with lowest book-to-market equity. Figure 1 suggests countercyclical variations in the expected value premium. For example, the realized value-minus-growth return hits the bottom during the period immediately before or shortly after the beginning of the recession in 2000. However, the value decile then outperforms the growth decile dramatically in earlier 2000s. This pattern of value first sinking below and then rising above growth also can be observed in the recessions of 1957–58, 1981–82, and 1990–91. Although outside our sample period, untabulated results also show that this dynamic profitability pattern of the value-minus-growth strategy appears in the Great Depression. Interestingly, the value

portfolio underperforms the growth portfolio by 13.8% per annum in 2007, suggesting that the U.S. economy is heading towards or is already in a recession at the time of this writing in September 2008.

To quantify the importance of the cyclical variations, we model the excess returns for each of the book-to-market portfolios as a function of an intercept term and lagged values of the one-month Treasury bill rate, the default spread, changes in the money stock, and the dividend yield. All the variables are common predictors of stock market excess returns. We use the one-month Treasury bill rate, TB , as a state variable to proxy for the unobserved expectations of investors on future economic activity. A negative shock to real economic growth might lead to an increase in the current and expected inflation, which in turn induces a higher Treasury bill rate. Thus, interest rates and stock returns are likely to be negatively correlated contemporaneously (e.g., Fama and Schwert 1977, Fama 1981, Campbell 1987, Glosten, Jagannathan, and Runkle 1993). Also, the Federal Reserve typically raises short-term interest rates in expansions to curb inflation pressures and lowers short-term interest rates in recessions to stimulate economic growth.

The default spread, DEF , is the difference between yields on Baa- and Aaa-rated corporate bonds from Ibbotson Associates. Value firms are likely to be more exposed to bankruptcy risks during recessions than growth firms, meaning that the returns of value stocks should have higher loadings on the default spread than the returns of growth stocks. Further, the empirical macroeconomics literature shows that the default spread is one of the strongest forecasters of the business cycle (e.g., Stock and Watson 1989 and Bernanke 1990). Not surprisingly, the default spread has been used as a primary conditioning variable in the literature on stock market predictability (e.g., Keim and Stambaugh 1986, Campbell 1987, Fama and French 1989, and Kandel and Stambaugh 1990). Indeed, Jagannathan and Wang (1996) use the default spread as the only instrument in modeling the expected market risk premium in their influential study of the conditional CAPM.

The growth in the money stock, ΔM , is defined as the 12-month log difference in the monetary base reported by the Federal Reserve Bank in St. Louis. We use the change in the money supply to measure the liquidity changes in the economy. ΔM also measures monetary policy shocks that can affect aggregate economic conditions. The dividend yield, DIV , is defined as dividends on the value-weighted CRSP market portfolio over the previous 12 months divided by the stock price at the end of the month. The variable has been shown to predict future stock returns (e.g., Campbell and Shiller 1988). The dividend yield captures mean reversion in expected stock returns because a high dividend yield means that dividends are discounted at a higher rate.

For each book-to-market decile portfolio, indexed by i , we estimate the following model:

$$r_t^i = \beta_{0,S_t}^i + \beta_{1,S_t}^i TB_{t-1} + \beta_{2,S_t}^i DEF_{t-1} + \beta_{3,S_t}^i \Delta M_{t-2} + \beta_{4,S_t}^i DIV_{t-1} + \epsilon_t^i \quad (11)$$

in which r_t^i is the monthly excess return for the i^{th} decile portfolio formed on book-to-market equity, $\epsilon_t^i \sim N(0, \sigma_{i,S_t}^2)$, and $S_t = \{1, 2\}$. Following Perez-Quiros and Timmermann (2000), we lag the one-month Treasury bill rate, the default spread, and the dividend yield by one period, and we lag the growth in money supply by two periods to allow for the publication delay for this variable. The conditional variance of excess returns, σ_{i,S_t}^2 is allowed to depend on the state of the economy:

$$\log(\sigma_{i,S_t}^2) = \lambda_{S_t}^i \quad (12)$$

For simplicity, we do not include ARCH terms or instrumental variables in the volatility equation.

State transition probabilities are specified as follows:

$$p_t^i = P(S_t^i = 1 | S_{t-1}^i = 1, \mathbf{Y}_{t-1}) = \Phi(\pi_0^i + \pi_1^i TB_{t-1}) \quad (13)$$

$$1 - p_t^i = P(S_t^i = 2 | S_{t-1}^i = 1) \quad (14)$$

$$q_t^i = P(S_t^i = 2 | S_{t-1}^i = 2, \mathbf{Y}_{t-1}) = \Phi(\pi_0^i + \pi_2^i TB_{t-1}) \quad (15)$$

$$1 - q_t^i = P(S_t^i = 1 | S_{t-1}^i = 2) \quad (16)$$

in which S_t^i is the state indicator for the i^{th} portfolio and Φ is the cumulative density function of a standard normal variable. Following Gray (1996), we capture the information of investors on state transition probabilities parsimoniously through the use of the one-month Treasury bill rate.

3.3 Estimation Results

We now present the estimation results for the ten book-to-market deciles.

3.3.1 The Interpretation of the States

Table 2 shows that state 1 is associated with low average returns and high conditional volatilities and that state 2 is associated with high average returns and low conditional volatilities. This evidence means that state 1 is the recessionary state and state 2 is the expansionary state. In particular, the low average returns in state 1 mean low average ex post realized returns, which in turn mean high ex ante expected returns, consistent with state 1 being a recessionary state. And the high average returns in state 2 mean high average ex post realized returns, which in turn mean low ex ante expected returns, consistent with state 2 being an expansionary state.

Moving from the growth decile to the value decile, we observe that the constant term is universally lower in state 1 and higher in state 2. The constant term in state 1 also is estimated with more precision than in state 2. Eight out of ten constant terms in state 1 are significant at the five percent level and all ten estimates are negative. In contrast, only one out of ten constant terms in state 2 is significant. Further, the difference in the constant term between states 1 and 2 increases in magnitude from 0.80% per month for the growth portfolio to 9.2% per month for the value portfolio. This evidence offers the first indication that the expected return of the value portfolio reacts more to negative aggregate shocks than that of the growth portfolio.

Table 2 also shows that all the volatilities are estimated quite precisely with small standard errors. Further, the volatility estimates are countercyclical: All ten deciles have volatilities in the recession state that are about twice as large as those in the expansion state. This pattern confirms the findings of Schwert (1989) that stock return volatilities are higher in recessions than those in expansions. However, the difference in volatilities between the two states is largely similar in magnitude across the ten deciles. This evidence contrasts with that in Perez-Quiros and Timmermann (2000) that the volatilities of small firms are more strongly affected by the recession state.

We can further clarify the interpretation of the two hidden states. Figure 2 plots the conditional transition probabilities of being in state 1 at time t conditional on the information set at time $t - 1$, $P(S_t = 1|\Omega_{t-1}; \theta)$, for the value and growth portfolios. We also overlay the transition probabilities with historical NBER recession dates. In our specification, the conditional transition probabilities depend on lagged conditioning information and reflect the perception of investors on the conditional likelihood of being in state 1 in the next period. From Figure 2, the transitional probabilities of being in state 1 are all quite high during the eight recessions since World War II. State 1 also captures times of high volatility such as October 1987 that is not in a recession. However, the correlation between the state probabilities for the value portfolio with the procyclical one-month Treasury bill rate is -0.20 . And the correlation between the state probabilities for the growth portfolio and the countercyclical default spread is 0.49 . On balance, the evidence suggests that the state probabilities are countercyclical, meaning that state 1 with low average returns and high volatilities can largely be interpreted as the recession state.

3.3.2 Conditional Mean Equations

The focus of our analysis is on the conditional mean equations. Table 2 shows that coefficients on the one-month Treasury bill rate are all negative for the ten book-to-market deciles in state 1.

All the coefficients are significant at the five percent level. More important, the magnitude of the coefficients varies systematically with book-to-market. Moving from the growth decile to the value decile, the coefficients increase in magnitude virtually monotonically from -5.68 with a standard error of 1.54 to -11.67 with a standard error of 3.28 . This evidence means that in recessions, value firms are more affected by interest rate shocks than growth firms.

By way of contrast, in the expansion state the excess returns of the book-to-market portfolios are not much affected by the short-term interest rates. Although all the coefficients on the Treasury bill rate are still negative, only three out of ten are significant. In particular, the coefficient for the growth portfolio is -1.45 , which is even slightly higher in magnitude than that for the value portfolio, -1.34 . However, both coefficients are within 1.2 standard errors of zero.

Table 2 also reports systematical variations in the coefficients of the portfolio excess returns on the default spread. In the recession state, all the deciles generate coefficients of the default spread that are positive and significant at the five percent level. More important, moving from the growth portfolio to the value portfolio, the coefficient increases largely monotonically from 4.02 with a standard error of 0.88 to 7.31 with a standard error of 1.79 . But in the expansion state, none of the ten estimated coefficients on the default spread are significant, although nine of ten remain positive. There is some, albeit weak, evidence that growth firms respond more to the default premium than value firms in the expansion state. The coefficient of growth firms in state 2 is 1.77 with a standard error of 0.96 , the coefficient that of value firms is only 0.38 with a standard error of 0.62 . On balance, however, the evidence suggests that the default spread mainly affect the expected returns in the recession state and particularly for value firms.

The coefficients on the growth in money supply are not significant in our specification. These coefficients are all positive in recessions, meaning that higher monetary growth is related to higher expected returns. A possible explanation is that the Federal Reserve increases the money supply in recessions, during which the expected excess returns of the testing portfolios are higher. Turning to the coefficients on the dividend yield, we observe that in the recession state, the coefficient for the growth portfolio is positive but insignificant, 0.22 with a standard error of 0.34 . In contrast, the coefficient for the value portfolio in the recession state is 1.52 , which is more than two standard errors from zero. However, six out of ten book-to-market deciles have insignificant coefficients on the dividend yield including the ninth decile. In the expansion state the growth portfolio has a significant coefficient of 0.83 (standard error = 0.28), but the remaining deciles have insignificant coefficients.

Our results so far are consistent with the flexibility hypothesis that value firms are more affected by worsening economic conditions than growth firms. However, they do not test whether the differential responses between value and growth firms are statistically significant. We now report a set of likelihood ratio tests for the existence of two states in the conditional mean equation, again following Perez-Quiros and Timmermann (2000). We condition on the existence of two states in the conditional volatility. This step is necessary because as pointed out by Hansen (1992), the standard likelihood ratio test for multiple states is not defined because the transition probability parameters are not identified under the null of a single state. The resulting likelihood ratio statistic follows a standard chi-squared distribution. More formally, we test the null hypothesis that the coefficients on the one-month Treasury bill rate, the default spread, the growth rate of money supply, and the dividend yield are equal across states, i.e., $\beta_{k,S_t=1}^i = \beta_{k,S_t=2}^i, k = 1, 2, 3, 4$ for each testing portfolio i .

Table 3 shows that the state dependence in the conditional mean equations is indeed statistically significant. The p -values for the likelihood ratio tests are equal or smaller than one percent for seven out of ten deciles, meaning that the null hypothesis is strongly rejected. In particular, the null hypothesis is rejected at the one percent level for the value and growth deciles.

4 A Joint Model of Expected Value and Growth Returns

We generalize the previous framework by estimating a bivariate Markov switching model for the excess returns on the value and the growth portfolios. Relative to the univariate framework that we have estimated separately for each portfolio, the bivariate framework offers several advantages. First, the joint framework allows us to impose the condition that the recession state occurs simultaneously for both value and growth portfolios. In so doing, we can obtain more precise estimates of the underlying state. The joint model also provides a natural framework for modeling the time-varying expected value premium. Finally, the joint model allows us to formally test the hypothesis that value firms display stronger cyclical variations in the expected returns than growth firms.

4.1 Model Specifications

Let $\mathbf{r}_t = (r_t^g, r_t^v)'$ be the (2×1) vector consisting of the excess returns on the growth portfolio, r_t^g , and those on the value portfolio, r_t^v . We specify the bivariate Markov switching model as follows:

$$\mathbf{r}_t = \beta_{0,S_t} + \beta_{1,S_t} TB_{t-1} + \beta_{2,S_t} DEF_{t-1} + \beta_{3,S_t} \Delta M_{t-2} + \beta_{4,S_t} DIV_{t-1} + \epsilon_t$$

in which β_{k,S_t} is a (2×1) vector with the elements $\begin{pmatrix} \beta_{k,S_t}^g \\ \beta_{k,S_t}^v \end{pmatrix}$ for $k = 1, 2, 3, 4$ and $\epsilon_t \sim \mathcal{N}(0, \Sigma_{S_t})$, $S_t = \{1, 2\}$, is a vector of residuals. Σ_{S_t} is a positive semi-definite (2×2) matrix that contains the variances and covariances of the residuals of the excess returns of the value and growth portfolios in state S_t . The diagonal elements of this variance-covariance matrix, Σ_{ii,S_t} , take the similar form as in the univariate model: $\log(\Sigma_{ii,S_t}) = \lambda_{S_t}^i$. And the off-diagonal elements, Σ_{ij,S_t} , assume a state-dependent correlation between the residuals, denoted ρ_{S_t} . More precisely, $\Sigma_{ij,S_t} = \rho_{S_t} (\Sigma_{ii,S_t})^{1/2} (\Sigma_{jj,S_t})^{1/2}$ for $i \neq j$. We maintain the transition probabilities from the univariate model, but now the same state drives both the value and the growth portfolios.

4.2 Estimation Results

Table 4 presents the results from the bivariate Markov switching model. Most important, the pattern of differential coefficients on the interest rates and on the default spreads in the conditional mean equations across the value and growth deciles is quantitatively similar to that from the univariate specifications. Moving from the growth decile to the value decile, the coefficient on the Treasury bill rate increases in magnitude from -6.74 (standard error = 2.18) to -10.76 (standard error = 2.25) in the recession state. And the coefficient on the default spread increases from 4.60 (standard error = 1.38) for the growth portfolio to 7.76 (standard error = 1.29) for the value portfolio.

We also present the likelihood ratio tests on the hypothesis that the difference across states 1 and 2 in the coefficient of the value portfolio exceeds that in the coefficient of the growth portfolio. Formally, for each set of coefficients indexed by k , we test the null hypothesis that:

$$\beta_{k,1}^g - \beta_{k,2}^g = \beta_{k,1}^v - \beta_{k,2}^v \quad (17)$$

against the alternative hypothesis that the difference in coefficients is larger for the value portfolio. The null is strongly rejected at the five percent significance level.

Imposing the same state across the value and growth deciles changes several results from the univariate specifications. The constant term continues to be lower in state 1 than that in state 2, but it no longer increases in magnitude from the growth decile to the value decile. Indeed, the null hypothesis that the degree of asymmetry across the states is identical across the value and growth portfolios cannot be rejected with a p -value of 0.30. Further, although the likelihood ratio test rejects the null hypothesis given by equation (17) for the coefficients on the growth in money supply and on the dividend yield, none of the estimates are individually significant. Thus, the variations

in the coefficients on the dividend yield across the book-to-market deciles in the univariate specifications in Table 2 do not survive the restriction of a single latent state across the testing portfolios.

4.3 Cyclical Variations in the Expected Excess Returns, the Conditional Volatilities, and the Conditional Sharpe Ratios

Figure 3 plots the expected excess returns for the value portfolio and the growth portfolio in Panel A and B, respectively, as well as for the value-minus-growth portfolio in Panel C. The solid lines use the estimates from the bivariate Markov switching model, and the dashed lines use the estimates from the univariate model. From Panels A and B, the series from the univariate and the bivariate models are largely similar. The expected excess returns of both value and growth firms tend to increase rapidly during recessions and decline more gradually during expansions.

Panel C reports some discrepancy in the expected value-minus-growth returns estimated from the univariate and the bivariate models. To the extent that the two expected return series differ, we rely more on the series from the bivariate model to draw our inferences. The reason is simple: the underlying state is designed to capture shocks to aggregate economic conditions and it makes sense to impose the restriction that the state applies to value and growth firms simultaneously. Estimating the Markov switching model separately for the individual portfolios, while an informative first step, is likely to contaminate the latent states with portfolio-specific shocks.

The solid line in Panel C of Figure 3 shows that the expected value-minus-growth returns are positive for 472 out of 648 months, about 73% of the time. The mean is 0.39% per month, which is more than 14 standard errors from zero. More important, the expected value premium displays time-variations closely related to the states of the economy: The series tends to be small and even negative prior to and during the early phase of recessions but to increase sharply during later stages of recessions. The evidence is consistent with the theories discussed in Section 2: As a recession deepens, value firms quickly lose flexibility in adjusting to adverse economic conditions and their assets become riskier, causing investors to require a higher risk premium for holding their stocks.

Time-variations in expected returns can be driven by the variations in conditional volatilities, the variations in conditional Sharpe ratios, or both. Panel A of Figure 4 plots the conditional volatilities for the value and growth portfolios. The volatilities reflect the switching probabilities and not just the volatilities of returns in a given state. Panel A shows that the conditional volatilities tend to spike upwards during most recessions for both value and growth firms. Value firms also have slightly higher volatilities than growth firms: The average ratio of the conditional volatility

of the value portfolio over the conditional volatility of the growth portfolio is 1.06 in our sample.

Panel B of Figure 4 plots the estimates of the conditional Sharpe ratios for value and growth firms from the bivariate Markov switching model. The Sharpe ratio dynamics are similar for the value and growth portfolios and both display strong cyclical variations. The Sharpe ratios tend to increase rapidly during recessions and to decline more gradually in expansions. Thus, the cyclical variations in expected excess returns for value and growth firms reported in Panel A of Figure 3 are driven by similar variations in both conditional volatilities and conditional Sharpe ratios. Panel B of Figure 4 also shows that the value decile has mostly higher conditional Sharpe ratios than the growth decile, especially in the early 2000s. Over the entire sample, the mean conditional Sharpe ratio is higher for value firms than for growth firms: 0.66 vs. 0.38 per annum.

To further illustrate the difference in Sharpe ratio between the value and growth deciles, Figure 5 plots the expected return, conditional volatility, and conditional Sharpe ratio for the value-minus-growth portfolio. Because volatilities and Sharpe ratios are not additive, these time-varying moments are estimated from using the value-minus-growth returns in the univariate Markov switching model. From Panel A, the expected value premium is closer to that estimated from the bivariate model, especially in the 1990s, than to the difference between expected value and growth returns that are separately estimated from the univariate model. In particular, the expected value premium is positive for 557 out of 648 months, or 86% of the time. The mean of the expected return is 0.52% per month and is more than 20 standard errors from zero.

From Panels B and C of Figure 5, the conditional volatilities and the conditional Sharpe ratios of the value-minus-growth portfolio both display strong countercyclical variations. In particular, the Sharpe ratios tend to spike up during recessions only to decline gradually in the subsequent expansions. The mean of the conditional Sharpe ratios in our sample is 0.15 per annum.

5 Are Value Firms Less Flexible Than Growth Firms?

We have shown that the expected excess returns of value firms display stronger countercyclical variations than the expected excess returns of growth firms. The evidence is largely consistent with the investment-based asset pricing theories discussed in Section 2. Guided by these theories, we now examine the potential sources of the time-variations in the expected value premium. Specifically, we test the hypothesis that value firms are less flexible than growth firms in adjusting to negative aggregate shocks. To this end, we perform descriptive tests using a variety of measures

of flexibility in the context of the book-to-market deciles. We also use the Fama-MacBeth (1973) cross-sectional regressions and the Fama-French (1993) portfolio approach to test if flexibility is related to the costs of equity capital in the cross section.

Our sample is from the merged CRSP and Compustat database from 1972 to 2007. The starting period is determined by data availability of some variables required in constructing flexibility proxies. We use all NYSE, Amex, and Nasdaq firms excluding financial firms with four-digit SIC codes between 6000 and 6999 and utilities with four-digit SIC codes between 4900 and 4999. CRSP contains monthly prices, shares outstanding, dividends, and returns for publicly traded firms. Compustat annual research files provide the relevant accounting information.

5.1 Measures of Real Flexibility

Direct measures of real flexibility are not available. As such, we propose several variables that aim to proxy for the flexibility. The first proxy is the ratio of fixed assets over total assets, denoted FA/TA . We use gross property, plant, and equipment (Compustat annual item 7) to measure fixed assets, and use item 6 to measure total assets. As discussed by Rajan and Zingales (1995), FA/TA is related to asset specificity and tangibility. Because costly reversibility primarily applies to investment on property, plant, and equipment, a higher FA/TA means less real flexibility. Saunders, Strock, and Travlos (1990) provide a different reason for using FA/TA as a proxy for flexibility: fixed costs of production are proportional to the scale of fixed assets, meaning that FA/TA also is a measure of operating leverage.

The second proxy for real flexibility is the frequency of disinvestment. We measure this frequency as the ratio of the number of firms that have disinvested in at least one year during the past three years divided by the total number of firms at the current year for a given portfolio. A firm is considered as having disinvested if its sales of property, plant, and equipment (Compustat annual item 107) is positive. The frequency of disinvestment measures the degree with which a firm is susceptible to costly reversibility. The idea is that the more frequently a firm needs to disinvest, the more susceptible the firm will be to costly reversibility, and less flexible the firm will be. Note that the frequency of disinvestment is only defined for a given portfolio. We also use a firm-specific measure of disinvestment, which is a dummy variable that takes the value of one if the firm has disinvested for at least one year during the previous three years and takes the value of zero otherwise.

The third proxy for real flexibility is operating leverage. Carlson, Fisher, and Giammarino (2004) argue that operating leverage is an important driving force of the value premium. The idea

is that if the fixed costs are proportional to the book value, value firms will have higher operating leverage, which in turn gives rise to higher risk than growth firms. We measure operating leverage as the ratio of the percentage change in operating income before depreciation (Compustat annual item 13) to the percentage change in sales (item 12). However, this ratio can be negative in a given year because sales and earnings can temporarily move in opposite directions. Further, if the change in sales is too small in a given year, the ratio will become unrealistically high. To obtain a sensible estimate of operating leverage for a given firm, we take the three-year moving average of the ratio of the percentage change in operating income before depreciation to the percentage change in sales as the measure of operating leverage. Moreover, if the ratio is negative for every year during the recent three years, we set its value to be missing in the current year.

The final individual proxy we use for real flexibility is financial leverage. The idea is similar to that of operating leverage. Interest expenditures add to the amount of fixed costs that firms incur to keep in production. The earnings of firms with high fixed costs will vary more with economic downturns than the earnings of firms with low fixed costs. Moreover, using a dynamic asset pricing model with debt, Livdan, Sapriz, and Zhang (2008) argue that more leveraged firms are burdened with more debt and must repay existing debt before financing new investments. As such, more leveraged firms are more likely to be constrained financially, are less flexible, and are riskier in assets and equity values. Following Fama and French (1992), we measure financial leverage, denoted A/ME , as the ratio of the book value of assets (Compustat annual item 6) over the market value of equity. For portfolios formed in June of calendar year t , both book assets and market equity are measured in fiscal year ending in calendar year $t - 1$. Using the debt-to-equity ratio (the ratio of total assets minus the book equity over the market equity) to measure financial leverage as in Bhandari (1988) yields largely similar results (not reported).

Each of these four flexibility proxies has its own merits but none of them are likely to be perfect. To minimize the effects of their individual measurement errors and to maximize their combined information content, we construct a composite inflexibility index by aggregating over these variables. Specifically, we sort firms into deciles in June of each year t on financial leverage, operating leverage, and the fixed-to-total assets ratio and record the decile assignments. For disinvestment, we assign a value of ten to the firms that have disinvested during the previous three years and a value of one to the firms that have not disinvested. We then take the average of the decile indexes for a given firm to obtain the composite inflexibility index assigned to the firm in the current year

t. Higher value of the inflexibility index means less flexibility.

5.2 Empirical Results

5.2.1 The Variations of Real Flexibility Across the Book-to-Market Portfolios

We first compute the flexibility measures for each firm and define the portfolio-level measures as the cross-sectional averages of the proxies across firms in each book-to-market decile. Table 5 reports the time series averages over the period from 1972 to 2007 for all the portfolio-level flexibility proxies.

Moving from the growth decile to the value decile, we observe a virtually monotonically increasing relation between book-to-market equity and the measures of inflexibility. The fixed-to-total assets ratio increases from 0.36 for growth firms to 0.55 for value firms, and the difference of 0.19 is more than 11 standard errors from zero. Value firms also are more likely to disinvest. For example, the frequency of disinvestment is 0.59 for value firms, which is about 36% higher than that of growth firms, 0.38. The disinvestment dummy, which effectively is a firm-level measure of the disinvestment frequency, yields similar results: The average value of the dummy goes up from 0.18 for the growth decile to 0.79 for the value decile. And the difference is more than seven standard errors from zero.

Consistent with prior studies such as Smith and Watts (1992), financial leverage and book-to-market equity have a monotonically increasing relation: The leverage of growth firms is on average 0.32, whereas the leverage of value firms is on average 4.71. And the difference is more than 14 standard errors from zero. Table 5 shows that the operating leverage increases almost monotonically from 1.74 for growth firms to 4.38 for value firms. The economic interpretation is that for one percentage change in sales, we should expect to see on average 1.74% change in earnings for growth firms but on average 4.38% earnings change for value firms. And the difference of 2.58% is almost 18 standard errors from zero. Finally, the composite inflexibility index also goes up monotonically from 0.62 for growth firms to 2.78 for value firms, and the difference is again highly significant.

5.2.2 Does Inflexibility Increase the Cost of Equity?

After documenting significant differences in real flexibility between value and growth firms, we now ask whether inflexibility increases the costs of equity capital of firms. The answer is affirmative.

We proceed in two steps. In the first step, we use the Fama-MacBeth (1973) two-step procedure: Each month we regress monthly stock returns on the lagged flexibility measures, and then average the time series of the regression coefficients and compute their *t*-statistics using the Newey-West (1987) standard errors. Table 6 reports the regression results. The first two specifications show

that book-to-market is positively related to future returns with a slope of 0.38 ($t = 6.08$), and that although the slope of the market equity is significant ($t = -2.10$), it is small in magnitude, -0.04 .

More important, the subsequent five specifications report univariate cross-sectional regressions on each of the four individual measures and the composite inflexibility index. Each of the inflexibility measures carries a positive coefficient, meaning that firms with less flexibility have higher costs of equity. Among the four individual measures, financial leverage and operating leverage have positive slopes that are significant at the one percent confidence level ($t = 4.06$ and 3.05 , respectively). The composite index of inflexibility has a significant positive coefficient of 0.12 , which is more than three standard errors from zero. The last specification shows that the composite inflexibility index remains significant with a coefficient of 0.07 ($t = 1.98$) after we control for book-to-market and size. Size is no longer significant but book-to-market retains its strong explanatory power for average returns with the presence of the composite inflexibility index.

In Table 7, we quantify the relation between inflexibility and costs of equity using the Fama-French (1993) portfolio approach. We sort all stocks on their composite inflexibility index into ten deciles at the end of June in each year t from 1972 to 2007. The equal-weighted and value-weighted returns for each portfolio are calculated from July of year t to June of year $t + 1$. From Panel A, moving from the decile with the lowest inflexibility index to the decile with the highest inflexibility index, the average equal-weighted returns increase from 0.87% to 1.90% per month. The increasing relation is virtually monotonic. The high-minus-low inflexibility portfolio earns an average equal-weighted return of 1.03% per month ($t = 4.11$). Controlling for the market beta and for the Fama-French factor loadings does not eliminate the positive relation between inflexibility and average equal-weighted returns. Moving from the low inflexibility to the high inflexibility decile, the CAPM alpha increases from -0.34% to 0.94% per month and the Fama-French alpha rises from -0.18% to 0.43% per month. Both differences are more than 3.7 standard errors from zero.

Panel B of Table 7 shows the value-weighted results. The basic result is unchanged: Firms with less flexibility continue to earn higher average returns than firms with more flexibility. The spread in the average value-weighted returns between the extreme deciles is 0.72% per month ($t = 2.65$). Adjusting for the market beta does not affect the result: The spread in the CAPM alpha across the two deciles is 0.86% , and is more than three standard errors from zero. When we use the Fama and French (1993) three-factor model to explain the ten value-weighted deciles formed on inflexibility, the alphas are all close to zero. And the difference between the low and high deciles is insignificant.

In sum, our results suggest a strong positive relation between real inflexibility and the costs of equity.

6 Conclusion

Using the two-state Markov switching framework of Perez-Quiros and Timmermann (2000), we document new evidence that the expected value premium displays strong countercyclical variations. In recessions the expected excess returns of value stocks are most strongly affected, and the expected excess returns of growth stocks are least affected, by worsening economic conditions as measured by higher one-month Treasury bill rates and higher default spreads. By way of contrast, in expansions the expected excess returns of both value and growth stocks have mostly insignificant loadings on the two aggregate economic indicators. Because of these asymmetries across the states of the economy, the expected value premium tends to spike upward rapidly during recessions only to decline more gradually in the subsequent expansions. Our evidence suggests that conditioning information is important in the cross section of average returns, lending support to the conditional asset pricing literature (e.g, Ferson and Harvey 1991, 1993, 1999, Jagannathan and Wang 1996, Lettau and Ludvigson 2001, and Ang and Chen 2007).

We also examine the potential sources of the time-variations in the expected value premium. Using a variety of flexibility proxies such as the ratio of fixed assets to total assets, the frequency of disinvestment, financial leverage, and operating leverage, we report new evidence that value firms are less flexible in adjusting to worsening economic conditions than growth firms. Moreover, using a composite inflexibility index that aggregates the information contained in the individual proxies, we show that inflexibility increases the costs of equity in the cross section. Our evidence is largely consistent with the theoretical predictions from the investment-based asset pricing literature (e.g., Carlson, Fisher, and Giammarino 2004, Zhang 2005, and Livdan, Saprizza, and Zhang 2008).

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Table 1 : Moments of Monthly Excess Returns for Ten Book-to-Market Deciles (January 1954 to December 2007)

This table reports the mean, volatility, skewness, and kurtosis of the continuously compounded excess returns on the decile portfolios formed on book-to-market equity. Excess returns are calculated as the difference between monthly stock returns and the one-month Treasury bill rate. The data for the book-to-market deciles and the one-month Treasury bill rate are from Kenneth French's Web site.

Portfolio	Mean	Volatility	Skewness	Kurtosis
Growth	0.482	5.037	−0.238	4.408
2	0.546	4.548	−0.435	4.942
3	0.615	4.513	−0.505	5.559
4	0.610	4.431	−0.424	5.342
5	0.680	4.226	−0.412	5.907
6	0.722	4.210	−0.369	5.511
7	0.721	4.198	0.027	4.896
8	0.858	4.294	−0.021	5.118
9	0.892	4.529	−0.103	5.037
Value	0.966	5.235	0.023	6.160
Value-minus-growth	0.484	4.275	0.438	4.412

Table 2 : Parameter Estimates for the Univariate Markov Switching Model of Excess Returns on Decile Portfolios Formed on Book-to-Market Equity (January 1954 to December 2007)

For each book-to-market decile i , we estimate the following two-state Markov switching model:

$$\begin{aligned}
r_t^i &= \beta_{0,S_t}^i + \beta_{1,S_t}^i TB_{t-1} + \beta_{2,S_t}^i DEF_{t-1} + \beta_{3,S_t}^i \Delta M_{t-2} + \beta_{4,S_t}^i DIV_{t-1} + \epsilon_t^i \\
\epsilon_t^i &\sim N(0, \sigma_{i,S_t}^2), \quad S_t^i = \{1, 2\} \\
p_t^i &= P(S_t^i = 1 | S_{t-1}^i = 1) = \Phi(\pi_0^i + \pi_1^i TB_{t-1}) \\
1 - p_t^i &= P(S_t^i = 2 | S_{t-1}^i = 1) \\
q_t^i &= P(S_t^i = 2 | S_{t-1}^i = 2) = \Phi(\pi_0^i + \pi_2^i TB_{t-1}) \\
1 - q_t^i &= P(S_t^i = 1 | S_{t-1}^i = 2)
\end{aligned}$$

in which r_t^i is the monthly excess return for a given decile portfolio and S_t^i is the regime indicator. TB is the one-month Treasury bill rate, DEF is the yield spread between Baa- and Aaa-rated corporate bonds, ΔM is the annual rate of growth of the monetary base, and DIV is the dividend yield of the CRSP value-weighted portfolio. Standard errors for the parameter estimates are reported in parentheses.

	Growth		Decile 2		Decile 3		Decile 4		Decile 5	
Constant, state 1	-0.027	(0.01)	-0.017	(0.01)	-0.015	(0.01)	-0.043	(0.02)	-0.088	(0.02)
Constant, state 2	-0.019	(0.01)	-0.009	(0.01)	-0.005	(0.02)	0.004	(0.01)	0.016	(0.01)
TB , state 1	-5.681	(1.54)	-5.624	(1.63)	-6.439	(1.21)	-6.980	(2.53)	-7.185	(3.16)
TB , state 2	-1.454	(1.51)	-1.406	(1.91)	-1.640	(1.95)	-1.917	(1.17)	-3.197	(1.12)
DEF , state 1	4.019	(0.88)	3.848	(0.83)	3.136	(0.69)	5.617	(1.28)	5.136	(1.79)
DEF , state 2	1.769	(0.96)	1.763	(1.07)	1.162	(1.12)	1.328	(0.73)	0.450	(0.65)
ΔM , state 1	0.077	(0.06)	0.045	(0.06)	0.019	(0.04)	0.063	(0.11)	0.124	(0.10)
ΔM , state 2	-0.049	(0.06)	-0.045	(0.06)	-0.031	(0.05)	-0.011	(0.04)	-0.029	(0.03)
DIV , state 1	0.220	(0.34)	0.122	(0.37)	0.486	(0.26)	0.271	(0.65)	1.795	(0.75)
DIV , state 2	0.832	(0.28)	0.397	(0.26)	0.473	(0.28)	0.055	(0.20)	0.112	(0.18)
Transition probability parameters										
Constant	1.568	(0.40)	1.647	(0.54)	1.994	(0.57)	1.775	(0.47)	2.178	(0.44)
TB , state 1	0.828	(0.92)	0.889	(1.31)	0.783	(1.71)	-0.047	(0.79)	-1.684	(0.83)
TB , state 2	0.131	(1.03)	0.155	(1.48)	-0.819	(1.92)	0.128	(0.88)	-1.124	(0.82)
Standard deviation										
σ , state 1	0.059	(0.00)	0.053	(0.00)	0.050	(0.00)	0.059	(0.00)	0.057	(0.00)
σ , state 2	0.028	(0.00)	0.030	(0.00)	0.024	(0.00)	0.033	(0.00)	0.032	(0.00)
Log likelihood value	1056		1112		1127		1133		1170	
	Decile 6		Decile 7		Decile 8		Decile 9		Value	
Constant, state 1	-0.060	(0.03)	-0.088	(0.02)	-0.091	(0.03)	-0.070	(0.03)	-0.082	(0.03)
Constant, state 2	0.009	(0.01)	0.021	(0.01)	0.011	(0.01)	0.010	(0.01)	0.010	(0.01)
TB , state 1	-7.725	(3.92)	-8.432	(2.80)	-8.810	(3.12)	-9.350	(3.24)	-11.667	(3.28)
TB , state 2	-2.309	(1.05)	-1.983	(1.08)	-2.447	(1.02)	-1.389	(1.05)	-1.339	(1.12)
DEF , state 1	5.951	(1.93)	6.180	(1.48)	6.402	(1.84)	6.853	(1.92)	7.309	(1.79)
DEF , state 2	0.392	(0.63)	-0.077	(0.65)	0.526	(0.57)	0.335	(0.57)	0.382	(0.62)
ΔM , state 1	0.095	(0.17)	0.135	(0.10)	0.052	(0.11)	0.066	(0.09)	0.182	(0.12)
ΔM , state 2	0.000	(0.03)	-0.069	(0.03)	-0.01	(0.03)	-0.019	(0.03)	0.019	(0.03)
DIV , state 1	0.697	(0.89)	1.605	(0.63)	1.839	(0.64)	1.190	(0.67)	1.523	(0.75)
DIV , state 2	0.181	(0.19)	0.085	(0.19)	0.223	(0.20)	0.196	(0.19)	0.137	(0.22)
Transition probability parameters										
Constant	1.704	(0.44)	1.436	(0.22)	1.354	(0.45)	1.278	(0.40)	1.409	(0.36)
TB , state 1	-0.754	(0.82)	-0.869	(0.41)	-0.806	(0.83)	-0.573	(0.80)	-0.056	(0.71)
TB , state 2	0.125	(0.73)	-0.008	(0.27)	0.439	(0.75)	0.350	(0.76)	0.752	(0.75)
Standard deviation										
σ , state 1	0.059	(0.00)	0.054	(0.00)	0.058	(0.00)	0.062	(0.00)	0.072	(0.00)
σ , state 2	0.033	(0.00)	0.031	(0.00)	0.033	(0.00)	0.031	(0.00)	0.037	(0.00)
Log likelihood value	1165		1160		1150		1121		1035	

Table 3 : Tests for Identical Slope Coefficients Across States in the Markov Switching Model (January 1954 to December 2007)

For each book-to-market decile, we estimate the following two-state Markov switching model:

$$\begin{aligned}
 r_t^i &= \beta_{0,S_t}^i + \beta_{1,S_t}^i TB_{t-1} + \beta_{2,S_t}^i DEF_{t-1} + \beta_{3,S_t}^i \Delta M_{t-2} + \beta_{4,S_t}^i DIV_{t-1} + \epsilon_t^i \\
 \epsilon_t^i &\sim N(0, \sigma_{i,S_t}^2), \quad S_t^i = \{1, 2\} \\
 p_t^i &= P(S_t^i = 1 | S_{t-1}^i = 1) = \Phi(\pi_0^i + \pi_1^i TB_{t-1}) \\
 1 - p_t^i &= P(S_t^i = 2 | S_{t-1}^i = 1) \\
 q_t^i &= P(S_t^i = 2 | S_{t-1}^i = 2) = \Phi(\pi_0^i + \pi_2^i TB_{t-1}) \\
 1 - q_t^i &= P(S_t^i = 1 | S_{t-1}^i = 2)
 \end{aligned}$$

in which r_t^i is the monthly excess return for a given decile portfolio and S_t^i is the regime indicator. TB is the one-month Treasury bill rate, DEF is the yield spread between Baa- and Aaa-rated corporate bonds, ΔM is the annual growth rate of the money supply, and DIV is the dividend yield of the CRSP value-weighted portfolio. We conduct likelihood ratio tests on the null hypothesis that the coefficients are equal across states, i.e., $\beta_{k,S_t=1}^i = \beta_{k,S_t=2}^i, k = \{1, 2, 3, 4\}$, for each book-to-market decile i . The p -value is the probability that the null hypothesis is not rejected. When testing the null hypothesis, we condition on the existence of two states in the conditional volatility.

	Growth	Decile 2	Decile 3	Decile 4	Decile 5
Unrestricted log likelihood value	1056	1112	1127	1133	1170
Restricted log likelihood with $\beta_{k,S_t=1} = \beta_{k,S_t=2}, k = \{1, 2, 3, 4\}$	1047	1105	1120	1130	1162
p -value	0.00	0.01	0.01	0.33	0.00
	Decile 6	Decile 7	Decile 8	Decile 9	Value
Unrestricted log likelihood value	1165	1160	1150	1121	1034
Restricted log likelihood with $\beta_{k,S_t=1} = \beta_{k,S_t=2}, k = \{1, 2, 3, 4\}$	1162	1138	1148	1102	1014
p -value	0.14	0.00	0.41	0.00	0.00

Table 4 : The Joint Markov Switching Model for Excess Returns on the Value Decile and on the Growth Decile (January 1954 to December 2007)

We estimate the following joint Markov switching model for excess returns on book-to-market deciles ten (value) and one (growth):

$$\begin{aligned}
\mathbf{r}_t &= \beta_{0,S_t} + \beta_{1,S_t} TB_{t-1} + \beta_{2,S_t} DEF_{t-1} + \beta_{3,S_t} \Delta M_{t-2} + \beta_{4,S_t} DIV_{t-1} + \epsilon_t \\
\epsilon_t &\sim N(0, \Sigma_{S_t}), \quad S_t = \{1, 2\} \\
\log(\Sigma_{ii,S_t}) &= \lambda_{S_t}^i \\
\Sigma_{ij,S_t} &= \rho_{S_t} (\Sigma_{ii,S_t})^{1/2} (\Sigma_{jj,S_t})^{1/2}, \quad i \neq j \\
p_t &= P(S_t = 1 | S_{t-1} = 1) = \Phi(\pi_0 + \pi_1 TB_{t-1}) \\
1 - p_t &= P(S_t = 2 | S_{t-1} = 1) \\
q_t &= P(S_t = 2 | S_{t-1} = 2) = \Phi(\pi_0 + \pi_2 TB_{t-1}) \\
1 - q_t &= P(S_t = 1 | S_{t-1} = 2)
\end{aligned}$$

in which $\mathbf{r}_t = (r_t^g, r_t^v)'$ is the (2×1) vector that contains the monthly excess returns on the growth and value portfolios, r_t^g and r_t^v , respectively. β_{k,S_t} , $k = 0, 1, 2, 3, 4$, is a (2×1) vector with elements $\beta_{k,S_t} = (\beta_{k,S_t}^g, \beta_{k,S_t}^v)'$. $\epsilon_t \sim \mathcal{N}(0, \Sigma_{S_t})$ is a vector of residuals. Σ_{S_t} is a positive semidefinite (2×2) matrix containing the variances and covariances of the residuals of the value and growth portfolio excess returns in state S_t . The diagonal elements of this variance-covariance matrix, Σ_{ii,S_t} , take the similar form as in the univariate model: $\log(\Sigma_{ii,S_t}) = \lambda_{S_t}^i$. The off-diagonal elements, Σ_{ij,S_t} , assume a state-dependent correlation between the residuals, denoted ρ_{S_t} , i.e., $\Sigma_{ij,S_t} = \rho_{S_t} (\Sigma_{ii,S_t})^{1/2} (\Sigma_{jj,S_t})^{1/2}$ for $i \neq j$. TB is the one-month Treasury bill rate, DEF is the yield spread between Baa- and Aaa-rated corporate bonds, ΔM is the annual rate of growth of the monetary base, and DIV is the dividend yield of the value-weighted market portfolio. Standard errors are in parentheses to the right of the parameter estimates. The correlation and transition probabilities are common to both deciles. For each set of coefficients, the p -value from the likelihood ratio tests reports the probability of the restriction that the asymmetry between the value and growth portfolios is identical against the alternative that the asymmetry is larger for the value portfolio.

	Growth (g)		Value (v)		Tests for identical asymmetries	
Constant, state 1	-0.043	(0.02)	-0.047	(0.02)	Constant: $\beta_{0,1}^g - \beta_{0,2}^g = \beta_{0,1}^v - \beta_{0,2}^v$	
Constant, state 2	-0.004	(0.01)	-0.003	(0.01)	Log likelihood value	2243
					p -value	(0.30)
TB , state 1	-6.741	(2.18)	-10.758	(2.25)	TB : $\beta_{1,1}^g - \beta_{1,2}^g = \beta_{1,1}^v - \beta_{1,2}^v$	
TB , state 2	-1.725	(1.47)	-2.965	(1.41)	Log likelihood value	2241
					p -value	(0.02)
DEF , state 1	4.599	(1.38)	7.761	(1.29)	DEF : $\beta_{2,1}^g - \beta_{2,2}^g = \beta_{2,1}^v - \beta_{2,2}^v$	
DEF , state 2	1.057	(0.72)	1.285	(0.77)	Log likelihood value	2240
					p -value	(0.01)
ΔM , state 1	0.093	(0.08)	0.081	(0.08)	ΔM : $\beta_{3,1}^g - \beta_{3,2}^g = \beta_{3,1}^v - \beta_{3,2}^v$	
ΔM , state 2	0.024	(0.06)	0.084	(0.06)	Log likelihood value	2240
					p -value	(0.01)
DIV , state 1	0.448	(0.49)	0.387	(0.25)	DIV : $\beta_{4,1}^g - \beta_{4,2}^g = \beta_{4,1}^v - \beta_{4,2}^v$	
DIV , state 2	0.420	(0.47)	0.430	(0.25)	Log likelihood value	2241
					p -value	(0.02)
Standard deviation parameters						
σ , state 1	0.064	(0.00)	0.070	(0.00)		
σ , state 2	0.037	(0.00)	0.037	(0.00)		
Parameters common to both deciles						
Correlation parameters						
ρ , state 1	0.638	(0.05)				
ρ , state 2	0.665	(0.04)				
Transition probability parameters						
Constant	1.284	(0.34)			TB : $\pi_1 = \pi_2$	
TB , state 1	0.250	(0.58)			Log likelihood value	2242
TB , state 2	0.375	(0.68)			p -value	(0.06)
Unconstrained log likelihood	2244					

Table 5 : Measures of Flexibility Across the Book-to-Market Deciles (1972 to 2007)

At the end of June of each year t , stocks are allocated into deciles based on book-to-market equity in fiscal year ending in calendar year $t - 1$. We report the summary statistics of the flexibility proxies in the year prior to the portfolio formation date. Book-to-market equity, B/M , is measured as in Davis, Fama, and French (2000) where book equity is the stockholders book equity (Compustat annual item 60), plus balance sheet deferred taxes and investment tax credit (item 35), minus book value of preferred stock (in the following order: item 56 or item 10 or item 130). The market equity is the price times shares outstanding at the end of December of calendar year $t - 1$. Fixed to total assets ratio, FA/TA , is the ratio of fixed assets (item 7) to total assets (item 6). Disinvestment frequency is the ratio of the number of firms that have disinvested (item 107 is positive) in the past three years divided by the total number of firms in the portfolio. Disinvestment dummy is an indicative variable that takes a value of one if item 107 (sale of property, plant and equipment) is positive for at least one year in the past three years and takes a value of zero otherwise. Financial leverage, A/ME , is the ratio of book assets (item 6) to market value of equity. Operating leverage is the ratio of the percentage change in operating income before depreciation (item 13) to the percentage change in sales (item 12). The composite inflexibility index is a sorted decile index of an arithmetic average of decile indexes of the four flexibility proxies. Higher value of this inflexibility index means less flexibility. We report the time series averages of annual cross-sectional averages, except for the disinvestment frequency, which is the time series average of annual disinvestment frequency of a given decile. We also report the heteroscedasticity-and-autocorrelation-consistent t -statistics that test the differences between the value and growth portfolios are individually zero.

Decile	B/M	FA/TA	Disinvestment frequency	Disinvestment dummy	A/ME	Operating leverage	Composite inflexibility
Growth	0.15	0.36	0.38	0.18	0.32	1.74	3.48
2	0.29	0.38	0.43	0.24	0.55	1.64	4.01
3	0.42	0.41	0.47	0.40	0.78	1.74	4.54
4	0.55	0.44	0.50	0.53	1.02	1.86	4.95
5	0.69	0.46	0.51	0.59	1.29	2.01	5.33
6	0.84	0.48	0.54	0.59	1.56	2.17	5.69
7	1.01	0.49	0.55	0.59	1.88	2.41	5.98
8	1.25	0.50	0.56	0.68	2.29	2.73	6.30
9	1.61	0.52	0.59	0.74	2.97	3.21	6.73
Value	2.53	0.55	0.59	0.79	4.71	4.38	7.11
Value-minus-growth	2.38	0.19	0.21	0.62	4.40	2.64	3.63
$t(\text{value-minus-growth})$	14.85	11.82	17.51	7.41	14.12	17.93	38.16

Table 6 : Fama-MacBeth Cross-Sectional Regressions of Monthly Excess Returns on Measures of Flexibility (January 1972 to December 2007)

Fixed to total assets, FA/TA , is the ratio of fixed assets (Compustat annual item 7) to total assets (item 6). Financial leverage, A/ME , is the ratio of book assets (item 6) to market value of equity. Operating leverage is the ratio of the percentage change in operating income before depreciation (item 13) to the percentage change in sales (item 12). The independent variables, FA/TA , A/ME , and operating leverage are integers from one to ten that represent the sorted decile index of the corresponding variable with ten being a highest value. The disinvestment dummy is an indicator variable that takes a value of one if a firm has disinvested in at least one year during the past three years over fiscal years ending calendar years $t - 4$ to $t - 1$ and takes a value of zero otherwise. The composite inflexibility index is a sorted decile index of an arithmetic average of decile indexes of the four flexibility proxies. Higher value of this inflexibility index means less flexibility. Control variables include book-to-market equity, B/M , measured in the fiscal year ending in calendar year $t - 1$, and size, measured as the market value of equity at the June of year t . Estimates of the regression coefficients are the time series averages of monthly cross-sectional regression coefficients. The t -statistics, in parenthesis, are adjusted for heteroscedasticity and autocorrelations.

Regression	B/M	Size	FA/TA	Disinvestment dummy	A/ME	Operating leverage	Composite inflexibility
1	0.38 (6.05)						
2		-0.04 (-2.10)					
3			0.04 (1.41)				
4				0.02 (1.73)			
5					0.12 (4.06)		
6						0.05 (3.05)	
7							0.12 (3.17)
8	0.33 (6.12)	-0.03 (-1.62)					0.07 (1.98)

Table 7 : Decile Portfolios Formed on the Composite Inflexibility Index (January 1972 to December 2007)

At the end of June of each year t , we sort stocks into deciles based on the composite inflexibility index as of fiscal year ending in calendar year $t - 1$. The composite inflexibility index is defined as the arithmetic average of decile indexes of four flexibility proxies including the ratio of fixed assets to total assets, financial leverage, operating leverage, and disinvestment frequency. Equal- and value-weighted portfolio returns are calculated from July of year t to June of year $t + 1$, and the portfolios are rebalanced in each June. For each composite inflexibility decile and the high-minus-low decile, we report average monthly returns, CAPM alpha, the alpha from the Fama-French (1993) three-factor model, and the Sharpe Ratio. The t -statistics that test the average return, CAPM alpha, and Fama-French alpha equal zero are reported in parentheses. The t -statistics are adjusted for heteroscedasticity and autocorrelations.

	Deciles formed on the composite flexibility index										H-L	t_{H-L}
	Low	2	3	4	5	6	7	8	9	High		
Panel A: Equal-weighted portfolios												
Average return	0.87 (1.90)	1.20 (3.52)	1.26 (3.95)	1.28 (4.24)	1.42 (4.77)	1.46 (4.98)	1.45 (5.12)	1.52 (5.29)	1.65 (5.79)	1.90 (6.37)	1.03	(4.11)
CAPM alpha	-0.34 (-1.23)	0.09 (0.43)	0.19 (1.00)	0.22 (1.16)	0.36 (2.04)	0.41 (2.34)	0.43 (2.49)	0.50 (2.77)	0.65 (3.54)	0.94 (4.73)	1.28	(5.74)
Fama-French alpha	-0.18 (-0.95)	0.06 (0.43)	0.03 (0.30)	0.05 (0.40)	0.16 (1.45)	0.19 (1.79)	0.12 (1.19)	0.13 (1.29)	0.18 (1.76)	0.43 (3.30)	0.60	(3.76)
Panel B: Value-weighted portfolios												
Average return	0.69 (1.88)	0.94 (3.59)	0.95 (3.20)	0.87 (3.89)	0.95 (4.14)	1.22 (5.45)	0.99 (3.99)	1.14 (5.23)	1.33 (6.30)	1.41 (5.77)	0.72	(2.65)
CAPM alpha	-0.46 (-2.48)	-0.07 (-0.56)	-0.11 (-1.28)	-0.12 (-1.30)	-0.02 (-0.29)	0.23 (2.60)	0.00 (0.01)	0.18 (1.65)	0.32 (2.48)	0.40 (2.54)	0.86	(3.23)
Fama-French alpha	0.02 (0.15)	0.16 (1.44)	-0.08 (-0.90)	-0.08 (-0.82)	-0.01 (-0.17)	0.14 (1.60)	-0.05 (-0.45)	0.02 (0.22)	0.02 (0.21)	-0.10 (-0.80)	-0.13	(-0.68)

Figure 1 : Year-by-Year Returns of the Value-Minus-Growth Strategy (Book-to-Market Decile Ten Minus Decile One), 1954 to 2007

This figure presents the annual buy-and-hold returns for the book-to-market decile ten minus decile one. The annual returns for the book-to-market deciles are from Kenneth French's Web site.

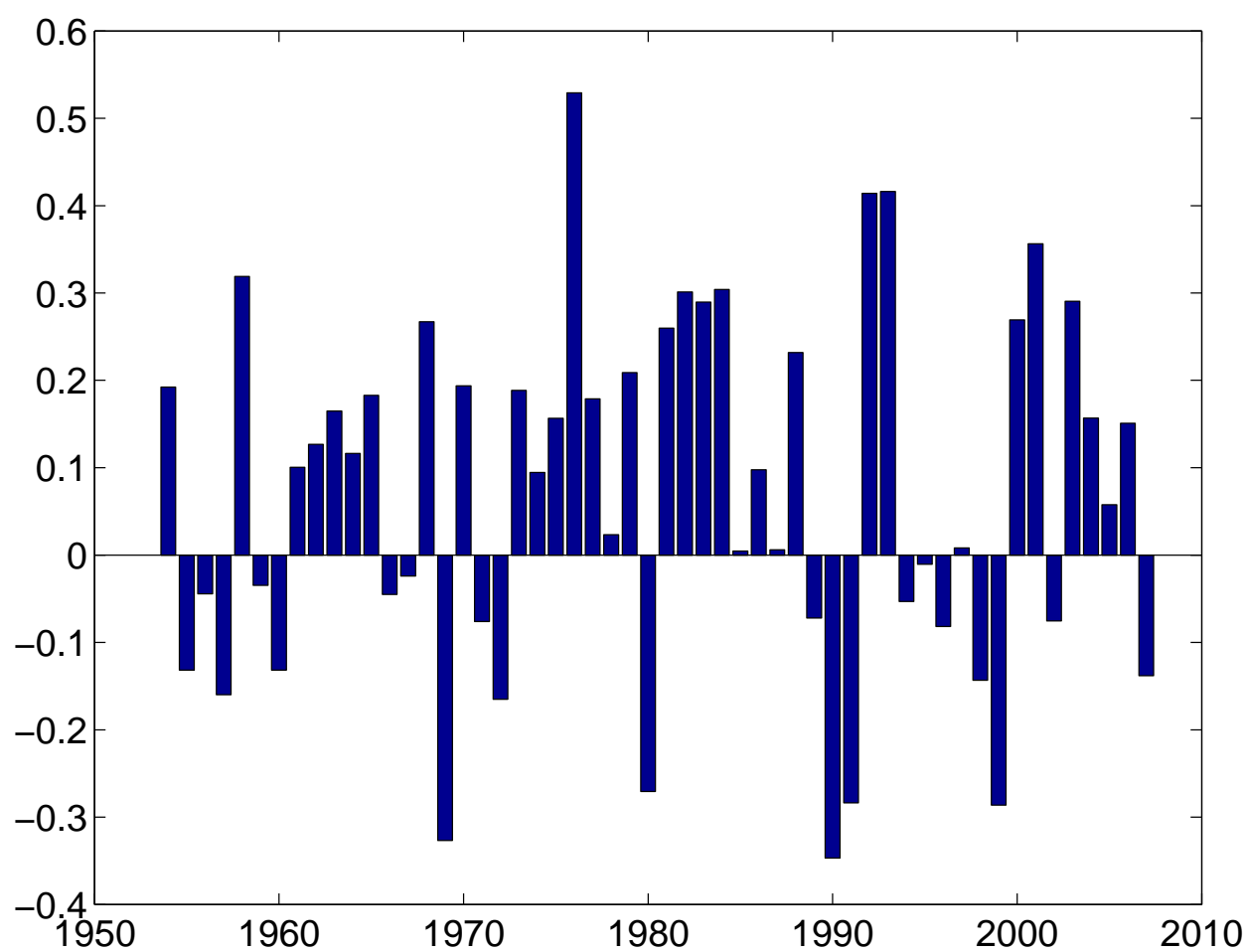


Figure 2 : Univariate Markov Switching Model, Probability of High Variance and Low Mean State (January 1954 to December 2007)

Time series of the probability of being in state 1 at time t conditional on information in period $t - 1$ is plotted for the value portfolio (Panel A) and for the growth portfolio (Panel B). We identify value and growth using the deciles formed on book-to-market equity available from Kenneth French's Web site. The value portfolio is defined as the decile with the highest book-to-market equity and the growth portfolio is defined as the decile with the lowest book-to-market equity. Shaded areas indicate NBER recession periods.

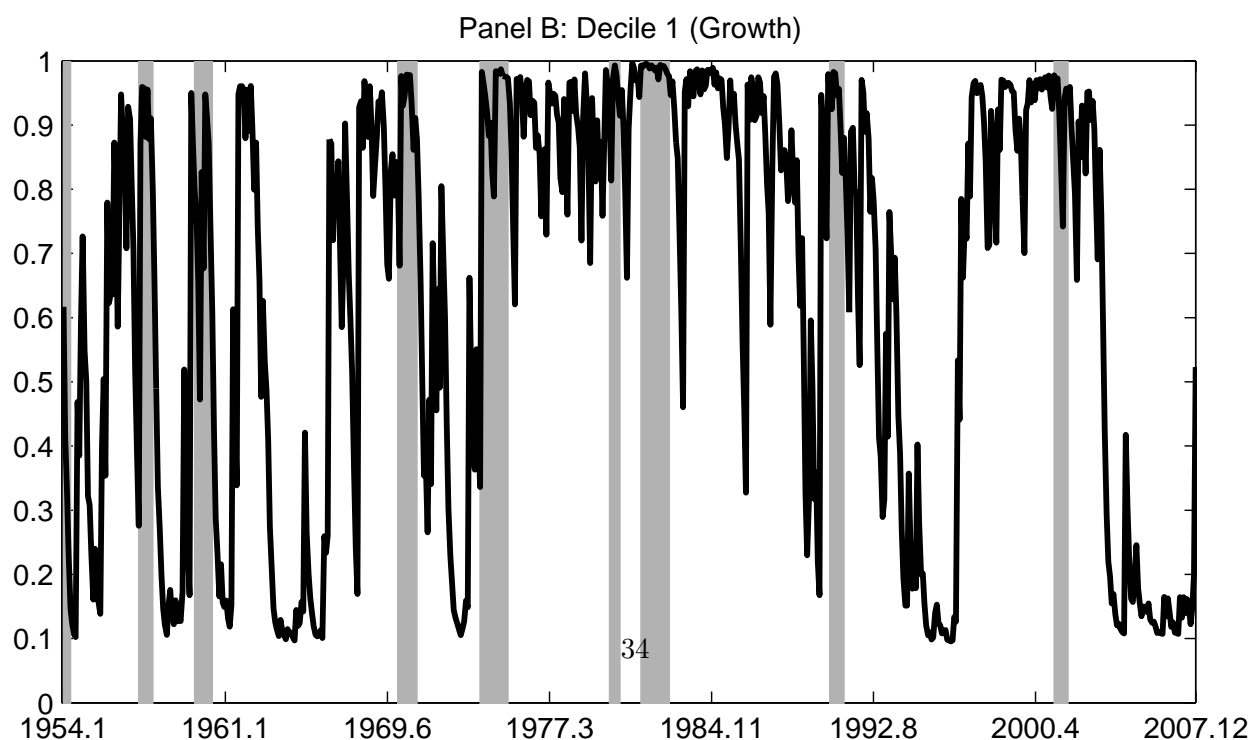
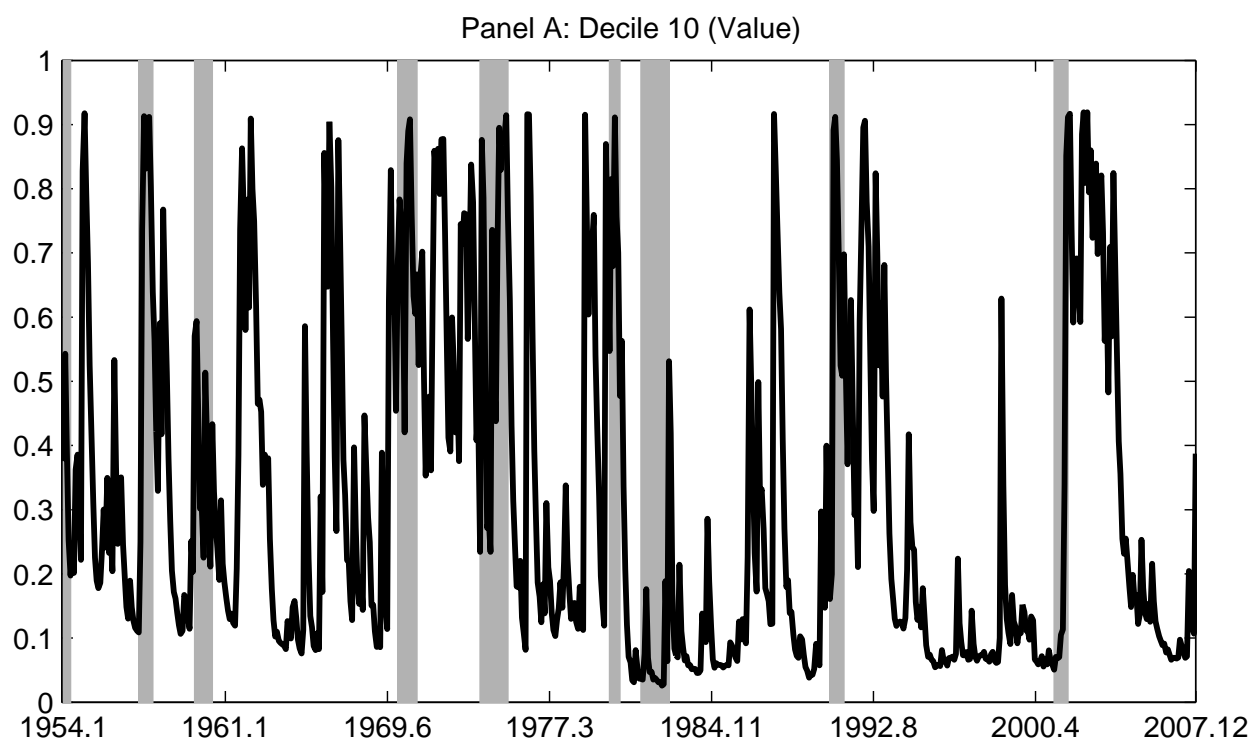


Figure 3 : Expected Excess Returns, Univariate and Bivariate Markov Switching Models

This figure plots the expected excess returns for the value portfolio (Panel A), the growth portfolio (Panel B), and their difference (Panel C) from the univariate and bivariate Markov switching models in Tables 2 and 4. The solid lines use the parameter estimates in the bivariate Markov switching model, and the dashed lines use the estimates from the univariate model. We identify value and growth using the deciles formed on book-to-market equity available from Kenneth French's Web site. The value portfolio is the decile with the highest book-to-market equity and the growth portfolio is the decile with the lowest book-to-market equity. Shaded areas indicate NBER recession periods.

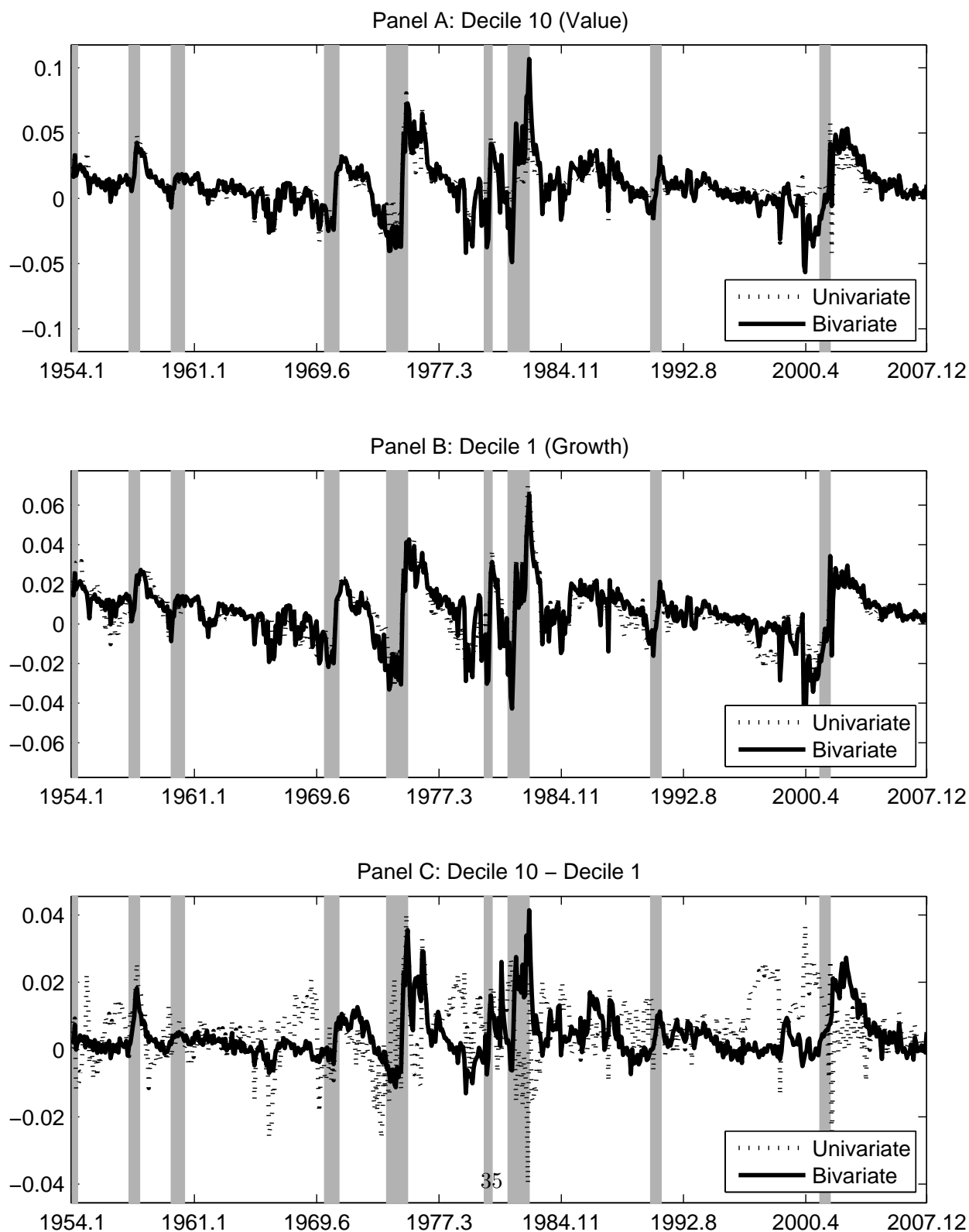


Figure 4 : Bivariate Markov Switching Model, Conditional Volatilities and Conditional Sharpe Ratios (January 1954 to December 2007)

Panel A plots the standard deviation of the conditional returns for the value and growth portfolios. Panel B plots the conditional Sharpe ratio defined as the expected excess return over the conditional volatility. The solid lines are for value firms and the dotted lines are for growth firms. We identify value and growth using the deciles formed on book-to-market equity available from Kenneth French's Web site. The value portfolio is defined as the decile with the highest book-to-market equity and the growth portfolio is defined as the decile with the lowest book-to-market equity. Shaded areas indicate NBER recession periods.

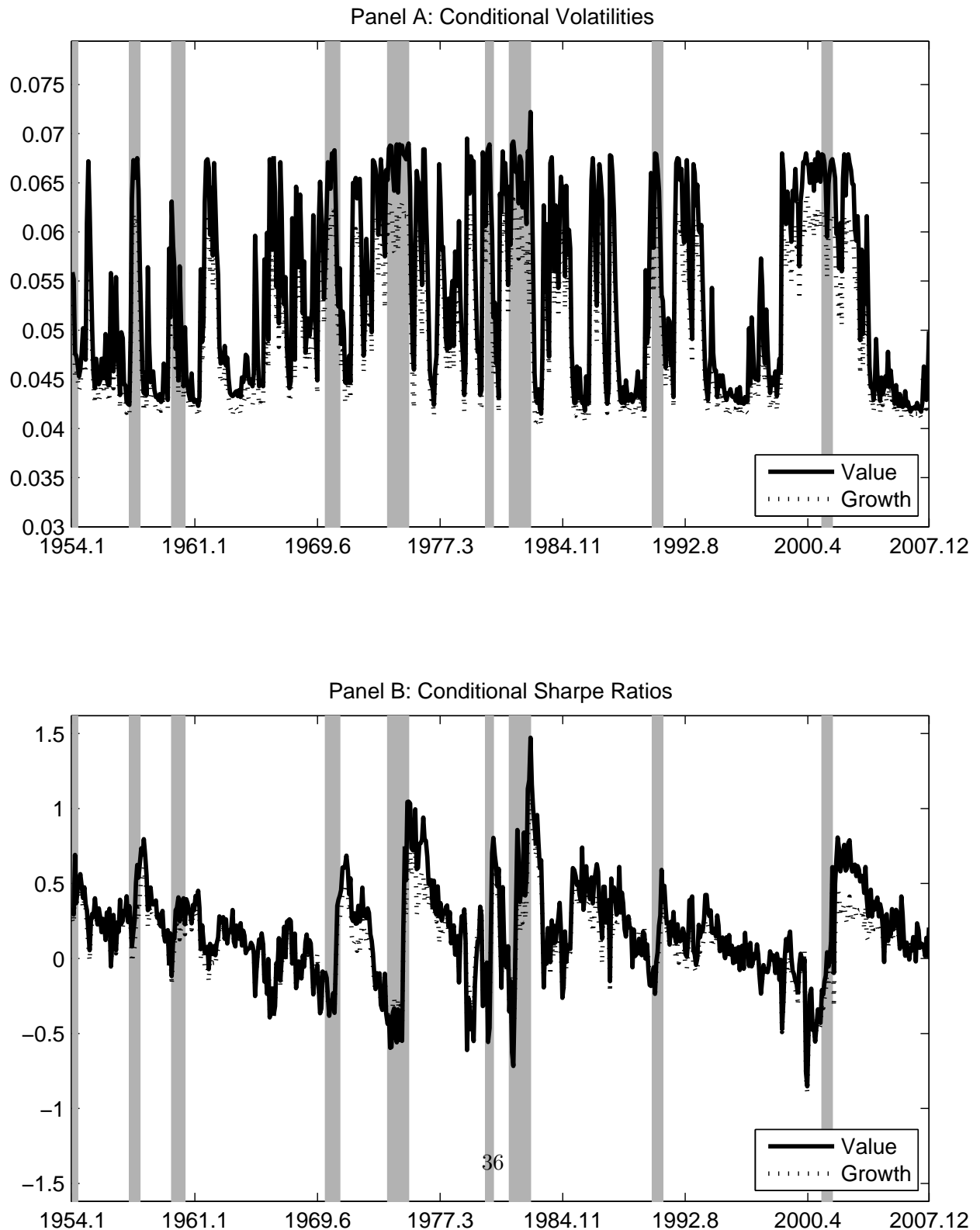


Figure 5 : Expected Returns, Conditional Volatility, and Conditional Sharpe Ratio for the Value-minus-Growth Portfolio Estimated from the Univariate Markov Switching Model

For the value-minus-growth portfolio, this figure plots the expected return (Panel A), the conditional volatility (Panel B), and the conditional Sharpe ratio (Panel C) from the univariate Markov switching model. We identify value and growth using the deciles formed on book-to-market equity available from Kenneth French's Web site. The value portfolio is the decile with the highest book-to-market equity and the growth portfolio is the decile with the lowest book-to-market equity. Shaded areas indicate NBER recession periods.

