MICHIGAN
ROSS SCHOOL OF BUSINESS

Working Paper

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
Associate Professor of Finance
Stephen M. Ross School of Business
at the University of Michigan

UNIVERSITY OF MICHIGAN

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

September 2008[§]

Abstract

Using the Markov switching framework of Perez-Quiros and Timmermann (2000), we show that the expected value-minus-growth returns display 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-variation in the expected value premium highlights 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, ER 7605 Bus Ad, Ann Arbor MI 48109-1234; and NBER. Tel: (734) 615-4854, fax: (734) 936-0282, and e-mail: zhanglu@bus.umich.edu.

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 emerging 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., 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 rates and high default spreads. By way of contrast, in expansions the expected excess returns of both value and growth stocks have insignificant loadings on the short-term interest rates and the default spread. Because of these asymmetries in response across the states of the economy, the expected value-minus-growth return displays strong cyclical variations: It tends to spike up rapidly during recessions only to decline more gradually in the ensuring expansions. We also document similar time-variations in the conditional volatility and conditional Sharpe ratio of the value-minus-growth portfolio.

Guided by investment-based theories, 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, using a composite inflexibility index that aggregates the information contained in the four aforementioned individual proxies, we show that firms with less real flexibility incur higher costs of equity on average than firms with more real flexibility.

Our Markov switching framework closely follows that of Perez-Quiros and Timmermann (2000).[1] We differ in both economic question and the 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 investigation is motivated by the 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 business cycle shocks between value and growth firms, an inquiry motivated by recent investment-based asset pricing theories (e.g., Carlson, Fisher, and Giammarino 2004 and Zhang 2005).

Time-varying means and volatilities of the market excess returns have received much attention in the time series predictability literature (e.g., Schwert 1989, Bekaert and Wu 2000, Ang and Bekaert 2007, and Cochrane 2008). In contrast, there has been little direct evidence to date on time-varying expected returns of anomalies-based investment strategies in general, and on the time-varying expected value premium in particular. Guidolin and Timmermann (2008a) find evidence of four regimes for the joint distribution of returns of the Fama-French (1993) three factors and emphasize the resulting short-term market timing opportunities for investors. We instead focus on the strong cyclical variations in the expected value premium and the underlying economic sources.

Our evidence echoes the conditional asset pricing literature on the importance of conditioning information in driving the cross section of average returns (e.g., Ferson and Harvey 1991, 1993, 1999, Jagannathan and Wang 1996, Lettau and Ludvigson 2001, Lustig and Van Nieuwerburgh

---

[1]Similar regime switching models have been extensively used in empirical asset pricing to successfully address diverse issues including international asset allocation (e.g., Ang and Bekaert 2002a and Guidolin and Timmermann 2008b), 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).

2005, and Ang and Chen 2007). The cross-sectional predictability literature has traditionally emphasized unconditional models (e.g., Fama and French 1993). Combining information in the times series and in the cross section, the time-varying expected value premium is unlikely to be explained by only unconditional models. Casting doubt on conditional asset pricing, Lewellen and Nagel (2006) argue that the conditional CAPM cannot explain the value premium because the covariance between value-minus-growth betas and the expected market risk premium is too small. Our evidence is not inconsistent with theirs because we estimate the expected value premium from a Markov switching predictive regressions framework, as opposed to the conditional CAPM.

Section 2 discusses the theoretical motivation for the time-varying expected value premium. Section 3 presents the estimation results from a univariate Markov switching model fitted to the book-to-market deciles. Section 4 estimates a joint regime switching model for the value and growth deciles simultaneously. Section 5 examines the sources of the time-variation in expected returns in relation to the real flexibility of firms. Finally, Section 6 concludes.

2 Sources of the Time-Variations in Expected Value Premium

Why should the expected returns of value firms covary more with economic downturns than the expected returns of growth firms? Equivalently, why would the expected value-minus-growth returns show countercyclical variations? Recent investment-based asset pricing theories have 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 current theoretical literature discusses three different but related sources that can lead to the relative inflexibility of value firms. These are costly reversibility, operating leverage, and debt.

Using a neoclassical industry equilibrium model, Zhang (2005) argues that value firms are riskier than growth firms in bad times when the price of risk is high. Specifically, because of costly reversibility and time-varying price of risk, value firms have less flexibility in scaling down. Conse-

quently, value firms are more adversely affected by negative aggregate shocks, are riskier, and earn higher expected returns than growth firms, especially in bad times.

Costly reversibility means that firms face higher costs in scraping than in expanding 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. By way of 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 to be more adversely affected by negative aggregate shocks 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 bad times than in good times. Consequently, the expected net present values of assets in place are even lower than they are with constant price of risk, meaning that value firms want to disinvest even more. Because scaling down is difficult, the fundamentals of value firms are even more at risk with respect to negative aggregate shocks than they are in the case of constant price of risk.

In sum, costly reversibility and time-varying price of risk deprive value firms of flexibility in scaling down to mitigate the impact of negative shocks, causing value firms to be riskier than growth firms in bad times. Combined with time-varying price of risk, the countercyclical risk dynamics of the value-minus-growth strategy generate countercyclical expected value-minus-growth returns. Gala (2007) shows that the effect of costly reversibility on risk and expected returns discussed by Zhang (2005) in the industry equilibrium model continues to hold in a general equilibrium model.[2]

The effect of costly reversibility on risk and expected returns are 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

---

[2]Gomes, Kogan, and Zhang (2003) also use a general equilibrium model to link risk and expected return to firm characteristics. However, in their model growth options are always riskier than assets in place. To generate positive average value-minus-growth returns, Gomes et al. assume that growth options are distributed equally across firms. Because more productive growth firms cannot invest more and grow faster, they pay more dividends and have shorter equity duration than value firms. This prediction is counterfactual: Dechow, Sloan, and Soliman (2004) document that long-duration stocks tend to be growth stocks, and that long-duration stocks have historically lower average returns.

costs. He finds that when the lower constraint is binding, the relation between expected return and book-to-market 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 predictions are largely consistent with those from Zhang (2005) and Gala (2007).

The second important source of the time-variation in expected value-minus-growth returns is operating leverage. 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 products of the firms in the economy decreases, equity values fall relative to book values and revenues fall relative to the average level. The fixed costs of production are fixed and do not decrease proportionally with revenues, meaning that earnings (revenues minus variable and fixed costs) will decrease more than proportionally than revenues. This operating leverage mechanism causes value firms to be more affected by negative aggregate shocks than growth firms. The reason is that for value firms, equity values fall more relative to book values and revenues fall more relative to the average. Consequently, 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 à la Hennessy and Whited (2005) into the investment-based asset pricing framework of Zhang (2005). Livdan et al. find that leverage ratios increase risk and expected returns, and that this effect is even more dramatic for less profitable value firms. In their model, there are two channels through which leverage affects risk and expected returns. First, according to the standard leverage hypothesis, 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 higher interest expenditures and perhaps retire a higher portion of the existing debt before financing new investments. Thus, these firms are more likely to face binding collateral constraints, are less flexible in using investment to smooth dividends, and are riskier and earn higher expected returns than less leveraged firms. Finally, why is the leverage effect on risk and expected returns 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 is more severe for less profitable firms because it interacts with other sources of inflexibility such as costly reversibility and operating leverage. Both are more important for less profitable value firms.[3]

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

Motivated by the predictions of recent investment-based asset pricing theories on the time-varying expected value-minus-growth returns, we adopt the Markov switching framework that explicitly allows for state dependence in expected stock returns. To facilitate economic interpretation, we allow only two possible hidden states to be determined by the data.

As discussed by Perez-Quiros and Timmermann (2000), the latent state approach has several advantages over the alternative method of conditioning on predetermined predictive variables. Inferred state probabilities provide important information on the directions in which the conditional distribution of stock returns varies. Further, it is not clear that variables such as industrial production or the NBER recession dates are natural indicators of states of nature. In contrast to the forward-looking stock returns data, these macroeconomic series are backward-looking and have certain measurement

---

[3]Obreja (2006) and Gomes and Schmid (2007) model defaultable debt and obtain similar predictions on the leverage effect on risk and expected returns. Garlappi and Yan (2007) introduce potential deviations from the absolute priority rule into an investment-based model with financial distress. Among other things, Garlappi and Yan show that financial leverage amplifies the magnitude of the value premium.

issues. Finally, the predictive regression approach typically assumes expected stock returns are a linear function of conditioning variables. But without a priori theoretical guidance, the functional form is approximate at best, and is likely to underestimate the variation in expected returns. Our Markov switching framework improves on the traditional approach along these dimensions.

Specifically, we use the Perez-Quiros and Timmermann (2000) Markov switching framework with time-varying transition probabilities, which is 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 let $\mathbf{X}_{t-1}$ be a vector of conditioning variables that contain information about r_t. The Markov switching frameworks allows the intercept term, slope coefficients, and volatility of excess returns to be functions of a single, latent state variable, S_t:

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

in which $\mathcal{N}(0, \sigma^2_{S_t})$ denotes a normal distribution with mean zero and variance, $\sigma^2_{S_t}$. Equation (1) allows the slope coefficients and the expected return to vary across states. We assume only two states, $S_t = 1$ or $S_t = 2$, meaning that the slopes and variance are either $(\beta_{0,1}, \boldsymbol{\beta}'_1, \sigma^2_1)$ or $(\beta_{0,2}, \boldsymbol{\beta}'_2, \sigma^2_2)$.

To specify how the underlying state evolves through time, we assume that the state transition probabilities follow a first-order Markov chain:

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

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

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

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

in which $\mathbf{Y}_{t-1}$ is a vector of variables that are 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 $\boldsymbol{\theta}$ denoted 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:

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

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:

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

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:

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

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:

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

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

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

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

the notion of time-variation 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 period from January 1954 to conform with the period after the Treasury-Federal Reserve Accord that allows the Treasury bill rates to vary freely.[4]

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 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 preliminary sense on the time-variation in the expected value-minus-growth return, we plot a bar graph in Figure 1 for the annual value-weighted value-minus-growth returns. The value portfolio is identified as the decile with the highest book-to-market equity, and the growth portfolio is identified as the decile with lowest book-to-market equity. Figure 1 suggests countercyclical variations in expected value-minus-growth returns. 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, value then outperforms growth 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, 1981–1982, and 1990–1991. Although outside our sample period,

---

[4]After the United States entered the World War II, the Federal Reserve formally committed to maintaining a low interest rate peg on government bonds in 1942. The interest rate peg allowed the federal government to obtain cheap debt financing for the war, but forced the Fed to give up control of the money supply. The Treasury-Federal Reserve Accord eliminated the interest rate peg and laid the institutional foundation for the Fed to pursuit independent monetary policy aimed at low inflation and economic stability.

we find in untabulated results that this dynamic profitability pattern of the value-minus-growth strategy also appears in the Great Depression. Interestingly, the value portfolio underperforms the growth portfolio by 13.8% per annum in 2007, suggesting that the economy is heading towards or has already been in a recession at the time of this writing in September 2008.

To quantify the importance of the cyclical variations in expected stock returns conditional on the aggregate economic conditions, we model excess returns on each of the book-to-market decile 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 commonly used predictors of stock market excess returns from the time series predictability literature.

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 economic shock to real economic growth might lead to an increase in the current and expected inflation, which, in turn, will induce a higher Treasury bill rate. Thus, real economic activity should be negatively correlated with the Treasury bill rate, suggesting a negative contemporaneous correlation between interest rates and stock returns (e.g., Fama and Schwert 1977, Fama 1981, Campbell 1987, Glosten, Jagannathan, and Runkle 1993). A more mechanic reason is that the Federal Reserve typically raises short-term interest rates in economic booms to curb inflation pressures and lowers short-term interest rates in economic recessions to stimulate economic activities. Finally, the Treasury bill rate also can be viewed as a proxy for firms' interest costs, which provide an important cost of capital channel of the monetary transmission mechanism. Intuitively, firms subject to tighter credits constraints are likely to be more negatively affected by bad news in the credit market conditions (e.g., Bernanke and Gertler 1989, Gertler and Gilchrist 1994, and Kiyotaki and Moore 1997).

The default spread, DEF, is defined as the difference between yields on Baa- and Aaa-rated corporate bonds from Ibbotson Associates. Value firms with low profitability are likely to be more exposed to bankruptcy risks during recessions than growth firms, meaning that value stock returns should have higher loadings on the default spread than growth stock returns. Further, the empirical

11

macroeconomics literature has shown 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 premium 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). The general finding is that the default spread is a positive predictor of future stock market returns. Indeed, Jagannathan and Wang (1996) use the default spread as the single instrument in modeling expected market risk premium.

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 the aggregate economic conditions. Finally, 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), although its predictive power has declined somewhat because of the shifts in payout policy from dividends to repurchases (e.g., Boudoukh, Michaely, Richardson, and Roberts 2007). The dividend yield captures mean reversion in expected stock returns because a high dividend yield means that dividends are discounted as a higher rate.

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

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

in which r_t^i is the monthly excess return for the ith decile portfolio formed on book-to-market equity, $\epsilon_t \sim N(0,\sigma_{i,S_t}^2)$, 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. But 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^2_{i,S_t} is allowed to depend on the state of the economy:

$$\log(\sigma^2_{i,S_t}) = \lambda^i_{S_t} \tag{12}$$

To keep the nonlinear specification simple, we do not include ARCH terms or linear terms with instrumental variables in the volatility equation (12).

State transition probabilities are specified as follows:

$$p^i_t = P(S^i_t = 1 | S^i_{t-1} = 1, \mathbf{Y}_{t-1}) = \Phi(\pi^i_0 + \pi^i_1 TB_{t-1}) \tag{13}$$

$$1 - p^i_t = P(S^i_t = 2 | S^i_{t-1} = 1) \tag{14}$$

$$q^i_t = P(S^i_t = 2 | S^i_{t-1} = 2, \mathbf{Y}_{t-1}) = \Phi(\pi^i_0 + \pi^i_2 TB_{t-1}) \tag{15}$$

$$1 - q^i_t = P(S^i_t = 1 | S^i_{t-1} = 2) \tag{16}$$

in which S^i_t is the state indictor for the ith portfolio and Φ is the cumulative density function of a standard normal variable. Following Gray (1996), we aim to capture parsimoniously the information of investors on state transition probabilities through the use of the one-month Treasury bill rate.

3.3 Estimation Results

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

3.3.1 Which States?

Table 2 shows that state 1 is associated with low mean returns and high conditional volatilities and that state 2 is associated with high mean returns and low conditional volatilities. Intuitively, this observation means that state 1 is the recession state and state 2 is the expansion 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 two. 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. More important, 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 negatively to recessionary shocks than that of the growth portfolio.

Table 2 also shows that all the volatilities are estimated quite precisely, as reflected by their small standard errors. Further, the volatility estimates demonstrate countercyclical variations: All ten deciles have volatilities in the recessionary state that are about twice as large as those in the expansionary state. This pattern confirms the previous findings of Schwert (1989) and Campbell, Lettau, Malkiel, and Xu (2001) 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 volatility of small firms is more strongly affected by a recessionary state.

We can further clarify the interpretation of the two hidden states identified by the excess returns of book-to-market deciles. Figure 2 plots the conditional transition probabilities of being in state 1 at time t conditional on the information set at time $t-1$, $P(S_t = 1|\Omega_{t-1}; \boldsymbol{\theta})$, 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 so they reflect the perception of investors on the conditional likelihood of being in state 1 in the next period. Figure 2 shows that the transitional probabilities of being in state 1 are all quite high during the eight recessions after the 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 countercylical default spread is 0.49. The evidence suggests that the state probabilities show a clear business cycle component, meaning that state 1 with low means and high volatilities can largely be interpreted as a 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 negative for all 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 also 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 adversely affected by interest rate shocks than growth firms.

By way of contrast, the excess returns of the book-to-market portfolios are not much affected by the short-term interest rate in the expansion state. 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 slightly higher in magnitude than that for the value portfolio, -1.34. But both coefficients are within 1.2 standard errors of zero.

Table 2 also reports systematical variations between book-to-market and the coefficients of the portfolio excess returns on the default spread. In the recession state, all the deciles generate co-efficients 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. In contrast, none of the ten estimated coefficients on the default spread are significant in the expansion state, although nine of ten remain positive. There is some but weak evidence that growth firms respond more to the default premium than value firms in economic expansions. The DEF-coefficient of growth firms in state 2 is 1.77, which is significant at the ten percent level, but that of value firms is only 0.38 with a standard error of 0.62. On balance, our evidence suggests that the default spread is mainly important for determining the expected returns in recessions and particularly for value firms.

The coefficients on the growth in money supply are not significant in our specification. These co-efficients are all positive in recessions, meaning that higher monetary growth is related with 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 with a standard error of 0.75. 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 positive coefficient of 0.83 (standard error = 0.28), which the remaining deciles have insignificant coefficients.

Our results so far are consistent with the flexibility hypothesis that value firms are more adversely affected by recessionary shocks than growth firms. However, they do not test whether the differential responses between value and growth firms are statistically significant. We take up this task now using a set of likelihood ratio tests, again following Perez-Quiros and Timmermann (2000).

Specifically, we report a set of likelihood ratio tests for the existence of two states in the conditional mean equation. In so doing, 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 equalized across states, i.e., $\beta_{k,S_t=1} = \beta_{k,S_t=2}$, for $k = \{1, 2, 3, 4\}$, for each testing portfolio. Table 3 shows that the state dependence in the conditional mean equation is not only economically important, but also statistically significant. The p-values for the likelihood tests are equal or smaller than one percent for seven out of ten deciles, meaning that the null hypothesis is strongly rejected. In particular, for the two extreme deciles, the null hypothesis is rejected at the one percent level.

4 A Joint Model of Expected Value and Growth Returns

We generalize the previous framework by estimating a bivariate Markov switching model to the excess returns on the value and the growth portfolios. Relative to the univariate framework that we have estimated separately for each portfolio, a joint, 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-minus-growth returns. Finally, the joint model allows us to formally test the hypothesis that value firms display a higher degree of cyclical variations in the expected return than growth firms, the key prediction developed in Section 2.

4.1 Model Specifications

Let $\mathbf{r}_t = (r_t^g, r_t^v)'$ be the (2×1) vector consisting of 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:

$$\mathbf{r}_t = \boldsymbol{\beta}_{0,S_t} + \boldsymbol{\beta}_{1,S_t} TB_{t-1} + \boldsymbol{\beta}_{2,S_t} DEF_{t-1} + \boldsymbol{\beta}_{3,S_t} \Delta M_{t-2} + \boldsymbol{\beta}_{4,S_t} DIV_{t-1} + \boldsymbol{\epsilon}_t$$

in which $\boldsymbol{\beta}_{k,S_t}$ is a (2×1) vector with the elements $\begin{pmatrix} \beta_{k,S_t}^g \\ \beta_{k,S_t}^v \end{pmatrix}$ 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. Σ_{S_t} is a positive semidefinite (2×2) matrix that contains 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: $\log(\Sigma_{ii,S_t}) = \lambda_{S_t}^i$. And the off-diagonal terms, Σ_{ij,S_t}, assume a state-dependent correlation between the residuals, denoted ρ_{S_t}. That is, $\Sigma_{ij,S_t} = \rho_{S_t} (\Sigma_{ii,S_t})^{1/2} (\Sigma_{jj,S_t})^{1/2}$ for $i \neq j$.

We maintain the transition probabilities from the univariate model:

$$p_t \;=\; P(S_t = 1 | S_{t-1} = 1, \mathbf{Y}_{t-1}) = \Phi(\pi_0 + \pi_1 TB_{t-1}) \tag{17}$$

$$1 - p_t \;=\; P(S_t = 2 | S_{t-1} = 1) \tag{18}$$

$$q_t \;=\; P(S_t = 2 | S_{t-1} = 2, \mathbf{Y}_{t-1}) = \Phi(\pi_0 + \pi_2 TB_{t-1}) \tag{19}$$

$$1 - q_t \;=\; P(S_t = 1 | S_{t-1} = 2) \tag{20}$$

but now the same state drives both the value and the growth portfolios ($S_t = S_t^g = S_t^v$).

4.2 Estimation Results

Table 4 presents estimation results for the bivariate Markov switching model. Most important, the pattern of differential coefficients on the interest rate and on the default premium in the conditional mean equation across value and growth is largely similar to that from the univariate specifications. Moving from growth to value, the coefficient on the one-month Treasury bill rate increases in magnitude from -6.74 with a standard error of 2.18 to -10.76 with a standard error of 2.25 in the recession state. And the coefficient on the default spread increases from 4.60 with a standard error of 1.38 for the growth portfolio to 7.76 with a standard error of 1.29 for the value portfolio.

We also present the likelihood ratio tests on the proposition that the difference across states 1 and 2 in the coefficient of the value portfolio exceeds that in the coefficient of the growth portfolio. Intuitively, we test whether value firms are more responsive to exogenous shocks on aggregate economic conditions than growth firms. Formally, for each set of coefficients indexed by k, we test the null hypothesis that:

$$\beta_{k,1}^g - \beta_{k,2}^g = \beta_{k,1}^v - \beta_{k,2}^v \tag{21}$$

against the alternative hypothesis that the difference in coefficients is larger for the value portfolio. The null of identical responses to shocks on the interest rate and on the default spread across value and growth firms is strongly rejected at the five percent significance level.

Imposing the same latent state across value and growth portfolios changes several auxiliary re-

sults 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 moving from the growth decile to the value decile. Indeed, the null hypothesis that the degree of asymmetry across the states is identical between 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 (21) for the coefficients on the growth in money supply and on the dividend yield, none of the coefficient estimates are individually significant. Thus, the variation in the coefficients on the dividend yield across the book-to-market deciles documented in the univariate specifications in Table 2 dooes not survive the restriction of a single latent state across the testing portfolios. Finally, as in the univariate model, the volatility estimates do not vary much across value and growth firms in either the recession state or the expansion state.

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

Figure 3 plots the expected excess return forecasts 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 parameter 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 across 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 state with portfolio-specific shocks.

The solid line in Panel C of Figure 3 shows that the expected return of the value-minus-growth

19

portfolio is positive for 472 out of 648 months, about 73% of the time. The mean of the expected return is 0.39% per month, which is more than 14 standard errors of zero. More important, the expected value-minus-growth return displays time-variations closely related to the state of the economy. The expected return 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 more risky, 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 ratios are similar for the value and growth portfolios and both display strong cyclical patterns. The 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 average conditional Sharpe ratio is higher for value firms than for growth firms: 0.19 vs. 0.11 per month.

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-minus-growth return is close 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-minus-growth return 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 of zero.

From Panels B and C of Figure 5, the conditional volatility and the conditional Sharpe ratio of the value-minus-growth portfolio both display strong countercyclical variations. In particular, the Sharpe ratio tends to spike up during recessions only to decline gradually in the subsequent expansions. The unconditional Sharpe ratio in our sample is 14.8% per annum.

5   Are Value Firms Less Flexible Than Growth Firms?

We have shown that the expected excess returns of value firms display a higher degree of countercyclical variations than the expected excess returns of growth firms. The evidence is largely consistent with the predictions of the recent investment-based asset pricing theories discussed in Section 2. Guided by these theories, we now examine the potential sources of the time-variation in the expected value-minus-growth returns. Specifically, we test the hypothesis that value firms are more inflexible than growth firms in adjusting to negative aggregate shocks. To this end, we perform descriptive tests using various measures of flexibility in the context of the book-to-market deciles. We also use Fama-MacBeth (1973) cross-sectional regressions and Fama-French (1993) time series regressions to test if flexibility is related to costs of equity capital in the cross section.

Our sample is from the merged CRSP and Compustat database from 1972 to 2007. The starting point of our analysis 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 measure total assets with item 6. 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. Saunders et al. argue that fixed costs of production are proportional to the scale of fixed assets.[5] Accordingly, 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

---

[5]A similar assumption is often made in the theoretical literature on capital investment (e.g., Abel and Eberly 1994) and on investment-based asset pricing (e.g., Carlson, Fisher, and Giammarino 2004 and Cooper 2006).

is that, when demand decreases in bad times, the equity value falls relative to the book value of assets. 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. We measure operating leverage as the ratio of the percentage change in operating income before depreciation to the percentage change in sales. We use Compustat annual item 13 for operating income before depreciation and item 12 for sales.

However, the ratio of the percentage change in earnings to the percentage change in sales 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 cash flows of firms with high fixed costs will vary more with economic downturns than the cash flows of firms with low fixed costs. Moreover, using a dynamic asset pricing model with debt, Livdan, Sapriza, and Zhang (2008) argue that more leveraged firms are burden with more debt and must repay existing debt before financing new investments. Accordingly, more leveraged firms are more likely to be constrained financially, are less flexible in smoothing cash flows, 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 is 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 $t - 1$.[6]

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

---

[6]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).

information contents, we construct a composite flexibility index by aggregating over the information in 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 flexibility index assigned to the firm in the current year t. Higher value of flexibility index means less flexibility.

5.2 Empirical Results

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

We first examine whether value firms are less flexible than growth firms. To this end, we 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 near monotonically increasing relation between book-to-market equity and the degree 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 are more likely than growth firms to be affected by costly reversibility because value firms 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 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 of 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. The positive relation between leverage and book-to-market is not surprising

because both have the market equity in the denominator. However, the calculation of operating leverage does not directly involve the market equity. Yet 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. Lastly, the composite index of inflexibility also goes up monotonically from 0.62 for growth firms to 2.78 for value firms.

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 cost of equity capital in general. 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 specification shows that book-to-market is positively related to future returns. The slope is 0.38 ($t = 6.08$). Although the slope of the market equity is significant ($t = -2.10$), it is small in economic magnitude, -0.04.

More important, the subsequent five specifications report univariate cross-sectional regressions on each of the four individual flexibility 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 capital. 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 constructed from averaging the information in the four individual measures 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 significantly related to average returns 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 index of inflexibility 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 index, the average equal-weighted returns increase from 0.87% to 1.90% per month. The increasing relation also is virtually monotonic. The high-minus-low inflexibility portfolio earns an average equal-weighted return of 1.03% ($t = 4.11$). Controlling for the market beta and for the Fama-French three factor loadings does not eliminate the positive relation between inflexibility and average equal-weighted costs of equity. 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. The differences are both 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% ($t = 3.23$). 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 not significant, meaning that the flexibility mechanism is closely related to the value premium.

In sum, our results confirm a strong positive relation between real inflexibility and costs of equity, consistent with the theoretical work by Carlson, Fisher, and Giammarino (2004) and Zhang (2005).

6 Conclusion

Using the two-state Markov switching framework of Perez-Quiros and Timmermann (2000), we document new evidence that the expected value-minus-growth returns display 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 up 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, Jagannathan and Wang 1996, Ferson and Harvey 1991, 1993, 1999, Lettau and Ludvigson 2001, and Ang and Chen 2001).

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 emerging investment-based asset pricing literature (e.g., Carlson, Fisher, and Giammarino 2004, Zhang 2005, and Livdan, Sapriza, and Zhang 2008).

References

Abel, Andrew B. and Janice C. Eberly, 1994, A unified model of investment under uncertainty, *American Economic Review* 84, 1369–1384.

Anderson, Christopher W. and Luis Garcia-Feijóo, 2006, Empirical evidence on capital investment, growth options, and security *Journal of Finance* 61 (1), 171–194.

Ang, Andrew and Geert Bekaert, 2002a, International asset allocation with regime shifts, *Review of Financial Studies* 15 (4), 1137–1187.

Ang, Andrew and Geert Bekaert, 2002b, Regime switches in interest rates, *Journal of Business and Economic Statistics* 20, 163–182.

Ang, Andrew and Geert Bekaert, 2007, Stock return predictability: Is it there? *Review of Financial Studies* 20 (3), 651–707.

Ang, Andrew and Joseph Chen, 2007, CAPM over the long run: 1926–2001, *Journal of Empirical Finance* 14 (1), 1–40.

Bekaert, Geert and Campbell R. Harvey, 1995, Time-varying world market integration, *Journal of Finance* 50 (2), 403–444.

Bekaert, Geert and Guojun Wu, 2000, Asymmetric volatility and risk in equity markets, *Review of Financial Studies* 13, 1–42.

Bernanke, Ben S., 1990, On the predictive power of interest rates and interest rate spreads, *New England Economic Review* 51–68.

Bernanke, Ben S. and Mark Gertler, 1989, Agency costs, net worth, and business fluctuations, *American Economic Review* 79, 14–31.

Bhandari, Laxmi Chand, 1988, Debt/equity ratio and expected common stock returns: Empirical evidence, *Journal of Finance* 43, 507–528.

Blanchard, Olivier J., 1993, Movements in the equity premium, *Brookings Papers on Economic Activity* 2, 75–138.

Boudoukh, Jacob, Roni Michaely, Matthew Richardson, and Michael R. Roberts, 2007, On the importance of measuring payout yield: Implications for empirical asset pricing, *Journal of Finance* 62 (2), 877–915.

Berk, Jonathan B, Richard C. Green, and Vasant Naik, 1999, Optimal investment, growth options, and security returns, *Journal of Finance* 54, 1153–1607.

Carlson, Murray, Adlai Fisher, and Ron Giammarino, 2004, Corporate investment and asset price dynamics: Implications for the cross section of returns, *Journal of Finance* 59 (6), 2577–2603.

Campbell, John Y., 1987, Stock returns and the term structure, *Journal of Financial Economics* 18, 373–399.

Campbell, John Y. and John H. Cochrane, 1999, By force of habit: A consumption-based explanation of aggregate stock market behavior, *Journal of Political Economy* 107, 205–251.

Campbell, John Y., Martin Lettau, Burton G. Malkiel, and Yexiao Xu, 2001, Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk, *Journal of Finance* 56 (1), 1–43.

Campbell, John Y. and Robert J. Shiller, 1988, The dividend-price ratio and expectations of future dividends and discount factors, *Review of Financial Studies* 1 (3), 195–228.

Cochrane, John H., 2007, The dog that did not bark: A defense of return predictability, *Review of Financial Studies* 21 (4), 1533–1575.

Cooper, Ilan, 2006, Asset pricing implications of non-convex adjustment costs and irreversibility of investment, *Journal of Finance* 61 (1), 139–170.

Daniel, Kent D., David Hirshleifer, and Avanidhar Subrahmanyam, 1998, Investor psychology and security market under- and overreaction, *Journal of Finance* 53 (6), 1839–1885.

DeBondt, Werner F. M., and Richard Thaler, 1985, Does the stock market overreact? *Journal of Finance* 40, 793–805.

Dechow, Patricia M., Richard G. Sloan, and Mark T. Soliman, 2004, Implied equity duration: a new measure of equity risk, *Review of Accounting Studies* 9, 197–228.

Fama, Eugene F., 1981, Stock returns, real activity, inflation, and money, *American Economic Review* 71, 545–565.

Fama, Eugene F. and Kenneth R. French, 1992, The cross-section of expected stock returns, *Journal of Finance* 47, 427–465.

Fama, Eugene F. and Kenneth R. French, 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3–56.

Fama, Eugene F. and James D. MacBeth, 1973, Risk, return, and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607–636.

Fama, Eugene F. and G. William Schwert, 1977, Asset returns and inflation, *Journal of Financial Economics* 5, 115–146.

Ferson, Wayne E. and Campbell R. Harvey, 1991, The variation of economic risk premiums, *Journal of Political Economy* 99 (2), 385–415.

Ferson, Wayne E. and Campbell R. Harvey, 1993, The risk and predictability of international equity returns, *Review of Financial Studies* 6 (3), 527–566.

Ferson, Wayne E. and Campbell R. Harvey, 1999, Conditioning variables and the cross section of stock returns, *Journal of Finance* 54 (4), 1325–1360.

Filardo, Andrew J., 1994, Business cycle phases and their transitional dynamics, *Journal of Business and Economic Statistics* 12, 299–308.

Gala, Vito D., 2007, Investment and returns, working paper, London Business School.

Garlappi, Lorenzo and Hong Yan, 2007, Financial distress and the cross section of equity returns, working paper, University of Texas at Austin.

Gertler, Mark and Simon Gilchrist, 1994, Monetary policy, business cycles, and the behavior of small manufacturing firms, *Quarterly Journal of Economics* 109, 309–340.

Glosten, Lawrence R., Ravi Jagannathan, and David Runkle, 1993, On the relation between the expected value and the volatility of the nominal excess return on stocks, *Journal of Finance* 48, 1779–1801.

Gomes, Joao F., Leonid Kogan, and Lu Zhang, 2003, Equilibrium cross section of returns, *Journal of Political Economy* 111 (4), 693–732.

Gomes, Joao F. and Lukas Schmid, 2007, Levered returns, working paper, University of Pennsylvania.

Gray, Stephen F., 1996, Modeling the conditional distribution of interest rates as a regime switching process, *Journal of Financial Economics* 42, 27–62.

Guidolin, Massimo and Allan Timmermann, 2006, An econometric model of nonlinear dynamics in the joint distribution of stock and bond returns, *Journal of Applied Econometrics* 21, 1–22.

Guidolin, Massimo and Allan Timmermann, 2008a, Size and value anomalies under regime shifts, *Journal of Financial Econometrics* 6, 1–48.

Guidolin, Massimo and Allan Timmermann, 2008b, International asset allocation under regime switching, skewness, and kurtosis, *Review of Financial Studies* 21, 889–935.

Hamilton, James D., 1989, A new approach to the economic analysis of non-stationary time series and the business cycle, *Econometrica* 57, 357–384.

Hansen, Bruce E., 1992, The likelihood ratio test under nonstandard conditions: Testing the Markov switching model of GNP, *Journal of Applied Econometrics* 7, S61–S82.

Hennessy, Christopher A. and Toni M. Whited, 2005, Debt dynamics, *Journal of Finance* 60 (3), 1129–1165.

Jagannathan, Ravi and Zhengyu Wang, 1996, The conditional CAPM and the cross-section of expected returns, *Journal of Finance* 51 (1), 3–53.

Kandel, Shmuel and Robert F. Stambaugh, 1990, Expectations and volatility of consumption and asset returns, *Review of Financial Studies* 3, 207–232.

Kein, Donald B. and Robert F. Stambaugh, 1986, Predicting returns in the stock and bond markets, *Journal of Financial Economics* 17, 357–390.

Kiyotaki, Nobuhiro and John Moore, 1997, Credit cycles, *Journal of Political Economy* 105, 211–248.

Kogan, Leonid, 2004, Asset prices and real investment, *Journal of Financial Economics* 73, 411–431.

Lakonishok, Josef, Andrei Shleifer, and Robert W. Vishny, 1994, Contrarian investment, extrapolation, and risk, *Journal of Finance* 49 (5), 1541–1578.

Lettau, Martin, and Sydney Ludvigson, 2001, Resurrecting the (C)CAPM: A cross-sectional test when risk premia are time-varying, *Journal of Political Economy* 109, 1238–1287.

Lewellen, Jonathan, and Stefan Nagel, 2006, The conditional CAPM does not explain asset-pricing anomalies, *Journal of Financial Economics* 82, 289–314.

Livdan, Dmitry, Horacio Sapriza, and Lu Zhang, 2008, Financially constrained stock returns, forthcoming, *Journal of Finance*.

Lustig, Hanno N., and Stijn Van Nieuwerburgh, 2005, Housing collateral, consumption insurance, and risk premia: An empirical perspective, *Journal of Finance* 60 (3), 1167–1219.

Newey, Whitney K. and Kenneth D. West, 1987, Hypothesis testing with efficient method of moments estimation, *International Economic Review* 28 (3), 777–787.

Obreja, Iulian, 2006, Financial leverage and the cross-section of stock returns, working paper, Carnegie-Mellon University.

Perez-Quiros, Gabriel and Allan Timmermann, 2000, Firm size and cyclical variations in stock returns, *Journal of Finance* 55 (3), 1229–1262.

Ramey, Valerie A. and Matthew D. Shapiro, 2001, Displaced capital: A study of aerospace plant closings, *Journal of Political Economy* 109, 958–992.

Rosenberg, Barr, Kenneth Reid, and Ronald Lanstein, 1985, Persuasive evidence of market inefficiency, *Journal of Portfolio Management* 11, 9–11.

Rajan, Raghuram G. and Luigi Zingales, 1995, What do we know about capital structure? Some evidence from international data, *Journal of Finance* 50 (5), 1421–1460.

Saunders, Anthony, Elizabeth Strock, and Nickolaos G. Travlos, 1990, Ownership structure, deregulation, and bank risk taking, *Journal of Finance* 45 (2), 643–654.

Schwert, G. William, 1989, Why does stock market volatility change over time? *Journal of Finance* 29 (5), 1115–1153.

Smith, Clifford W. Jr. and Ross L. Watts, 1992, The investment opportunity set and corporate financing, dividend, and compensation policies, *Journal of Financial Economics* 32, 263–292.

Zhang, Lu, 2005, The value premium, *Journal of Finance* 60 (1), 67–103.

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 portfolio, we estimate the following two-state Markov switching model:

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

in which r_t is the monthly excess return for a given decile portfolio and S_t 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:

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

in which r_t is the monthly excess return for a given decile and S_t 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 equalized across states, i.e., $\beta_{k,S_t=1} = \beta_{k,S_t=2}, k = \{1,2,3,4\}$. 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 Book-to-Market Decile Ten (Value) and Decile One (Growth) Portfolios (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):

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

in which $\mathbf{r}_t = (r^g_t, r^v_t)'$ is the (2×1) vector that contains the monthly excess returns on the growth and value portfolios, r^g_t and r^v_t, respectively. $\boldsymbol{\beta}_{k,S_t}, k = 0,1,2,3,4$, is a (2×1) vector with elements $\boldsymbol{\beta}_{k,S_t} = (\beta^g_{k,S_t}, \beta^v_{k,S_t})'$. $\boldsymbol{\epsilon}_t \sim \mathcal{N}(0,\Sigma_{S_t})$ 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: $\log(\Sigma_{ii,S_t}) = \lambda^i_{S_t}$. The off-diagonal terms, 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: $\beta^g_{0,1} - \beta^g_{0,2} = \beta^v_{0,1} - \beta^v_{0,2}$	
Constant, state 1	-0.043	(0.02)	-0.047	(0.02)	Log likelihood value	2243
Constant, state 2	-0.004	(0.01)	-0.003	(0.01)	p-value	(0.30)
					TB: $\beta^g_{1,1} - \beta^g_{1,2} = \beta^v_{1,1} - \beta^v_{1,2}$	
TB, state 1	-6.741	(2.18)	-10.758	(2.25)	Log likelihood value	2241
TB, state 2	-1.725	(1.47)	-2.965	(1.41)	p-value	(0.02)
					DEF: $\beta^g_{2,1} - \beta^g_{2,2} = \beta^v_{2,1} - \beta^v_{2,2}$	
DEF, state 1	4.599	(1.38)	7.761	(1.29)	Log likelihood value	2240
DEF, state 2	1.057	(0.72)	1.285	(0.77)	p-value	(0.01)
					ΔM: $\beta^g_{3,1} - \beta^g_{3,2} = \beta^v_{3,1} - \beta^v_{3,2}$	
ΔM, state 1	0.093	(0.08)	0.081	(0.08)	Log likelihood value	2240
ΔM, state 2	0.024	(0.06)	0.084	(0.06)	p-value	(0.01)
					DIV: $\beta^g_{4,1} - \beta^g_{4,2} = \beta^v_{4,1} - \beta^v_{4,2}$	
DIV, state 1	0.448	(0.49)	0.387	(0.25)	Log likelihood value	2241
DIV, state 2	0.420	(0.47)	0.430	(0.25)	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	$(0.685$	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 table entries are the time series averages of annual cross-sectional medians, except for the disinvestment frequency, which is the time series average of annual disinvestment frequency of a given decile. The heteroscedasticity-and-autocorrelation-consistent t-statistics that test the differences in characteristics between the value and growth portfolios are individually zero also are reported.

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(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 flexibility index is a sorted decile index of an arithmetic average of decile indexes of the four flexibility proxies. Higher value of this the flexibility 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 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 Flexibility Index (January 1972 to December 2007)

At the end of June of each year t, we sort stocks into deciles based on the composite flexibility index as of fiscal year ending in calendar year $t-1$. The composite flexibility 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 flexibility 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.

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

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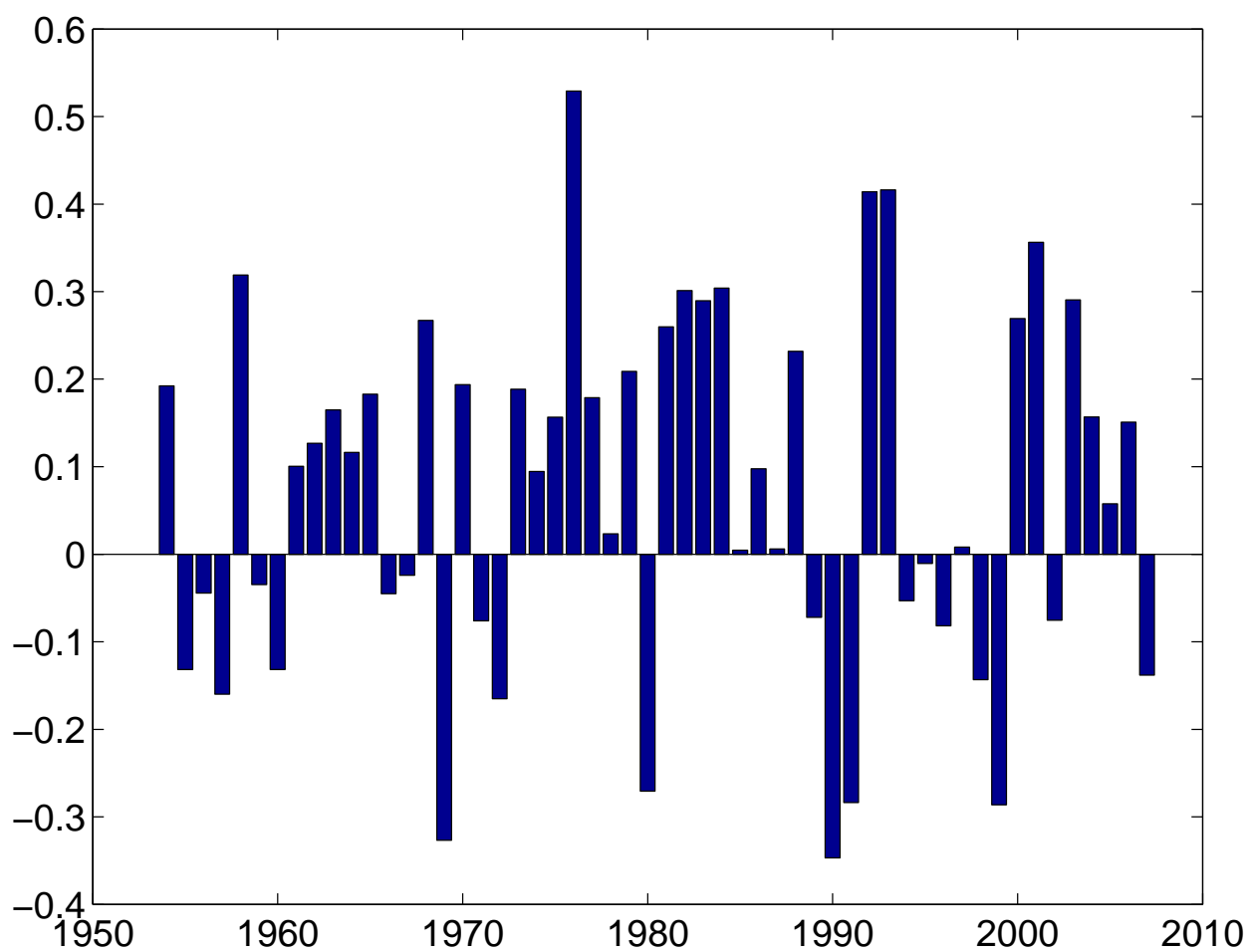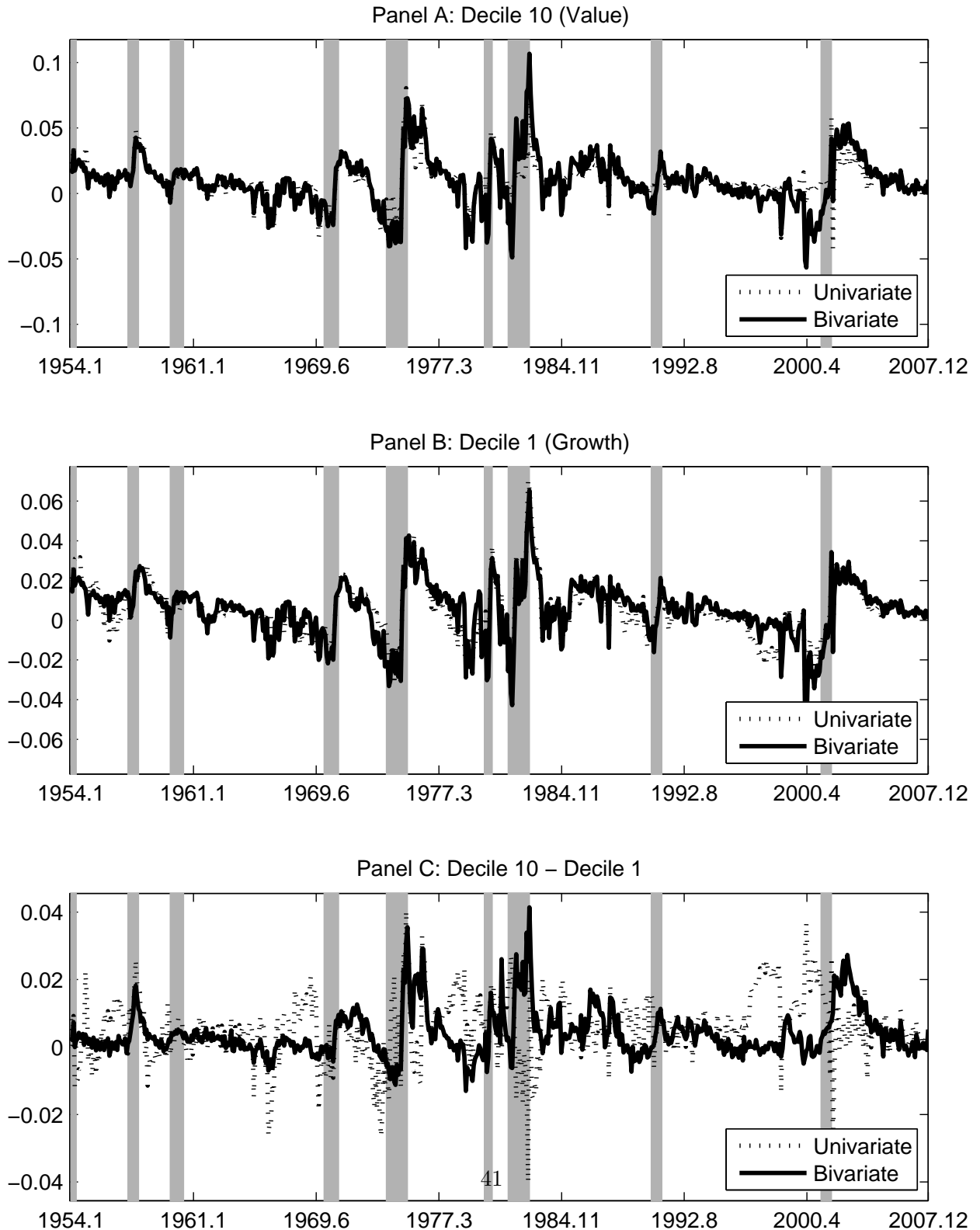
Figure 2 : Univariate Markov Switching Model, Probability of High Variance and Low Mean State (January 1954 to December 2007)

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.

Panel A: Decile 10 (Value)


Panel B: Decile 1 (Growth)

40
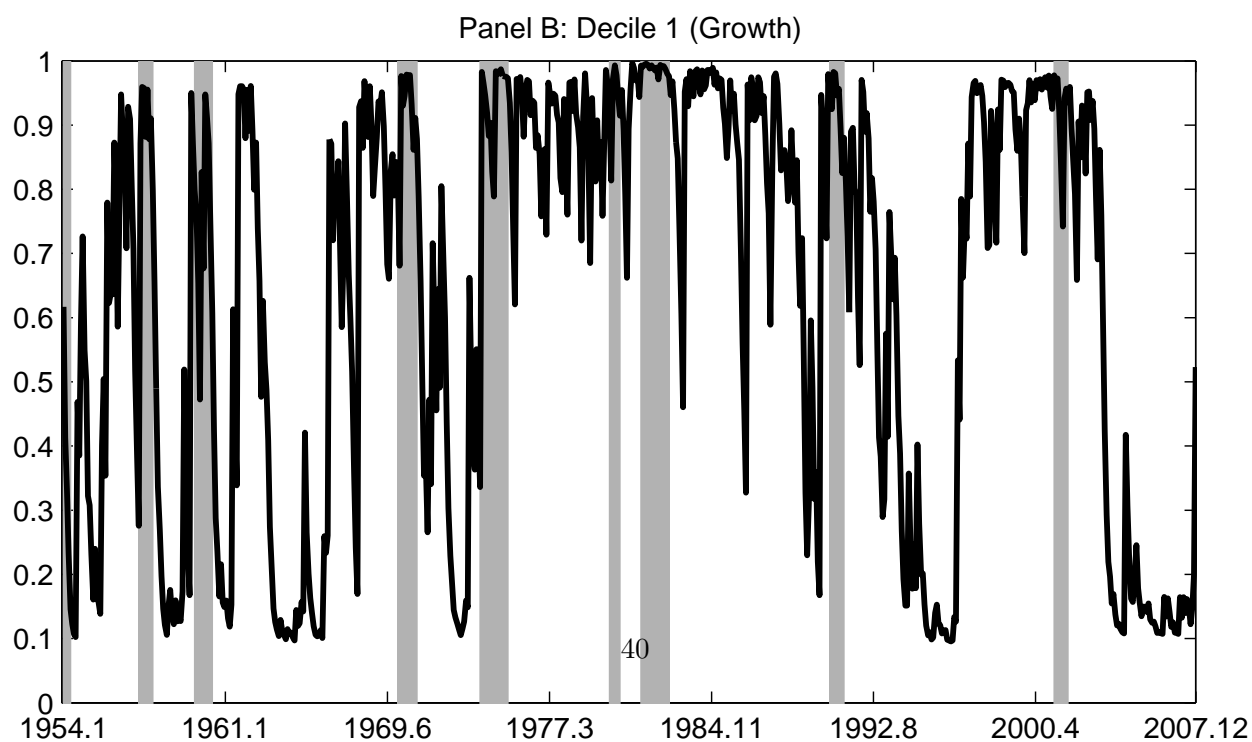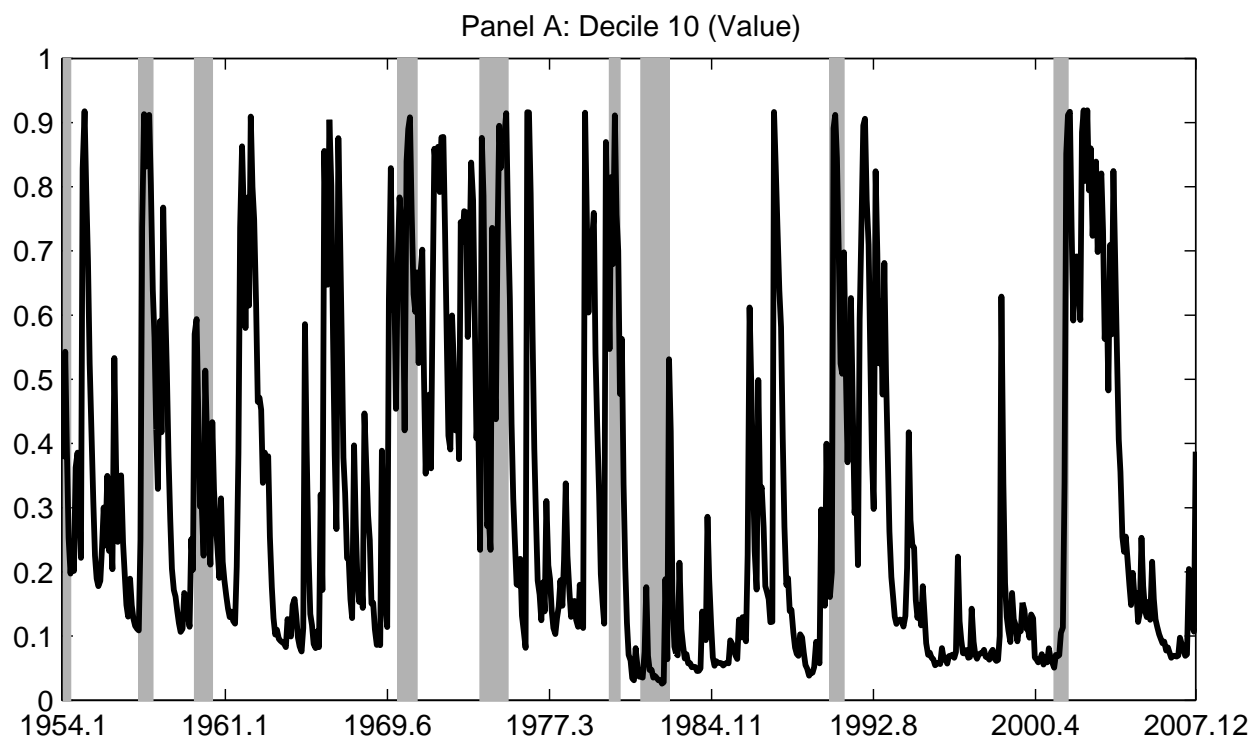
Figure 3 : Expected Excess Returns, Univariate and Bivariate Markov Switching Models

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 Markow switching models in Tables 2 and 4. The solid lines use 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.

Panel A: Decile 10 (Value)

Panel B: Decile 1 (Growth)

Panel C: Decile 10 – Decile 1

41

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.

Panel A: Conditional Volatilities

Panel B: Conditional Sharpe Ratios

42
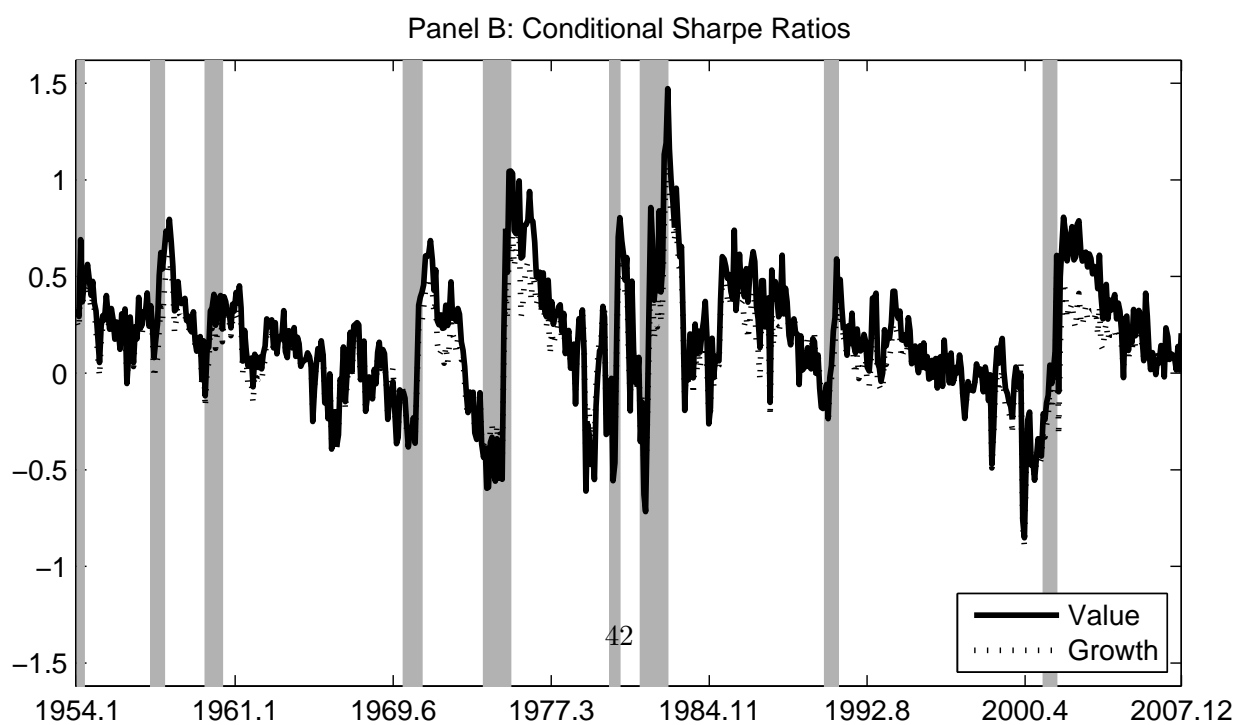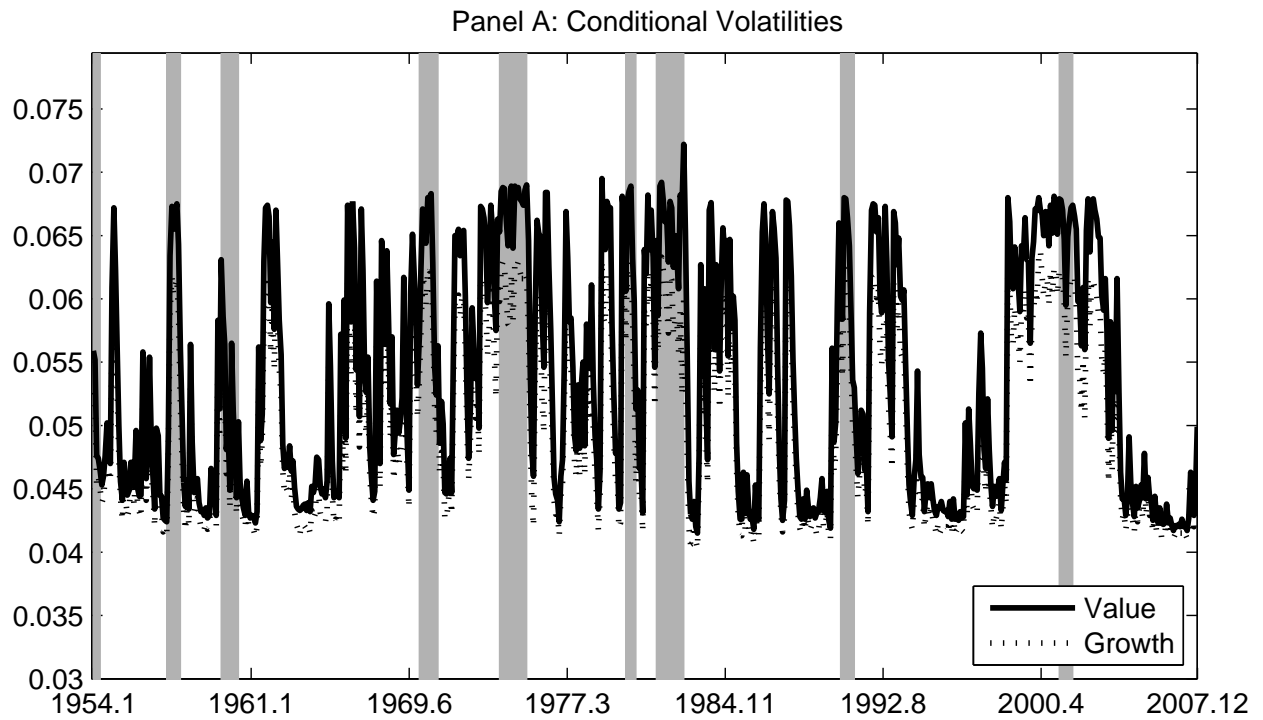
Figure 5 : Expected Returns, Conditional Volatility, and Conditional Sharpe Ratio for the Value-minus-Growth Portfolio Estimated from the Univariate Markov Switching Model

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 Markow 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.

Panel A: Expected Return

Panel B: Conditional Volatility

Panel C: Conditional Sharpe Ratio

43