Is Value Really Riskier Than Growth?

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Abstract

We investigate the risk of value and growth in different market states and using alternative risk measures such as downside beta and higher moments in a regime-switching framework. We find little or no evidence that value is riskier than growth, and that evidence is specific to the period that includes the Great Depression there. Within the post-1963 sample, there are periods when the value premium can be explained by the CAPM, whilst during other periods the premium is explained by the fact that the returns on value firms increase more than the returns on growth stocks in periods of strong market performance, whilst in downturns growth stocks suffer more than value, and these features are captured by different upside/downside betas or higher moments. These results are not consistent with a risk-based explanation of the value premium.

JEL Classifications: G12

Keywords: Value Premium, Regime Switching, Beta, Downside/Upside Beta, Higher Moments

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Many studies have tried to explain the value premium identified by Rosenberg, Reid and Lanstein (1985) and Fama and French (1992, 1993). To the proponents of conventional asset pricing theory, the value premium is a puzzle, since growth stocks whose values depend more on business cycles should be riskier than value stocks whose values are less dependent on economic situations, and thus growth stocks are expected to have higher betas and higher returns. Empirical evidence, however, does not support this argument; value stocks have higher returns than growth stocks but have lower betas. For example, the famous Fama-French's HML (high book-to-market portfolio returns minus low book-to-market portfolio returns) returns 0.45% a month (standard error 0.13) for the period from January 1963 to December 2006. Even after considering the systematic risk, the estimated alpha is 0.58% which is highly significant. Recently Chen, Petkova and Zhang (2006) show that there is not much evidence that the value premium has weakened in recent times, so the anomaly persists.

Fama and French (1993, 1995) argue that HML is a risk factor that represents financial distress of weak firms with low earnings, which tend to have high book-to-market ratios. On the other hand Lakonishok, Shleifer and Vishny (1994) suggest investors' incorrect extrapolation of the past earnings growth of firms as the source of the value premium. Others try to explain the premium in the framework of the CAPM, with mixed results. For example, Jagannathan and Wang (1996) and Ang and Chen (2007) propose conditional CAPM models. Lewellen and Nagel (2006) and Petkova and Zhang (2005) also use conditional CAPM models to investigate the value premium, but their results are not as strong as those of Ang and Chen (2007). Campbell and Vuolteenaho (2004), on the other hand, decompose the beta of a stock into the 'good' beta that comes from news about the discount rate and the 'bad' beta from news about the future cash flows, and show that value stocks have higher proportion of 'bad' betas. These studies, however, have been criticized by Daniel and Titman (2005) who show that the favourable results could be due to the low power of the tests used.

Recently, risk-based explanations for the value premium have been proposed which seek answers from the inflexibility of value firms upon economic conditions in the framework of real options models. Zhang (2005), for example, provides an explanation in the neoclassical framework with rational expectations and competitive equilibrium; value firms are less flexible and thus riskier than growth firms, especially in bad times, since value firms have more assets in place and thus it is more costly for these firms to scale down production than for growth firms which have fewer assets in place. On the other hand, in expansions value firms are favoured in detriment of growth firms, which need to invest to take advantage of the optimistic economic environment. Most of the empirical evidence supporting this argument is provided in the firm or industry level using firm characteristics. Xing and Zhang (2005) show that value firms in the manufacturing sector perform worse than growth firms in the negative business cycle and vice versa, using variables such as earnings growth, sales growth, investment growth, and investment rate, whilst Cooper, Gerard and Wu (2005) investigate the link between the rate of capacity and the degree of investment irreversibility and the book-to-market ratio. One caveat with the empirical studies above is that they use subsets of stocks, whilst the value premium is calculated using a much larger number of stocks from the whole market. For example, the number of manufacturing firms Xing and Zhang (2005) use is only 21% (37% in market capitalization) of the firms publicly traded in the market. In addition, the firm characteristics used by these studies may reflect business cycles, but are not necessarily concurrent with the movements in financial markets because the lead and lag relationship between the firm characteristics and the dynamics in the stock market is not likely to be constant.

Some of the studies mentioned above attempt to model time-varying risk and the expected market risk premium directly. We do not follow this path for two reasons. First, by modelling time-varying risk and the expected market risk premium directly, these studies fail to show conclusive evidence that time-varying risk explains the value premium. Second, the choice to use a conditional model and to estimate the expected market risk premium involves either a subjective decision about which conditioning variables to use, or a high degree of model parameterisation (as in Ang and Chen (2007)).

Motivated by time-varying risk preferences (Campbell and Cocharane, 1999; Gordon and St-Amour, 2000), we develop a pricing kernel that investors with a well-behaved utility function would optimize the expected utility of their portfolios in response to time-varying preferences and distributions of asset returns. Depending on the risk preference, our model include two widely known equilibrium asset pricing models in addition to the CAPM: the lower partial moment CAPM (henceforth LCAPM) and the higher moment CAPM (henceforth HCAPM). The LCAPM, which was developed by Bawa and Lindenberg (1977) and Harlow and Rao (1989), includes asymmetric reactions to downside and upside markets separately. Chan (1988), De Bondt and Thaler (1987), and Petkova and Zhang (2005) use it to investigate the value premium but give us mixed results. The HCAPM introduced by Kraus and Litzenberger (1976) prices higher moments. A closely related study is Harvey and Siddique (2000) who model conditional skewness. Higher moments explain asset returns with asymmetry or fat tails, but are not necessarily the same as the upside and downside betas.

One major difference of the approach above from those of previous studies is that any of the three models − CAPM, LCAPM, and HCAPM − can explain asset returns in the regime switching framework we employ. Since these are based on equilibrium models, our approach is still within the rationality framework. Thus we seek explanations on the value premium in the conventional risk-return framework by concentrating on the empirical possibility of changing risk measures and its impact on asset pricing. When there is no difference in upside and downside betas or when higher moments are not priced, the model is equivalent to the conventional CAPM and therefore the LCAPM or HCAPM is selected only when asymmetries or fat-tails matter in asset pricing.

With appropriate risk measures chosen for different time periods, we investigate whether or not value firms are riskier than growth firms. As argued by Zhang (2005), if value firms are riskier than growth firms during troughs, the asymmetric models should show that the downside beta is higher than upside beta for value-minus-growth portfolios during bear markets or that the coefficients on higher moments should be significant during bear markets such that value firms become riskier.

Our results show that, when we identify the market state through a regime-switching model for the market return, there is little or no difference in the risk of value-minus-growth portfolios across market regimes, and this difference does not explain the value premium, except when the sample includes the Great Depression period. Moreover, when we investigate the value premium using different risk measures, we find that there are periods of time when the premium can be explained by the CAPM, whilst during other periods the premium is explained by the fact that the returns of value firms increase more than the returns on growth stocks in periods of strong market performance, whilst in downturns growth stocks suffer more than value stocks. These features are captured by the upside/downside betas in the LCAPM or by the coefficient of the square and cube of the market return in the HCAPM. Overall, our results are not consistent with a risk-based explanation of the value premium.

The rest of this work is organized as follows. In Section I we explain the methodology used. Section II contains the empirical results, with explanations of the data set and empirical tests. Conclusions are in Section III.

I. Regime Switching Model

In this section we first propose the pricing kernel that depends on time-varying risk preferences and distributions of asset returns, which produce different risk measures over time. We then introduce a regime switching model that allows these risk measures to be used over time, and the method used to estimate it.

A. Asset Pricing Model with Time-varying Preferences toward Risk

The single factor equilibrium capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965) predicts a linear relationship between risk and return for risky assets. However, a number of studies have demonstrated that the market beta alone cannot explain 'anomalies', in particular, cross-sectional asset returns. In response to the failure of the single factor model, recent studies propose several variants of the model by allowing state-dependent preferences through wealth dependencies (Bakshi and Chen, 1996), or time-varying habits (Campbell and Cocharane, 1999). Gordon and St-Amour (2000, 2004) develop a discrete-time model in which risk aversion follows a two state Markov process, under the assumption that risk aversion is contingent on a preference state. These models include time-varying preferences in a way that marginal utility and required returns increase in recessions and decrease in economic expansions. In our study we apply the idea of time-varying preferences to a pricing kernel in order to obtain appropriate risk measures when preferences time-vary.

Consider the basic consumption-based pricing equation from the first order condition for an investor holding a risky asset,

$$E\left[k_{t+1}(1+R_{i,t+1})\right]=1, \tag{1}$$

where $R_{i,t+1}$ is the return on asset i, k_{t+1} is the marginal rate of substitution (MRS) (pricing kernel or stochastic discount factor) that represents investor's willingness to substitute consumption at time t+1 for consumption at time t. Investors with a well-behaved utility function which satisfies conditions proposed by Arrow (1971), would optimize the expected utility of their portfolios in response to time-varying preferences and distributions of asset returns, which suggests that the specification of the pricing kernel also time-varies.

There are a number of different pricing kernels, but a natural method would be to expand the MRS using a Taylor expansion as in Hwang and Satchell (1999) and Harvey and Siddique (2000). Consider a utility function that satisfies Arrow's (1971) conditions for stochastic preferences toward risk. Taking a Taylor series expansion and separating $R_{m,t+1}$ with respect to a specified target return gives us

$$k_{t+1}=\theta_{0t}+\theta^{+}_{1t}\,max\left(R_{m,t+1},R_{target}\right)+\theta^{-}_{1t}\,min\left(R_{m,t+1},R_{target}\right)+\theta_{2t}R^{2}_{m,t+1}+\theta_{3t}R^{3}_{m,t+1} \quad (2)$$

if terms involving $R^4_{m,t+1}$ and higher orders are ignored. The specification can produce three equilibrium models, CAPM, HCAPM, and LCAPM, depending on $\theta_{0t}, \theta^{-}_{1t}, \theta^{+}_{1t}, \theta_{2t}, \theta_{3t}$, and the moments of $R_{m,t+1}$.

The first model is the conventional CAPM. When asset returns are elliptical or quadratic utility is chosen, then $R^2_{m,t+1}$ and higher orders can be ignored and we have $\theta^{+}_{1t} = \theta^{-}_{1t} = \theta_{1t} \neq 0$ and $\theta_{2t} = \theta_{3t} = 0$. Then the marginal rate of substitution is linear in the market return

$$k_{t+1} = \theta_{0t} + \theta_{1t}R_{m,t+1} \quad (3)$$

which produces the conventional CAPM. For a quadratic utility that satisfies non-satiation and decreasing marginal utility, we have $\theta_{1t} < 0$ and the marginal rate of substitution decreases (or decreasing marginal utility) with $R_{m,t+1}$.

In addition to this special case, we have two more specifications of the marginal rate of substitution, which produces LCAPM and HCAPM. The second equilibrium model is the upside/downside CAPM model (the Lower Partial Moment CAPM, LCAPM) of Bawa and Lindenberg (1977) and Harlow and Rao (1989), which has been a popular method to investigate asymmetric reactions to market movements or if downside beta is priced.[1] When $\theta^{+}_{1t} \neq \theta^{-}_{1t}$ and $\theta_{2t} = \theta_{3t} = 0$, the marginal rate of substitution reacts differently to positive and negative market returns

$$k_{t+1} = \theta_{0t} + \theta^{+}_{1t}max\left(R_{m,t+1}, R_{target}\right) + \theta^{-}_{1t}min\left(R_{m,t+1}, R_{target}\right) \quad (4)$$

which produces the LCAPM model:

$$E(r_{pt}) = \beta^{-}Cov(r_{pt}, r^{-}_{mt}) + \beta^{+}E(r_{pt}, r^{+}_{mt}) \quad (5)$$

where r_{pt} is the excess return on portfolio *p*, $r^{+}_{mt} = r_{mt}I\left(r_{mt} > r_{\text{target}}\right)$ and $r^{-}_{mt} = r_{mt}I\left(r_{mt} < r_{\text{target}}\right)$ are the positive and negative components of the market return in excess of the target return r_{target}, and *I(.)* is the indicator variable.

Another equilibrium model can be obtained when the two additional terms, $\mathrm{R}^2_{\mathrm{m,t+1}}$ and $r^3_{m,t+1}$, are not negligible in the pricing kernel. When $\theta^{+}_{1t} = \theta^{-}_{1t} = \theta_{1t}$, we have

$$k_{t+1} = \theta_{0t} + \theta_{1t}R_{m,t+1} + \theta_{2t}R^2_{m,t+1} + \theta_{3t}R^3_{m,t+1}\,. \quad (6)$$

For a utility function which satisfies conditions proposed by Arrow (1971), we have $\theta_{1t} < 0$ and $\theta_{2t} > 0$. Furthermore, from the results of Scott and Horvath (1980), we have $\theta_{3t} < 0$. The MRS that satisfies these conditions decreases for positive market return and skewness whereas it increases with market volatility. The asset pricing model with the cubic kernel pricing (HCAPM) is

$$E\left(r_{pt}\right) = \beta_1 Cov\left(r_{pt}, r_{mt}\right) + \beta_2 Cov\left(r_{pt}, r^2_{mt}\right) + \beta_3 Cov\left(r_{pt}, r^3_{mt}\right) \quad (7)$$

where the second and third terms are called co-skewness and co-kurtosis respectively.[2]

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[1] See Kim and Zwalt (1979), Chen (1982), De Bondt and Thaler (1987), Chan (1988) and Petkova and Zhang (2005).

[2] Note that there are several different approaches to include higher moments. For example, Kraus and Litzenberger (1976), Friend and Westerfield (1980) and Sears and Wei (1985), Barone-Adesi (1985), Harvey and Siddique (2000).

Although both the HCAPM and LCAPM can model asymmetry in asset returns, the HCAPM models returns as a non-linear function of the market return, whilst in the LCAPM asset returns are priced linearly with market returns conditioning on up- and down-markets. Therefore the two models are not necessarily the same and in particular, the HCAPM can be used to price kurtosis in addition to skewness in asset returns.

Depending on preferences and distributions of asset returns, the MRS in (2) suggests three equilibrium based models, i.e., the traditional CAPM, the LCAPM that allows different responses to up- and down-market states, and the HCAPM that models skewness and fat-tails in addition to the traditional beta. Empirically, most of the previous studies test one of these models against the other models for certain sample periods and then conclude which one explains assets' returns better than the others. For example, beta appears to be priced before 1968 (Fama and MacBeth (1973)), but not from 1963 to 1990 (Fama and French (1992)). Lim (1989) reports that skewness is priced in some sub-periods. These empirical results indicate the possibility that asset returns are priced with different risk measures for different time periods. In our generalised framework, we do not test whether or not a risk measure dominate the others for the entire sample period, but we focus on which one is selected over time. When asset returns are normally distributed for a specific time period, for example, the CAPM explains asset returns.

C. Regime Switching Model with Alternative Risk Measures

In order to model asset returns with different risk measures over different time periods, we assume that there are N regimes defined by S_t, a random Markov regime variable that for each time t assigns a value in $\{1,\ldots,N\}$. When a dummy variable, S_{jt}, j=1, 2, …, N, is defined for each regime, that is, $S_{jt}=1$ when $S_t=j$ and $S_{jt}=0$ otherwise, our model is given by

$$r_{pt}=\alpha_i+\sum_{j=1}^{N}S_{jt}m_{jt}+\varepsilon_{it}, \tag{8}$$

where m_{jt} is a fully-specified relationship between the portfolio return, r_{pt}, and the set of factors in regime j, and $\varepsilon_{it}\sim\left(0,\sigma_{i,t}^2\right)$, where $\sigma_{it}^2=\sum_{j=1}^{N}\sigma_{i,j}^2 S_{jt}$.

For m_{jt} the following three models are used. First, for the CAPM we have

$$m_{1t}=\beta r_{mt}, \tag{9}$$

where $r_{mt}=R_{mt}-R_f$, the market return in excess of the risk-free rate. Following the discussion in Sections I.A and I.B, we allow the LCAPM and the HCAPM to be selected by defining

$$m_{2t}=\beta^- r_{mt}^- +\beta^+ r_{mt}^+ \tag{10}$$

and

$$m_{3t}=\beta_1 r_{mt}+\beta_2\left(R_{mt}-E\left(R_{mt}\right)\right)^2+\beta_3\left(R_{mt}-E\left(R_{mt}\right)\right)^3. \tag{11}$$

When the data generating processes follow equations (9), (10) and (11), they are *equivalent* to the CAPM, LCAPM, and HCAPM, respectively. Therefore, our regime switching model can be presented as:

$$\begin{aligned} r_{pt} &= \alpha + S_{1t}\left[\beta r_{mt}\right] + S_{2t}\left[\beta^{+} r_{mt}^{+} + \beta^{-} r_{mt}^{-}\right] \\ &\quad + S_{3t}\left[\beta_1 r_{mt} + \beta_2\left(R_{mt} - E\left(R_{mt}\right)\right)^2 + \beta_3\left(R_{mt} - E\left(R_{mt}\right)\right)^3\right] + \varepsilon_t \quad . \end{aligned} \tag{12}$$

Note that the transition probability matrix will describe how likely it is to migrate from one regime, say the CAPM, to another, say, the HCAPM. Since we specify a first-order Markov chain, the only information that matters to predict the regime at time *t+1* is the regime at time *t*.

This regime-dependent risk measure model is quite flexible since asset returns can be modelled with time variation in both asset returns' distribution and investors' risk preferences. Over different time periods, any one of the models can dominate the other two, or there may be no dominant model. The estimates of the parameters and probabilities of regimes could provide answers to the questions of whether and when value firms are riskier than growth firms; e.g., by comparing β, β^{-}, and β^{+} of value and growth portfolios. If $\beta^{-} > \beta^{+}$ in the LCAPM during bear markets, the portfolio is riskier in downside markets. On the other hand, when $\beta_2 < 0$ (β_2>0) in the HCAPM, the portfolio is expected to show lower returns (higher returns) and be riskier (less risky) than other portfolios that just follow the CAPM. When β_3>0 ($\beta_3 < 0$) and market returns are positively skewed, the portfolio is expected to show higher (lower) returns than the symmetric CAPM and the portfolio is less risky (riskier).

D. Estimation Method

We estimate the regime-switching model (12) via a Bayesian Markov Chain Monte Carlo (MCMC) Gibbs-sampling approach. As Kim and Nelson (1999) point out, using the Gibbs sampler to estimate unobserved variables as well as parameters allows us to draw from the relevant distributions simultaneously. Besides, the model has conditioning features that make it simple to implement the Gibbs sampler. Another reason to use an MCMC method is that it provides posterior distributions from which we draw the parameter estimates and conduct significance tests directly. Finally, by averaging the generated values of the regime dummy variables we also get estimates of the smoothed probabilities of regime selection over time, which are useful to study the implications of our model.

The Gibbs sampling estimation of model (12) consists of two steps. Let $\boldsymbol{\theta} = \left(\alpha, \beta, \beta^{-}, \beta^{+}, \beta_1, \beta_2, \beta_3, \sigma_1, \sigma_2 \sigma_3, P\right)$ denote the vector of parameters in the model. In the first step, conditional on $\boldsymbol{\theta}$, we sample from the distribution of $\tilde{\mathbf{S}}_T = \left(S_1 \ldots S_T\right)$ using the multi-move algorithm of Carter and Kohn (1994). Conditional on $\tilde{\mathbf{S}}_T$, the model reduces to a regression model with known structural breaks, so in the second step each parameter in $\boldsymbol{\theta}$ is sampled in turn, conditioned on these structural breaks. We use standard conjugate Gaussian distributions for the regression coefficients and the inverted gamma distribution for the variance, as in Zellner (1971). Note that the LCAPM cannot be directly estimated with the constant due to the issue discussed in Post and Van Vliett (2005): if the constant is included, the estimated downside and upside betas are not consistent with what the LCAPM suggests.[3] Consequently, throughout this study, we first estimate β^- and β^+ by running a regression without the constant to obtain $\hat{\beta}^-$ and $\hat{\beta}^+$ that are consistent with the LCAPM theory, and then calculate the constant from the residuals; $r_{pt} - \hat{\beta}^- r_{mt}^- - \hat{\beta}^+ r_{mt}^+$. The transition probabilities are estimated using conjugate beta priors. We allow for a large number of burn-in iterations to guarantee convergence. All results are obtained with 10,000 iterations after 30,000 burn-in iterations.

II. Empirical Results

We first describe the various value, growth and value-minus-growth portfolios we use in this study, and then present the conventional OLS estimates for each of the three models. In subsection C, we report the results of our investigation of the risk of value and growth portfolios according to the regime of the market as inferred from a regime-switching model. In subsection D, we report our main results obtained with the regime-switching model with alternative risk measures. Robustness tests are discussed in subsection E.

A. Data

There are many different ways of constructing value/growth portfolios. Book-to-market, earnings, and other firm characteristics have been used with different breakpoints in the literature. Rather than testing a large number of different value/growth portfolios, we focus on the two popular value/growth portfolios. The first value/growth portfolios are Fama and French's (1993) H (high book-to-market or value portfolio), L (low book-to-market or growth portfolio), and HML (value minus growth) portfolios, which are constructed using a two-by-three sort on size and book-to-market. HML has been used as a standard measure of the value premium since Fama and French (1993), and has been used in many studies, including Petkova and Zhang (2005) and Fama and French (2006a). The second value/growth portfolios consider size, since the value premium is supposedly stronger among smaller firms (Loughran (1997) and Fama and French (2006a)). From a five-by-five sort on size and book-to-market the small-value (Hs) and small-growth (Ls) portfolios can be calculated, and the small value premium HMLs is the small-value portfolio (Hs) minus the small-growth portfolio (Ls). To check the robustness of our results, we also use value/growth portfolios based on a decile sort on earnings-to-price ratio[4]. The excess market return is the CRSP value-

[3] Ignoring this issue, as most studies do, produces non-trivial distortions in upside and downside betas. For example, when we use the HML returns from 1963 to 2006 (data from Kenneth french's data library), the estimation of downside and upside betas (where the target return is zero) for the HML portfolio estimated *with* the constant term are -0.288 and -0.261 (not statistically different from each other), whilst those *without* the constant are -0.360 and -0.168 (different at less than 1% significance level). The conclusion in each case is quite different; in the former, there is no difference between upside and downside betas, whilst in the latter upside beta is larger than downside beta.

[4] Fama and French (2006a) show that the value premium becomes less dependent on size if earnings-to-price ratio is used instead of book-to-market ratio

weighted portfolio return minus the one-month Treasury bill rate. All the data are obtained from Kenneth French's data library.[5]

We take the sample period from July 1926 through December 2006 and consider different sub-samples within this period: the full sample (1926-2006), the post-depression sample (1935-2006), and the post-1963 sample (1963-2006). We focus more on the post-1963 sample because the value premium is more difficult to explain during this period. The value premium in the period from 1926 to 1963 can be explained using the simple CAPM or the conditional CAPM; see Ang and Chen (2007) and Fama and French (2006a). We consider the post-depression sample because the Great Depression was a remarkably unique event which could alter the results significantly. In our robustness checks we also consider the pre-1963 sample.

The value premium can be measured by average returns or unconditional alphas of value-minus-growth portfolios. Table 1 reports several descriptive statistics for our portfolios. Consistent with previous studies, i.e. Fama and French (1992, 1993, 2006) and Davis, Fama and French (2000), the value premium exists and is stronger for small stocks. The value premia from HML and HMLs in the full sample (Panel A) are, in terms of average returns (unconditional OLS alphas), 0.42% and 0.51% (0.32% and 0.48%), respectively. When we exclude the Great Depression (Panel B), the value premia from the HML and HMLs portfolios increase to 0.48% and 0.56% (0.51% and 0.66%) in terms of average returns (unconditional OLS alpha). Finally, in the more recent period from 1963 to 2006 (Panel C), the average returns (unconditional OLS alphas) of the HML and HMLs portfolios still remain high, at 0.45% and 0.62% (0.58% and 0.78%), respectively.

Other statistics suggest that all value portfolios have fatter tails (higher kurtosis) than the growth portfolios and the market in all sample periods, whilst growth portfolios tend to have less extreme returns than the market. However, the value portfolios have larger skewness than the growth portfolios and thus the value-minus-growth portfolios have positive skewness.

B. Preliminary Results with Unconditional Models

We use OLS estimation to investigate how each model performs separately at explaining the value and growth portfolios. Panels A, B and C of Table 2 report the results using the full, post-depression and post-1963 periods, respectively. The estimates show little evidence that value is riskier than growth. The CAPM betas of HML and HMLs are positive only when the sample includes the Great Depression (see Panel A), whilst in the post depression and post-1963 samples betas are negative and mostly significant (Panels B and C). The LCAPM estimates suggest that value is not riskier than growth in any of the samples; in the full samples the downside betas of HML and HMLs are not significantly different from zero, whilst in the post-depression and post-1963 samples the downside betas are negative and statistically significant. Specifically, in the post-depression sample, the downside betas of HML and HMLs (-0.36 and -0.50) are roughly double the upside betas (-0.17 and -0.22), so during this period we expect that the value-minus-growth strategies to have high returns when the market return is negative, but negative returns when the market return is positive. The coefficients of HML on the square and cube of the market return are positive and significant in the full

[5] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

sample. However, they do not represent risk; the positive coefficient on the square market return (b_2) suggests that the return on HML increases further when the market return is positive, but decreases less when market returns are negative. Also, since the market has positive skewness in the full sample (Panel A, Table 1), HML increases even further with the positive b_3.

The OLS alphas are not different from zero when different responses to up- and down-markets are considered. The LCAPM alphas are much smaller than the CAPM alphas in all three samples. For instance, in the full sample the LCAPM explains the value premium ($\hat{\alpha}_{LCAPM} = -0.15\%$, t-stat = -1.39), whilst the CAPM does not ($\hat{\alpha}_{CAPM} = -0.51\%$, t-stat = 4.56). This results has been obtained by Chan (1988), De Bondt and Thaler (1987) and was replicated in Petkova and Zhang (2005). However, the the LCAPM works only when the Great Depression is included in the analysis. For the post-1963 samples the OLS alphas are still positive and significant.

This exploratory analysis shows that asymmetries in the unconditional models can explain the value premium, in particular, when the Great Depression period is included. However, the results with the post-1963 period are not consistent with Zhang's (2005) implication that value firms are in advantage in favourable economic situations (in up-market) since the upside betas of growth firms are higher than those of value firms, and overall do not elicit evidence that value might be riskier than growth.

C. Is Value Riskier than Growth? Reinvestigation with Markov Switching Market Regimes

In this subsection we first show that market states derived from the estimated expected market risk premium may be too noisy. Then we reinvestigate if value is riskier than growth in different market states that we estimate with a Markov regime switching model.

C.1 Identification of Markov Switching Market Regimes

Although macroeconomic variables are economically motivated and thus are widely used in the literature as conditioning variables (see e.g. Ferson and Harvey (1999) and Petkova and Zhang (2005)), it seems difficult for us to conclude that the estimated expected market return from regressing on these conditioning variables is a good proxy for the expected market risk premium. To investigate this, as in Petkova and Zhang (2005), we run Center for Research in Security Prices (CRSP) value-weighted market returns in excess of one month Treasury Bill rate (r_{mt}) on the following four lagged macroeconomic variables: the one month Treasury Bill (TBill), credit spread (CS) (the difference between Moody's AAA and BAA rated corporate bonds), term spread (TS) (the difference between the US 10 year and the 1 year treasury bond rates), and dividend yield (DY) (the CRSP value-weighted dividend yields). For the period between January 1963 and December 2004 (504 monthly observations) we have

$$r_{mt+1} = \underset{(0.060)}{0.0004} - \underset{(1.432)}{2.211} TBill_t + \underset{(2.053)}{1.461} CS_t + \underset{(0.178)}{0.042} TS_t - \underset{(0.072)}{0.084} DY_t + \hat{\varepsilon}_{mt+1},$$

where the numbers in brackets are the Newey-West heteroskedasticity consistent *t* statistics. None of the lagged macroeconomic variables are significant at the 1% level.[6] Moreover, the value of R-square is only 1.85%. In other words, less than 2% of *ex post* market returns reflects *ex ante* market returns if the regression is a proper way to estimate the expected market returns. These results suggest that even though we admit that individual beliefs are not homogeneous (Ross (1978)), the difference between *ex post* and *ex ante* returns appears to be too large to justify using the simple regression to approximate the expected market returns. Cooper and Gubellini (2008) recently show that the results from conditional models (including the one used by Petkova and Zhang (2005)) are extremely sensitive to the conditioning variables used.

We consider a different approach to identify the market states, which is motivated by the regime-switching literature and the modelling of business cycles. Following Hamilton (1989) and Schwert (1989), Turner, Startz and Nelson (1989) and Hamilton and Susmel (1994) show that there are distinct regimes in the S&P 500 index, in terms of mean and volatility. Moreover, Hamilton and Lin (1996) investigate the relationship between stock returns and real output growth in industrial production, and conclude that economic recessions are the primary drivers of fluctuations in market volatility. More recently, Perez-Quiros and Timmermann (2000) use regime-switching models to study the risk of firms with different sizes in expansions and recessions. These studies suggest that regime switching models are an effective tool to identify regimes which are linked to economic conditions.

This approach allows us to study the risk of the value-minus-growth strategy in different market conditions, whilst avoiding a high degree of parameterisation and subjective choices of conditioning variables. Specifically, we investigate the risk of value and growth by estimating the CAPM conditioned on the state of the market as inferred from the regime-switching model of the market return. If value is riskier than growth during bad states when the market is doing poorly, there should be an increase in the beta of HML in the corresponding market regime[7].

We model the data-generating process of the market return as a three-state first-order Markov process with switching mean and variance[8]. Our model for the market return can be described in the following way. Let S_t be a regime variable assuming the values of 1, 2 or 3 according to the appropriate regime, and $S_{jt} = I\left(S_t = j\right)$ be dummy variables which assume the value of 1 when the market is in regime $j = 1,2,3$, where *I*(.) is the indicator variable. The three-regime model is then given by

$$\begin{aligned} r_{mt} &= \mu_1 S_{1t} + \mu_2 S_{2t} + \mu_3 S_{3t} + \sigma_{m,t}\varepsilon_t \\ \sigma^2_{m,t} &= \sigma^2_{m,1} S_{1t} + \sigma^2_{m,2} S_{2t} + \sigma^2_{m,3} S_{3t} \end{aligned}, \tag{13}$$

where $r_{mt} = R_{mt} - R_f$ is the market return in excess of the risk-free rate, and μ_j and $\sigma_{m,j}$ are the expected excess market return and volatility, respectively, in regime *j*. Following

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[6] We also estimated the regression equation using 5 year sub-sample periods, and obtained similar results.

[7] This approach is related to the one followed by Petkova and Zhang (2005, Section 4), except that they regress HML returns on a dummy variable indicating whether the estimated expected market risk premium is lower than its sample average (good times) or higher (bad times).

[8] We also considered a model with two regimes, but found that three regimes better specify the market states than two regimes. Namely, for all three periods a model with three-regimes captures the features of the data (such as heteroskedasticity, skewness and excess kurtosis) well, in the sense that a Jarcque-Bera test of the standardised residuals does not reject normality.

Hamilton (1989), we allow the regime variable S_t to be governed by a first-order Markov chain with a transition probability matrix $P = \{ p_{ij} \}$, where $p_{ij} = P(S_t = j \mid S_{t-1} = i)$ is the probability that regime *i* at time *t*-1 is followed by regime *j* at time *t*. We interpret each regime according to estimates of the mean and volatility of the market. We estimate the regime-switching model for the three sample periods using the Bayesian MCMC Gibbs-sampling estimation, which is standard from the regime-switching literature (see Kim and Nelson (1999) for example). From the MCMC estimates of the dummy variable S_t , we reconstruct the smoothed probabilities of the market being in each regime in each month.

Figures 1.A-C plots the smoothed probabilities of each regime for the full, post-Depression and post-1963 samples, respectively. Table 3 reports descriptive statistics for the market return, and also the value, growth and value-minus-growth portfolios in each of these regimes. We label each regime according to the characteristics of the market return. We name Regime 3 as "Bear market", since the mean return is negative and the volatility is high. Likewise, Regime 2 is labelled "Bull market", since the mean return is positive and the volatility is low. Finally, Regime 1 is labelled "Transition", when the market is neither bullish nor bearish. For example, for the full sample, the average monthly market return in the bull and bear markets are 1.26% and -059%, respectively, whilst the volatilities are 2.95% and 11.19% (see the column labelled "Market" in Table 3). Figure 1.A shows that the bear market regime is selected mostly during the Great Depression and during the period from the middle of 1937 through the middle of 1940, which includes the first two years of the Second World War, and then during short periods such as the 1973 oil crisis and the Black Monday month of October 1987. When we exclude the Great Depression period (Figure 1.B), we find that the bear market regime now includes many other periods.

In the post-1963 sample (Figure 1.C), the bear market regime captures periods such as the two oil crises, the Mexican moratorium of 1982, the Black Monday of 1987, the Russian crisis of 1998, the burst of the internet bubble and the period following the terrorist attacks of 2001. The bull regime includes most of the economic expansion of the US economy in the early 1960s, and the also a period from the early 1990s to around 1996. The overall picture we obtain with these results is that the return on the aggregate stock market can be modelled as a mixture of longer expansion or bull market periods with high returns and low volatility (the mean return and volatility in the bull regime are 1.58% and 3.53%), and infrequent and shorter periods of contraction during which the stock market does very poorly and has high volatility (the mean return and volatility in the bull regime are -1.13% and 6.89%), which agrees with the modelling of regimes and the business cycle using macroeconomic data as in Hamilton (1989).

It is difficult to infer a relationship between the state of the market and the average value-minus-growth return. Table 3 shows that when the whole sample is used, the average HML return seems to increase with the market return: it is highest (0.53% in terms of average return) when the market is in the bull market regime and lowest (0.18%) when the market is in the bear regime (the difference in the median HML across regimes is statistically significant at 1%). However, in the more recent post-1963 period, we find that, as expected from the estimates of the LCAPM in Table 2, the average HML return is higher in the bear market regime, at 1.21% a month) and actually negative in the bull market regime (these differences are statistically significant). Therefore, over the last 40 years growth stocks do marginally better than value stocks during bull markets, but do much worse than value stock in the bear market regime. This is contrary to what one expects from the theory of Zhang (2005). However, we notice that the post-1963 period has relatively few recessions and also contains the unprecedented boom in the stock market in the late 1990s (which was driven by growth stocks), so we should be cautious regarding this interpretation.

C.2 The Post-1963 Value Premium

We now proceed to investigate the risk of the value, growth and value-minus-growth portfolios in different market states. We estimate the CAPM conditioned on the state of the market (transition, bull or bear). The purpose of this subsection is to investigate the asymmetric reactions of value and growth firms to market conditions suggested by Zhang (2005).

Panels A, B and C of Table 4 report the estimation results for the H, L and HML portfolios using the full, post-depression and post-1963 periods, respectively[9]. The risk of the value portfolio increases during bear market only if the sample includes the period of the Great Depression. When we exclude the Great Depression (Panel B), value is not riskier than growth in any of the regimes, whilst alpha is positive and statistically significant in the bull and transition regimes. Also, in the post-1963 sample (Panel C), value is significantly less risky than growth in the bull and bear regimes, whilst in the transition regime beta is not statistically different from zero. Also, as expected, the value premium is very strong in the bear market regime (the bear-market alpha is 0.82%, t-statistic 2.56), but not very strong in the bull regime (the bull-market alpha is only 0.31% and not statistically significant).

The period since 1963 is particularly troublesome for a risk-based explanation of the value premium. Not only does value have lower betas than growth, whilst having higher average returns; growth is riskier than - or at least as risky as - value in all market regimes. Other studies such as Petkova and Zhang (2005) and Ang and Chen (2007) provide little or no evidence that value is riskier than growth for this period. Ang and Chen's estimate of time-varying betas for the period are mostly negative and they argue that the (unconditionally) high value premium during the period can be explained by small-sample properties of the unconditional alpha when betas are time-varying. Petkova and Zhang's (2005) evidence for this period goes in opposite directions from a risk-based explanation of the value premium: value betas covary negatively with the market risk premium, whilst growth betas have no significant covariation with the market risk premium. When the results in panels A and C are compared, we conclude that it is only when the Great Depression period is included that these conditional models explain the value premium and that value is riskier than growth. However, the Great Depression being an extreme recession with unique characteristics (as pointed out by Bernanke (1983)), it is the value premium for the post-1963 period that we need to analyse.

The approach above, however, may be criticised in two points. First, this analysis assumes that the risk of HML is related to the state of the economy as measured by the market regimes. Even if the risk of HML is not related to the different

[9] The results with the Hs, Ls and HMLs portfolios are largely similar, so we do not present or comment about them.

market regimes, there could still be increases (decreases) in this risk over different periods. Second, if the investors' utility function is better specified by power utility and higher moments such as skewness and kurtosis matter in asset return distribution, asymmetry or fat-tails should be priced. These asymmetric risk measures might be particularly relevant, considering that value and growth are expected to react differently to periods of good and bad economic conditions. Therefore we consider the possibility that different risk measures other than the CAPM beta, such as the downside beta and higher moments, matter to explain portfolios' returns over time, without the explicit assumption that they must be related to the state of the market or economy.

D. Regime Switching Risk Measures

The results so far have revealed no conclusive empirical evidence supporting Zhang's (2005) theory or Petkova and Zhang's (2006) result that value is riskier than growth in bad times. In this subsection we investigate whether or not our regime switching model with different risk measures can capture the asymmetric risk pattern of HML over time. We combine the three models (CAPM, LCAPM and HCAPM) in the regime-switching model in Equation (12), so each model has the possibility of being selected in each month. If there are periods when the relationship between the portfolios and the market is symmetric, then the CAPM should be selected. Asymmetries can be modelled by two alternative models: either in dichotomous up and down markets (LCAPM) or in a continuous framework (HCAPM).

We estimate the regime-switching model for the H, L, HML, Hs, Ls and HMLs portfolios for the Post-1963 period. We focus on this sample for a few reasons. First, as stated before, the value premium is more difficult to explain during this period. Second, there is a structural break in the early 1960s (see for instance Section 3.1 of Petkova and Zhang (2005), and Figure 1 of Fama French (2006)), and thus using a long time series without considering the breaks could be misleading. Our earlier results also confirm that including the Great Depression period could give us wrong inferences about the value premium for the last 40 years. Finally, our regime switching model allows different classes of risks, but not time-varying risks within a regime.

The results are displayed in Table 5, in which we report the posterior means and standard deviations of the parameters from the MCMC iterations. The smoothed probabilities in Figure 2 can be interpreted as the probability that, at each month, the CAPM, LCAPM and HCAPM are selected.

It is important to note that the regime switching risk measures explain the value premium in terms of alpha. The posterior distributions of the alphas of HML and HMLs suggest that HML and HMLs can be explained by the model at the 1% significance level. As explained in the next section, the value premium is explained by the higher upside betas of the value-minus-growth portfolios, relative to their downside betas, and the positive coefficient on the squared and cubed market returns. This result suggests that it is not increased downside risk during bearish markets that drives the value premium. In the following subsections, we examine the risk of the value portfolio and the value premium in more detail.

D.1 Is Value Riskier than Growth?

From the estimates in Table 5, there is no evidence that value is riskier than growth in any of the regimes. First, the CAPM beta is negative (and significant) for both portfolios: for HML (HMLs) the average posterior beta is -0.16 (-0.28), with a standard deviation of 0.07 (0.05). Second, in the LCAPM regime, the downside betas of both portfolios are also negative and significant. The downside beta of HML (HMLs) is -0.69 (-0.87), with a standard deviation of 0.16 (0.14). Finally, in the HCAPM regime, beta is not significantly different from zero for either of the value-minus-growth portfolios, but the coefficients on the square and cube of the market return are positive and statistically significant[10]. A positive coefficient on the second moment of excess market return makes HML concave to market movements, increasing returns whilst decreasing risk.

These estimates also suggest that the average HML (HMLs) return might be higher in the LCAPM and HCAPM regimes. In the LCAPM regime, this is expected because even though both the downside and the upside betas are negative, the downside beta is larger than the upside beta, so the return on HML will increase more when the market return is negative than the decrease when the market return is positive[11]. In the HCAPM regime, in addition to the increase due to the positive coefficient on the squared market return, the positive coefficient on the third moment of excess market returns increases the returns of HML even further because the market has positive skewness in this regime (not reported).

Table 6 displays the average HML and HMLs returns in each of the three regimes. The t-statistics show whether the average return within a regime is significantly different from that of the whole sample. The average value-minus-growth returns in the CAPM regime are significantly lower than those of the whole period: they are only 0.01% and -0.10% for HML and HMLs, respectively. As expected, in the LCAPM and HCAPM regimes the average returns are much higher and in some cases significant. We examine whether these differences are significant with a non-parametric median test for robustness, since we do not know the distribution of market returns within a regime. The hypothesis that the median return is the same across regimes is rejected at the 1% significance level for both HML and HMLs. On the other hand, the difference in market returns across regimes is not significant.

Again, these results are at odds with a risk-based explanation of the value premium. First, they show no sign that value is riskier than growth. Second, even though we found that the selection of the different risk measures is linked to differences in the average returns of the value-minus-growth portfolios, the regimes do not seem to be linked to the condition of the market in terms of average market returns. According to Zhang (2005), value becomes riskier than growth in bad times and thus the value premium is expected to be linked to market conditions. Chen, Petkova and Zhang (2006), for instance, argue that the value premium peaks in recessions in the post-1963 sample. However, from the 77 months of recession in our sample (according to the NBER), 40 months occur in the LCAPM regime, and thus our results suggest that the value premium is higher during recessions not because value becomes riskier than

[10] In the sense that their estimated posterior distributions do not include the value zero.

[11] The probability that the upside beta is higher than the downside beta is around 90% (99%) for the HML (HMLs) portfolio. This probability is calculated by counting the number of cases in the MCMC iterations that upside beta is higher than downside beta and is more robust relative to alternative methods that assume a specific probability density function.

growth, but because of the difference in upside and downside betas between value and growth stocks. Indeed, the average excess value (H) and growth (L) returns in the LCAPM regime are 0.66% and -0.45%, respectively, which shows that a large part of the positive HML return comes from the negative returns of growth stocks. On the other hand, in the HCAPM regime the average HML return increases due to the higher moments associated with the value portfolio, and the average excess returns on the H and L portfolios during this regime are 1.38% and 0.36%. Therefore in this regime the high value-minus-growth returns come from the outperformance of value relative to growth, especially when the market return is high.

D.2 Selection of Regimes

In this subsection we study the selection of each regime through time. The transition probabilities tell us how likely it is to remain in each model (i.e., the CAPM, LCAPM or HCAPM) or to move to another one. Also, we analyse the smoothed probabilities that each regime has been selected at each month.

The regimes are persistent for all portfolios except the L portfolio. Figure 2 shows that for the L portfolio, the only persistent regime is the LCAPM regime. Since the higher moment coefficients are not significant, and the betas in the CAPM and HCAPM regimes are very close, the L portfolio could be well described by a model with two regimes (CAPM and LCAPM). So there are periods when growth stocks behave similarly in up and down markets, and other periods when downside risk is increased. For the H portfolio, all regimes are persistent, as indicated by the transition probabilities.

The HML and HMLs portfolios tend to exhibit similar (but weaker) patterns to the H and Hs portfolios, respectively (see Figure 2). It should be noticed that, in the case of portfolio Hs, the HCAPM regime is quite persistent, even though the higher moments are not significant. The estimate of beta in this regime, though, is much smaller than in the CAPM regime, so we can attribute the persistence to the difference in beta.

The smoothed probabilities of the regimes for HML and HMLs seem to be quite similar, which indicates that both strategies behave similarly with regard to the selection of the regimes. We know that the average value-minus-growth return is close to zero (for HML) or negative (for HMLs) when the CAPM regime is selected, that is, when the relationship between the return on the value-minus-growth strategies and the return on the market is symmetrical. This regime is selected over short one or two-year long periods, with the exception of two longer periods, one in the late 1970s and another from 1985 to 1992. Overall, this is the most prevalent regime: it is selected in 241 (249) months when the model is estimated with the HML (HMLs) portfolio, which corresponds to almost half of the whole sample. Therefore, the value premium is close to zero during half of the Post-1963 sample.

The LCAPM regime is selected during some turbulent periods, such as the oil crisis of 1973 and a four-year period following the burst of the internet bubble in 2000. The average excess return on the H and L portfolios during this regime are 0.66% and -0.45%, respectively, and thus much of the HML return during this period comes from the negative returns of growth firms.

The HCAPM is the least persistent regime for both HML and HMLs; the probability of remaining in this regime (p_{33}) is 0.84 and 0.82 for the HML and HMLs portfolios, respectively. This regime is selected in 131 (120) months for the HML (HMLs) portfolio, which corresponds to around 25% (22%) of the whole sample. It is selected over short periods, usually less than a year, except for the period from the middle of 2003 until early 2005. We find that the value premium is strongest in the HCAPM regime for the HML strategy because of the high returns of value firms. The average excess return on the H and L portfolios during this regime are 1.38% and 0.36%, respectively.

These results are quite interesting, because although the value premium is high in both the LCAPM and HCAPM regimes, the reasons are quite different. In the former regime, the value premium comes from the negative returns of growth firms, especially when the market is doing poorly, whilst in the latter it stems from the outperformance of value relative to growth when the market is doing well.

E. Robustness checks

So far we have reported results obtained using two sets of portfolios, both of which are based on a two-way sorting procedure using market equity and the ratio of book to market equity. We have also focused more on the more recent sample period from 1963 onwards. We address the first issue by replicating our results using value, growth and value-minus-growth portfolios based on a decile sort on Earnings/Price ratio. We define the highest decile to be the value portfolio (H_EP) and the lowest decile to be the growth portfolio (L_EP), and the value-minus-growth portfolio (HML_EP) is the H_EP portfolio minus the L_EP portfolio. To address the second issue, we replicate our results for the Pre-1963 sample period, using the H, L and HML portfolios.

E.1 Portfolios formed on Earnings/Price ratio

Panel A of Table 7 reports descriptive statistics for the value, growth and value-minus growth portfolios based on a decile sort on Earnings/Price. The value premium defined by Earnings/Price ratio is higher than Fama and French's HML; the average HML_EP return over the 1963-2006 period is 0.60%, compared to 0.45% of HML. The CAPM alpha of HML_EP is also higher at 0.69%, compared to 0.58% of HML. The results obtained with the CAPM, LCAPM and HCAPM are similar to the ones obtained with the size and book-to-market-sorted portfolios, so we do not report them. Next, we estimate the CAPM in the different market regimes. The results are reported on Table 8. Similarly to our previous results in Table 4, value (H_EP) is not riskier than growth (L_EP) in any of the market regimes, and alpha is large in the bear and transition regimes (although it is not statistically significant in the bear regime).

Finally, we estimate the regime-switching model (12) for the H_EP, L_EP and HML_EP portfolios. The results are reported in Table 9 and are quite similar to those obtained before. In Panel A of Table 10, we repeat our analysis of the average value premium and market return in each regime, and the results are also similar to those obtained with the HML portfolio: the value premium is highest in the LCAPM regime, at 1.29%, and nearly zero in the CAPM regime at 0.08%. It is also very high in the HCAPM regime, at 0.93%. As with the results for the HML portfolio, the difference in the median HML_EP return across regimes is statistically significant.

E.2 The pre-1963 period

In this subsection we repeat our analyses for the pre-1963 sample. This period is quite interesting because it contains the Great Depression, but also the remarkable post-war expansion of the US economy. When we estimate the regime-switching model for the market return over this period, we find that one of the regimes captures almost exclusively the Great Depression (see Figure 1.D), whilst the other two regimes have characteristics of bull and bear markets. Therefore we name the regimes 'Great Depression', 'Bull' and 'Bear'. The average market return in the Great Depression, Bull and Bear market regimes are -0.42%, 1.95% and -1.13%, respectively, and the market volatilities are 12.99%, 2.93% and 5.85% (not reported).

The descriptive statistics over the pre-1963 period are reported in Panel B of Table 7, which shows that there is no value premium over the period: the average return of the HML strategy is 0.37%, and the CAPM alpha is only 0.05%, and not statistically significant. The estimates of the CAPM in the different market regimes are reported in Panel B of Table 8. The table shows that value is significantly riskier than growth in all three regimes, and the CAPM explains the returns on HML in all three regimes. The risk of HML is highest in the Great Depression (beta is 0.41 and statistically significant), whilst it is similar in the bull and bear regimes.

The estimate of the regime-switching model with alternative risk measures (12) shows that value is riskier than growth in the CAPM and LCAPM regimes (the beta of HML in the CAPM regime is 0.20, and the downside beta in the LCAPM regime is 0.45, both statistically significant). Also, the upside beta of HML is positive and larger than its downside beta, suggesting that value firms are favoured by increases in the market return, relative to growth firms. In the HCAPM regime, none of the coefficients is statistically significant. Unlike our previous results, the average HML premium in the pre-1963 period does not seem to be related to these regimes (nor does the market return, see Panel B of Table 10).

Summarising our robustness checks, the results using the alternative portfolios formed on Earnings/Price largely confirm our evidence for the post-1963 sample. The results with the pre-1963 sample are supportive of the risk base explanation of the value premium: during this period, value is riskier than growth, the value premium is explained by the CAPM and the risk of HML is highest in bad states of the market. We conclude that the evidence supporting the theory, e.g. Petkova and Zhang (2005), is mainly driven by the inclusion of the pre-1963 period in the sample.

III. Conclusion

This work contributes to the debate about the value premium in two ways. First, we show that the empirical conclusion of Petkova and Zhang (2005) that value is riskier than growth in bad times is driven by the pre-1963 period and the method they use to estimate the market risk premium. When we use a different method (a regime-switching model) to identify the market state, there is little or no evidence that value is riskier than growth, and thus the value premium is not explained by higher risk of value firms in bad times.

Second, we propose a regime-switching model which allows three different risk measures to be selected over time, relaxing the CAPM statement which is derived under restrictive assumptions such as normality of returns and quadratic utility. When both the probability density function of asset returns and investors' risk aversion change over time, the simple mean-variance analysis could misspecify asset returns. Periods when returns are normally distributed can be modelled by the CAPM, but periods when returns become heavy-tailed and/or skewed or when downside and upside betas differ may be explained by higher moments in the HCAPM or dichotomous downside/upside betas in the LCAPM. Finally, we find that the value premium in the post-1963 sample can be empirically explained with this generalised model, but value is not riskier than growth in any of the regimes.

Overall, our results are not consistent with the risk-based explanation of the value premium proposed by Zhang (2005). We find only partial evidence that our empirical results support the risk-based explanation during the period of strong market performance. This is reflected by the higher upside beta of value relative to its downside beta (or the positive coefficients on the square and cube of the market return). On the other hand, growth stocks behave in the opposite way; their returns decrease more in down markets than they increase in up markets.

These results make a risk-based explanation of the premium less likely and also allow us to view the anomaly from a different perspective. As in Zhang (2005), during bull periods investors would gladly pay more to hold value firms but would not be willing to pay much for growth firms. Unless these asymmetric risk patterns can be linked to some kind of fundamental risk which is not captured by beta, our results point to behavioural explanations of the value premium, such as the one proposed by Lakonishok, Shleifer and Vishny (1994). In this case, the question is why the anomaly persists, many years after having been documented.

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Table 1 - Descriptive statistics of several value, growth and value-minus-growth portfolios

The sample is from January 1963 to December 2004. All HML portfolios consist of a high (H) book-to-market portfolio (value portfolio) subtracted from a low (L) book-to-market portfolio (growth). H and L are the value and growth portfolios obtained with a 2 by 3 sort on size and book to market. Hs and Ls are the small-value and small-growth portfolios obtained with a five-by-five sort on size and book-to-market. Panel A reports unconditional OLS alphas (and the appropriate t-statistic adjusted using the Newey and West (1987) method) average monthly return, monthly volatility (both in %), skewness and kurtosis for each portfolio. Panel B reports the correlations between the various H, L and HML portfolios.

Panel A. January 1927 - December 2006

	H	L	HML	Hs	Ls	HMLs	Market
Monthly return (%)	1.084	0.668	0.415	1.231	0.722	0.510	0.650
Monthly volatility (%)	7.652	6.386	3.592	8.356	7.854	3.668	5.437
Skewness	2.052	0.459	1.896	2.292	1.051	0.970	0.220
Kurtosis	23.919	10.317	18.928	25.528	13.558	12.096	10.911
Alpha (CAPM) (%)	0.258	-0.065	0.323	0.364	-0.114	0.478	
t-stat	2.449	-1.128	2.690	2.888	-0.996	3.813	

Panel B. January 1935 - December 2006

	H	L	HML	Hs	Ls	HMLs	Market
Monthly return (%)	1.154	0.675	0.479	1.284	0.721	0.563	0.696
Monthly volatility (%)	5.742	5.511	2.939	6.385	6.794	3.174	4.527
Skewness	0.185	-0.413	0.756	0.302	-0.239	0.334	-0.536
Kurtosis	11.021	5.985	8.968	11.438	5.982	6.874	6.292
Alpha (CAPM) (%)	0.371	-0.138	0.510	0.454	-0.205	0.659	
t-stat	3.869	-2.530	4.564	3.839	-1.867	5.470	

Panel C. January 1963 - December 2006

	H	L	HML	Hs	Ls	HMLs	Market
Monthly return (%)	0.894	0.441	0.453	1.075	0.456	0.619	0.477
Monthly volatility (%)	4.633	5.558	2.901	5.329	6.961	3.325	4.380
Skewness	-0.318	-0.458	0.011	-0.331	-0.328	-0.135	-0.510
Kurtosis	6.859	4.706	5.552	7.291	4.842	5.832	5.135
Alpha (CAPM) (%)	0.448	-0.135	0.583	0.593	-0.202	0.795	
t-stat	4.072	-1.754	4.415	4.030	-1.312	5.358	

Table 2 - OLS regressions of CAPM, LCAPM (Lower Partial Moment CAPM) and HCAPM (Higher-moment CAPM) for several value, growth and value-minus-growth portfolios.

The results are for the models

$$r_{pt} = \alpha + r_{mt} + \varepsilon_t \quad (1)$$

$$r_{pt} = \alpha + \beta^{+} r_{mt}^{+} + \beta^{-} r_{mt}^{-} + \varepsilon_t \quad (2)$$

$$r_{pt} = \alpha + \beta_1 r_{mt} + \beta_2 \left(R_{mt} - E\left(R_{mt}\right)\right)^2 + \beta_3 \left(R_{mt} - E\left(R_{mt}\right)\right)^3 + \varepsilon_t \quad (3)$$

,

where r_{pt} denotes the excess return on either a value, growth or value-minus-growth portfolio, r_{mt} denotes the excess market return, $r_{mt}^{-} = r_{mt} I\left(r_{mt} < 0\right)$ and $r_{mt}^{+} = r_{mt} I\left(r_{mt} > 0\right)$ are the negative and positive components of the market return and R_{mt} is the market return. The t-stats are computed using the Newey and West (1987) method to correct for heteroskedasticity and autocorrelation with 3 lags. H and L are the value and growth portfolios obtained with a 2 by 3 sort on size and book to market, and HML is the H portfolio subtracted from the L portfolio. Hs and Ls are the small-value and small-growth portfolios obtained with a five-by-five sort on size and book-to-market, and HMLs is the Hs portfolio subtracted from the Ls portfolio.

Panel A. January 1927 - December 2006

		H		L		HML		Hs		Ls		HMLs	
Model		Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
CAPM	a	0.258	2.449	-0.065	-1.128	0.323	2.690	0.364	2.888	-0.114	-0.996	0.478	3.813
	b	1.270	17.700	1.128	54.660	0.142	1.904	1.333	16.617	1.284	29.679	0.048	0.696
LCAPM	a	-0.224	-2.158	-0.071	-1.234	-0.154	-1.385	-0.181	-1.372	-0.173	-1.495	-0.008	-0.071
	b^{-}	1.133	18.642	1.125	39.203	0.008	0.112	1.180	17.633	1.264	23.096	-0.084	-1.292
	b^{+}	1.385	9.472	1.128	30.952	0.257	1.758	1.464	8.743	1.296	15.414	0.168	1.221
HCAPM	a	0.102	0.942	-0.144	-2.450	0.246	2.000	0.188	1.391	-0.279	-2.360	0.467	3.522
	b_1	1.161	20.820	1.161	43.669	0.000	-0.003	1.220	17.745	1.318	23.320	-0.098	-2.120
	b_2	0.738	3.412	0.206	1.695	0.532	2.444	0.815	2.918	0.500	2.006	0.315	1.330
	b_3	0.032	2.459	-0.011	-2.268	0.043	3.925	0.033	1.983	-0.012	-1.230	0.045	4.259

Table 2 (continued)

Panel B. January 1935 - December 2006

		H		L		HML		Hs		Ls		HMLs	
Model		Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
CAPM	a	0.371	3.869	-0.138	-2.530	0.510	4.564	0.454	3.839	-0.205	-1.867	0.659	5.470
	b	1.124	25.030	1.168	86.487	-0.045	-1.028	1.192	23.242	1.330	44.230	-0.138	-3.361
LCAPM	a	0.119	1.311	-0.040	-0.753	0.159	1.587	0.213	1.831	-0.010	-0.093	0.223	2.100
	b^-	1.057	16.894	1.195	59.159	-0.138	-1.978	1.133	16.837	1.385	32.989	-0.253	-3.574
	b^+	1.199	13.138	1.139	41.556	0.060	0.751	1.267	11.350	1.274	21.131	-0.007	-0.092
HCAPM	a	0.343	2.629	-0.140	-2.363	0.483	3.600	0.481	2.940	-0.170	-1.373	0.651	4.635
	b_1	1.077	26.593	1.167	71.609	-0.090	-2.136	1.142	23.784	1.325	38.693	-0.184	-4.281
	b_2	0.412	0.683	0.017	0.129	0.395	0.736	0.144	0.196	-0.153	-0.456	0.297	0.568
	b_3	0.045	1.826	0.001	0.204	0.043	1.864	0.042	1.362	0.001	0.060	0.041	1.664

Panel C. January 1963 - December 2006

		H		L		HML		Hs		Ls		HMLs	
Model		Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
CAPM	a	0.448	4.072	-0.135	-1.754	0.583	4.415	0.593	4.030	-0.202	-1.312	0.795	5.358
	b	0.935	23.620	1.208	70.235	-0.273	-6.812	1.011	20.936	1.381	34.660	-0.369	-8.937
LCAPM	a	0.235	2.456	-0.020	-0.272	0.255	2.187	0.381	2.920	0.061	0.405	0.320	2.497
	b^-	0.881	13.205	1.240	47.903	-0.360	-5.082	0.962	11.780	1.458	25.213	-0.496	-6.425
	b^+	1.005	13.442	1.173	37.597	-0.168	-2.232	1.083	11.094	1.302	18.845	-0.219	-2.803
HCAPM	a	0.507	3.833	-0.062	-0.717	0.569	3.772	0.757	4.181	0.016	0.091	0.741	4.672
	b_1	0.919	23.645	1.220	58.244	-0.300	-7.074	0.979	21.614	1.404	32.300	-0.425	-9.792
	b_2	-0.249	-0.335	-0.462	-2.351	0.214	0.292	-0.750	-0.826	-1.319	-2.698	0.570	0.903
	b_3	0.011	0.265	-0.022	-2.201	0.033	0.837	0.017	0.353	-0.053	-2.062	0.070	2.196

Table 3 - Descriptive statistics of value, growth and value-minus-growth portfolios in different market regimes

We model the market return with a first-order regime-switching process for the mean market return and the market volatility. We report descriptive statistics for the return on the market portfolios, as well as the value, growth and value-minus-growth portfolios as defined by the H, L and HML portfolios from a 2 by 3 sort on size and book to market in each of the three regimes. We also conduct a Kruskal-Wallis test of equality of median HML and market returns in each regime.

Panel A. January 1927 - December 2006

	Regime 1: Transition				Regime 2: Bull Market				Regime 3: Bear Market			
	H	L	HML	Market	H	L	HML	Market	H	L	HML	Market
Monthly return (%)	0.812	0.492	0.320	0.172	2.087	1.554	0.532	1.258	0.046	-0.142	0.188	-0.591
Monthly volatility (%)	5.985	6.358	3.461	5.135	3.876	3.474	2.273	2.952	17.482	12.693	6.995	11.187
Skewness	-0.266	-0.177	0.083	-0.170	0.269	-0.042	0.654	-0.116	1.627	0.828	2.085	0.627
Kurtosis	4.246	2.700	4.971	2.666	3.710	3.140	5.010	2.740	7.395	5.022	10.004	4.806

Test: equality of median value premium across regimes: 0.001

Test: equality of median market return across regimes: <0.0001

Panel B. January 1935 - December 2006

	Regime 1: Transition				Regime 2: Bull Market				Regime 3: Bear Market			
	H	L	HML	Market	H	L	HML	Market	H	L	HML	Market
Monthly return (%)	2.245	1.841	0.404	1.298	1.873	1.345	0.528	1.153	-0.532	-1.051	0.519	-1.131
Monthly volatility (%)	5.149	4.844	2.838	4.041	3.424	3.093	2.101	2.625	8.689	8.517	4.141	6.887
Skewness	0.232	0.046	0.320	-0.017	0.104	-0.418	0.964	-0.336	0.589	0.075	0.813	-0.035
Kurtosis	3.773	2.574	4.390	2.429	3.351	2.968	6.992	2.810	8.589	3.803	7.728	4.196

Test: equality of median value premium across regimes: 0.683

Test: equality of median market return across regimes: <0.0001

Panel C. January 1963 - December 2006

	Regime 1: Transition				Regime 2: Bull Market				Regime 3: Bear Market			
	H	L	HML	Market	H	L	HML	Market	H	L	HML	Market
Monthly return (%)	-0.532	-1.051	0.519	-1.131	2.245	1.841	0.404	1.298	-0.435	-1.644	1.209	-1.538
Monthly volatility (%)	8.689	8.517	4.141	6.887	5.149	4.844	2.838	4.041	6.638	7.740	3.833	6.343
Skewness	0.589	0.075	0.813	-0.035	0.232	0.046	0.320	-0.017	0.186	0.043	0.066	0.091
Kurtosis	8.589	3.803	7.728	4.196	3.773	2.574	4.390	2.429	5.110	3.202	3.843	3.359

Test: equality of median value premium across regimes: <0.0001

Test: equality of median market return across regimes: <0.0001

Table 4 - OLS regressions of CAPM for value, growth and value-minus-growth portfolios in different market regimes

	Panel A. January 1927 - December 2006						Panel B. January 1935 - December 2006						Panel C. January 1963 - December 2006					
	H						H						H					
	Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market		Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market		Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market	
	a	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*
coefficient	0.219	1.019	0.389	1.136	0.762	1.465	0.335	1.12	0.456	1.105	0.354	1.134	0.47	1.079	0.415	0.895	0.441	0.935
t-stat	1.197	20.395	3.997	27.905	1.263	14.274	2.925	26.292	3.211	22.427	1.286	14.229	2.926	22.592	2.932	19.009	1.566	15.292

	L						L						L					
	Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market		Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market		Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market	
	a	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*
coefficient	-0.129	1.185	-0.093	1.096	0.363	1.108	-0.16	1.09	0.009	1.138	-0.084	1.206	-0.27	1.18	0.104	1.221	-0.383	1.185
t-stat	-1.292	57.047	-1.337	44.115	1.431	30.804	-1.879	36.471	0.101	49.727	-0.635	59.56	-2.117	25.602	0.765	35.542	-2.316	47.757

	HML						HML						HML					
	Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market		Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market		Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market	
	a	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*
coefficient	0.348	-0.167	0.482	0.04	0.399	0.356	0.494	0.029	0.447	-0.033	0.438	-0.072	0.74	-0.101	0.31	-0.326	0.824	-0.251
t-stat	1.627	-3.059	4.019	0.848	0.712	3.439	3.581	0.542	2.708	-0.599	1.535	-0.976	3.988	-1.535	1.517	-5.914	2.557	-4.129

Table 5 - Estimation results for the regime-switching model

The sample is from January 1963 to December 2004. We estimate the model below with a Gibbs-sampling MCMC method. The model is

$$r_{pt} = \alpha + S_{1t}\left[\beta r_{mt}\right] + S_{2t}\left[\beta^- r_{mt}^- + \beta^+ r_{mt}^+\right] + S_{3t}\left[\beta_1 r_{mt} + \beta_2 \left(R_{mt} - E(r_{mt})\right)^2 + \beta_3 \left(R_{mt} - E(r_{mt})\right)^3\right] + \varepsilon_{pt},$$

where r_{pt} is the return on either a value, growth or value-minus-growth portfolio, $S_{jt} = I\left(S_t = j\right)$ is a dummy-variable indicating occurrence of regime $j = 1,2,3$ (where regime 1 = CAPM, regime 2 = LCAPM, regime 3 = HCAPM), r_{mt} denotes excess market return, , $r_{mt}^- = r_{mt} I\left(r_{mt} < 0\right)$ is the negative component of the market return, $r_{mt}^+ = r_{mt} I\left(r_{mt} > 0\right)$ is the positive component of the market return, R_{mt} is the raw market return and $\varepsilon_{pt} \sim (0, \sigma_j^2)$. The transition probabilities are $p_{ij} = P(S_{t+1} = j \mid S_t = i)$. Panel A (B) reports results for the H, L and HML (Hs, Ls and HMLs) portfolios. H and L are the value and growth portfolios obtained with a 2 by 3 sort on size and book to market, and HML is the H portfolio subtracted from the L portfolio. Hs and Ls are the small-value and small-growth portfolios obtained with a five-by-five sort on size and book-to-market, and HMLs is the Hs portfolio subtracted from the Ls portfolio. The figures are based on 10000 Gibbs-sampling iterations. The coefficients b_2 and b_3 are multiplied by 100 for visualisation purposes.

		Panel A. H, L and HML portfolios						**Panel B. Hs, Ls and HMLs portfolios**					
		H		**L**		**HML**		**Hs**		**Ls**		**HMLs**	
		Mean	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
	a	0.213	0.087	-0.035	0.074	0.253	0.115	0.338	0.118	0.028	0.140	0.308	0.121
CAPM	*b*	0.897	0.038	1.187	0.071	-0.161	0.072	1.369	0.049	1.470	0.106	-0.281	0.046
LCAPM	b^-	0.642	0.106	1.318	0.080	-0.691	0.155	0.677	0.143	1.277	0.115	-0.873	0.135
	b^+	0.747	0.091	1.178	0.079	-0.475	0.110	1.110	0.130	0.959	0.088	-0.489	0.124
HCAPM	b_1	1.230	0.049	1.196	0.094	-0.098	0.103	0.818	0.053	1.631	0.089	-0.132	0.106
	b_2	1.940	0.391	-0.429	0.503	3.374	0.850	-0.474	0.655	-0.820	1.067	2.087	1.107
	b_3	0.109	0.041	-0.016	0.039	0.166	0.047	0.022	0.053	-0.124	0.053	-0.045	0.055
	p_{11}	0.966	0.023	0.720	0.181	0.885	0.078	0.915	0.044	0.903	0.059	0.851	0.076
	p_{12}	0.021	0.018	0.073	0.068	0.045	0.036	0.070	0.041	0.043	0.033	0.036	0.026
	p_{13}	0.014	0.014	0.208	0.175	0.069	0.071	0.016	0.015	0.054	0.052	0.113	0.073
	p_{21}	0.034	0.026	0.082	0.070	0.054	0.039	0.084	0.048	0.040	0.030	0.041	0.029
	p_{22}	0.854	0.053	0.811	0.123	0.865	0.067	0.870	0.056	0.851	0.100	0.919	0.037
	p_{23}	0.112	0.052	0.106	0.112	0.081	0.059	0.046	0.036	0.109	0.093	0.041	0.032
	p_{31}	0.015	07.016	0.212	0.175	0.090	0.077	0.017	0.016	0.042	0.050	0.141	0.078
	p_{32}	0.091	0.047	0.099	0.111	0.074	0.061	0.036	0.029	0.106	0.094	0.038	0.032
	p_{33}	0.894	0.051	0.690	0.188	0.836	0.094	0.947	0.034	0.852	0.104	0.821	0.085
	1	1.639	0.242	1.376	0.425	3.581	1.018	3.716	0.817	26.510	4.956	3.151	0.682
	2	8.463	1.530	6.184	1.085	11.721	1.933	19.166	3.131	4.761	1.072	16.130	2.843
	3	2.211	0.580	1.567	0.492	3.861	1.291	3.074	0.642	5.382	1.042	4.929	1.441

Table 6 - Average value premium and market return per regime and test of the equality of the median value premium and median market return during each of the regimes

This table reports the average HML and average excess market returns per regime. The t-statistics for average HML (excess market return) compare the HML returns (excess market return) in each regime with the average HML (excess market return) over the complete sample. We also conduct a Kruskal-Wallis test of equality of median HML and market returns in each regime. We collect returns for each regime when the probability of each regime is the highest one at time *t*. Panel A reports results using the regimes inferred by applying the regime-switching model to the HML portfolio, and Panel B reports the same test using the regimes inferred from applying the regime-switching model to the HMLs portfolio. HML is the H portfolio subtracted from the L portfolio, where H and L are the value and growth portfolios obtained with a 2 by 3 sort on size and book to market. HMLs is the Hs portfolio subtracted from the Ls portfolio, where Hs and Ls are the small-value and small-growth portfolios obtained with a five-by-five sort on size and book-to-market. The sample period is 1963-2004.

Regime	Number of months	Average HML (HMLs) (%)	t-stat	p-value for H_0: median HML (HMLs) is equal in all regimes	Average excess market return (%)	t-stat	p-value for H_0: median market return is equal in all regimes
Panel A. Regimes inferred using HML portfolio, sample: 1963-2004							
CAPM	241	0.011	-3.820		0.562	0.298	
LCAPM	150	0.667	0.587	<0.0001	0.252	-0.578	0.569
HCAPM	131	1.021	3.180		0.577	0.305	
Whole sample	522	0.453			0.477		
Panel B. Regimes inferred using HMLs portfolio, sample: 1963-2004							
CAPM	249	-0.102	-4.140		0.668	0.658	
LCAPM	153	1.110	1.983	<0.0001	-0.136	-1.658	0.116
HCAPM	120	0.768	1.575		0.861	1.191	
Whole sample	522	0.619			0.477		

Table 7 - Descriptive statistics of additional value, growth and value-minus-growth portfolios

We report descriptive statistics for value, growth and value-minus growth portfolios based on a decile sort on Earning-to-Price ratio over the period July 1963- December 2006, and for the value, growth and value-minus-growth portfolios obtained with a 2 by 3 sort on size and book to market over the period January 1927- June 1963. We report unconditional OLS alphas (and the appropriate t-statistic adjusted using the Newey and West (1987) method) average monthly return, monthly volatility (both in %), skewness and kurtosis for each portfolio.

Panel A. Portfolios formed on Earnings/Price, July 1963 - December 2006

	H_EP	L_EP	HML_EP	Market
Monthly return	0.959	0.359	0.600	0.477
Monthly volatility	5.263	5.740	4.591	4.380
Skewness	-0.134	-0.200	0.402	-0.510
Kurtosis	6.052	4.466	5.552	5.135
Alpha (CAPM)	0.481	-0.212	0.693	
t-stat	3.313	-1.969	3.111	

Panel B. Portfolios formed on Size and B/M - January 1927 - June 1962

	H	L	HML	Market
Monthly return	1.306	0.936	0.371	0.854
Monthly volatility	10.110	7.237	4.267	6.462
Skewness	1.923	0.885	2.478	0.421
Kurtosis	16.589	11.544	19.444	10.570
Alpha (CAPM)	0.067	0.009	0.058	
t-stat	0.378	0.114	0.331	

Table 8 - OLS regressions of CAPM for additional value, growth and value-minus-growth portfolios in different market regimes

Panel A. Portfolios formed on Earning/Price, July 1963 - December 2006

H_EP

	Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market	
	a	*b*	*a*	*b*	*a*	*b*
coefficient	0.511	1.136	0.285	1.022	0.551	0.984
t-stat	2.599	17.194	1.439	17.117	1.456	13.227

L_EP

	Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market	
	a	*b*	*a*	*b*	*a*	*b*
coefficient	-0.233	1.18	-0.252	1.27	-0.34	1.16
t-stat	-1.493	18.927	-1.325	25.016	-1.374	23.988

HML_EP

	Regime 1: Transition		Regime 2: Bull Market		Regime 3: Bear Market	
	a	*b*	*a*	*b*	*a*	*b*
coefficient	0.745	-0.044	0.537	-0.249	0.891	-0.176
t-stat	2.424	-0.396	1.549	-2.534	1.621	-1.552

Panel B. Portfolios formed on Size and B/M - January 1927 - June 1962

H

	Regime 1: Great Depression		Regime 2: Bull Market		Regime 3: Bear Market	
	a	*b*	*a*	*b*	*a*	*b*
coefficient	1.116	1.501	0.143	1.294	-0.062	1.427
t-stat	1.323	13.996	0.952	20.999	-0.143	10.329

L

	Regime 1: Great Depression		Regime 2: Bull Market		Regime 3: Bear Market	
	a	*b*	*a*	*b*	*a*	*b*
coefficient	0.484	1.087	0.058	1.002	0.049	1.149
t-stat	1.23	25.52	0.782	44.379	0.234	25.002

HML

	Regime 1: Great Depression		Regime 2: Bull Market		Regime 3: Bear Market	
	a	*b*	*a*	*b*	*a*	*b*
coefficient	0.633	0.414	0.085	0.292	-0.11	0.278
t-stat	0.798	3.835	0.507	5.008	-0.277	2.521

Table 9. Estimation results for the regime-switching model for value, growth and value-minus-growth portfolios formed on Earnings/Price Ratio and for the pre-1963 period

We estimate the model below with a Gibbs-sampling MCMC method. The model is

$$r_{pt} = \alpha + S_{1t}\left[\beta r_{mt}\right] + S_{2t}\left[\beta^{-} r_{mt}^{-} + \beta^{+} r_{mt}^{+}\right] + S_{3t}\left[\beta_1 r_{mt} + \beta_2\left(R_{mt} - E(r_{mt})\right)^2 + \beta_3\left(R_{mt} - E(r_{mt})\right)^3\right] + \varepsilon_{pt} ,$$

where r_{pt} is the return on either a value, growth or value-minus-growth portfolio, $S_{jt} = I\left(S_t = j\right)$ is a dummy-variable indicating occurrence of regime $j = 1,2,3$ (where regime 1 = CAPM, regime 2 = LCAPM, regime 3 = HCAPM), r_{mt} denotes excess market return, , $r_{mt}^{-} = r_{mt} I\left(r_{mt} < 0\right)$ is the negative component of the market return, $r_{mt}^{+} = r_{mt} I\left(r_{mt} > 0\right)$ is the positive component of the market return, R_{mt} is the raw market return and $\varepsilon_{pt} \sim (0, \sigma_j^2)$. The change of regimes is governed by transition probabilities $p_{ij} = P\left(S_{t+1} = j \mid S_t = i\right)$.

Panel A reports results for value, growth and value-minus growth portfolios based on a decile sort on Earning-to-Price ratio over the period July 1963- December 2006, and Panel B for the value, growth and value-minus-growth portfolios obtained with a 2 by 3 sort on size and book to market over the period January 1927- June 1963. The figures are based on 10000 Gibbs-sampling iterations. The coefficients b_2 and b_3 are multiplied by 100 for visualisation purposes.

		Panel A. Portfolios formed on Earnings/Price, July 1963 - December 2006						Panel B. Portfolios formed on Size and B/M - January 1927 - June 1962					
		H_EP		L_EP		HML_EP		H		L		HML	
		Mean	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
	a	0.202	0.119	-0.050	0.097	0.171	0.184	-0.110	0.110	-0.081	0.059	-0.087	0.120
CAPM	b	1.000	0.078	1.502	0.128	0.052	0.110	1.324	0.038	0.891	0.016	0.202	0.041
LCAPM	b^-	0.580	0.182	1.101	0.140	-1.132	0.203	1.424	0.109	1.099	0.039	0.454	0.114
	b^+	0.816	0.123	0.894	0.168	-0.649	0.150	1.820	0.070	1.102	0.031	0.669	0.061
HCAPM	b_1	1.331	0.115	1.080	0.060	0.193	0.145	0.906	0.057	1.148	0.033	-0.078	0.068
	b_2	2.563	0.972	0.454	0.529	4.006	0.997	-0.456	0.526	1.318	0.235	0.758	0.617
	b_3	0.178	0.054	0.017	0.036	0.203	0.051	-0.047	0.033	0.129	0.020	-0.032	0.036
	p_{11}	0.908	0.065	0.681	0.188	0.899	0.081	0.907	0.038	0.928	0.029	0.906	0.050
	p_{12}	0.041	0.039	0.287	0.184	0.043	0.041	0.046	0.028	0.035	0.021	0.052	0.035
	p_{13}	0.051	0.047	0.032	0.033	0.058	0.063	0.047	0.027	0.036	0.021	0.042	0.036
	p_{21}	0.059	0.050	0.295	0.190	0.054	0.046	0.070	0.039	0.040	0.025	0.067	0.042
	p_{22}	0.760	0.080	0.666	0.189	0.792	0.093	0.912	0.043	0.893	0.046	0.913	0.046
	p_{23}	0.181	0.076	0.039	0.047	0.154	0.094	0.018	0.017	0.067	0.037	0.020	0.020
	p_{31}	0.065	0.053	0.023	0.026	0.069	0.068	0.060	0.033	0.033	0.024	0.049	0.041
	p_{32}	0.166	0.072	0.036	0.043	0.151	0.099	0.018	0.016	0.069	0.037	0.025	0.023
	p_{33}	0.769	0.082	0.941	0.050	0.780	0.114	0.922	0.037	0.898	0.040	0.927	0.048
	1	4.076	0.847	4.982	1.392	9.160	2.339	3.656	0.589	0.616	0.132	3.556	0.810
	2	15.578	3.349	6.272	1.310	27.560	4.252	29.791	5.383	3.896	0.656	22.304	3.808
	3	3.458	1.017	2.289	0.966	12.403	4.028	2.402	0.438	1.017	0.188	3.282	0.886

Table 10 Average value premium and market return per regime and test of the equality of the median value premium and median market return across regimes for value, growth and value-minus-growth portfolios formed on Earnings/Price Ratio and for the pre-1963 period

This table reports the average value premium and average excess market returns per regime. Panel A reports results for the value-minus growth portfolio based on a decile sort on Earning-to-Price ratio over the period July 1963- December 2006, and Panel B for the value-minus-growth portfolios obtained with a 2 by 3 sort on size and book to market over the period January 1927- June 1963. The t-statistics for average value premium (excess market return) compare the value-minus-growth portfolios' returns (excess market return) in each regime with the average value-minus-growth return (excess market return) over each complete sample. We conduct a Kruskal-Wallis test of equality of median value premium and market returns in each regime. We collect returns for each regime when the probability of each regime is the highest one at time *t*. HML_EP is the H_EP portfolio subtracted from the L_EP portfolio, where H_EP and L_EP are the value and growth portfolios obtained with a 2 by 3 sort on size and book to market. HML is the H portfolio subtracted from the L portfolio, where H and L are the value and growth portfolios obtained with a 2 by 3 sort on size and book to market.

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Regime	Number of months	Average HML (HML_EP) (%)	t-stat	p-value for H_0: median HML (HML_EP) is equal in all regimes	Average excess market return (%)	t-stat	p-value for H_0: median market return is equal in all regimes
Panel A. Regimes inferred using HML_EP portfolio, sample period: 1963-2006							
CAPM	264	0.086	-3.058		0.840	1.547	
LCAPM	137	1.293	1.146	0.032	0.551	0.178	0.012
HCAPM	121	0.934	0.890		-0.400	-2.005	
Whole sample	522	0.600			0.477		
Panel B. Regimes inferred using HML portfolio, sample period: 1927-1963							
CAPM	196	0.169	-1.353		0.898	0.121	
LCAPM	135	1.010	1.052	0.594	1.091	0.307	0.755
HCAPM	113	-0.041	-2.210		0.495	-0.778	
Whole sample	444	0.371			0.854		

Figure 1- Inferred probabilities of each model for several growth, value and value-minus-growth portfolios

We estimate a regime-switching model of the market return over the full sample from July 1926 to December 2006. We plot the smoothed probabilities of each regime, inferred from 10,000 MCMC draws of the regime dummy variable.

Figure 1.A – Full sample (1926-2006)

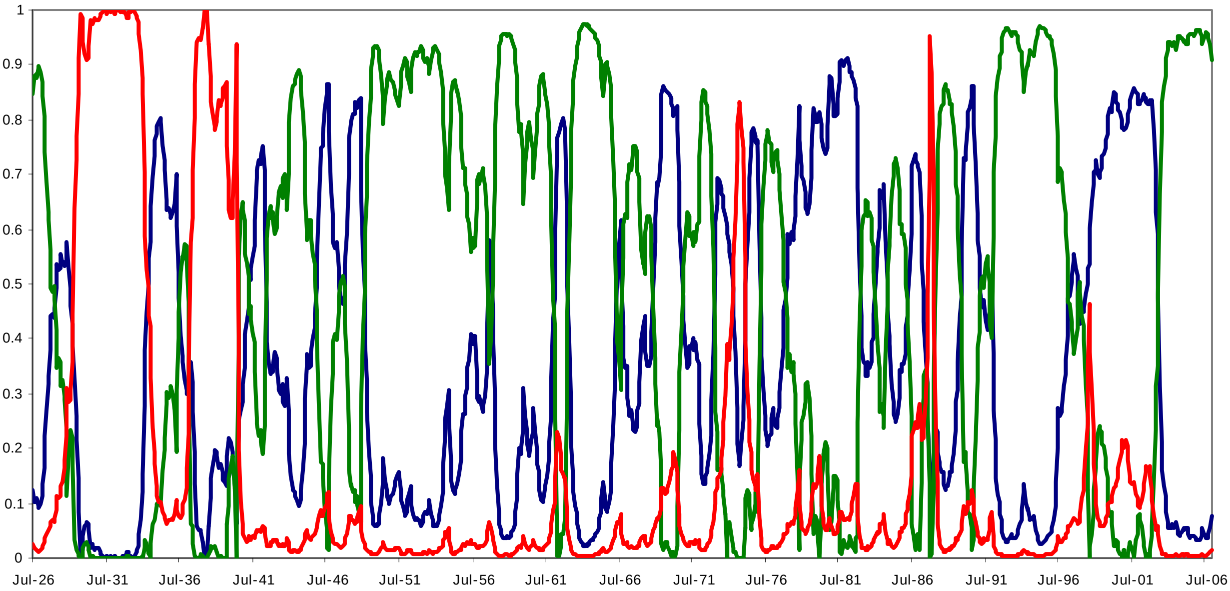

Figure 1.B – Post-Depression sample (1935-2006)

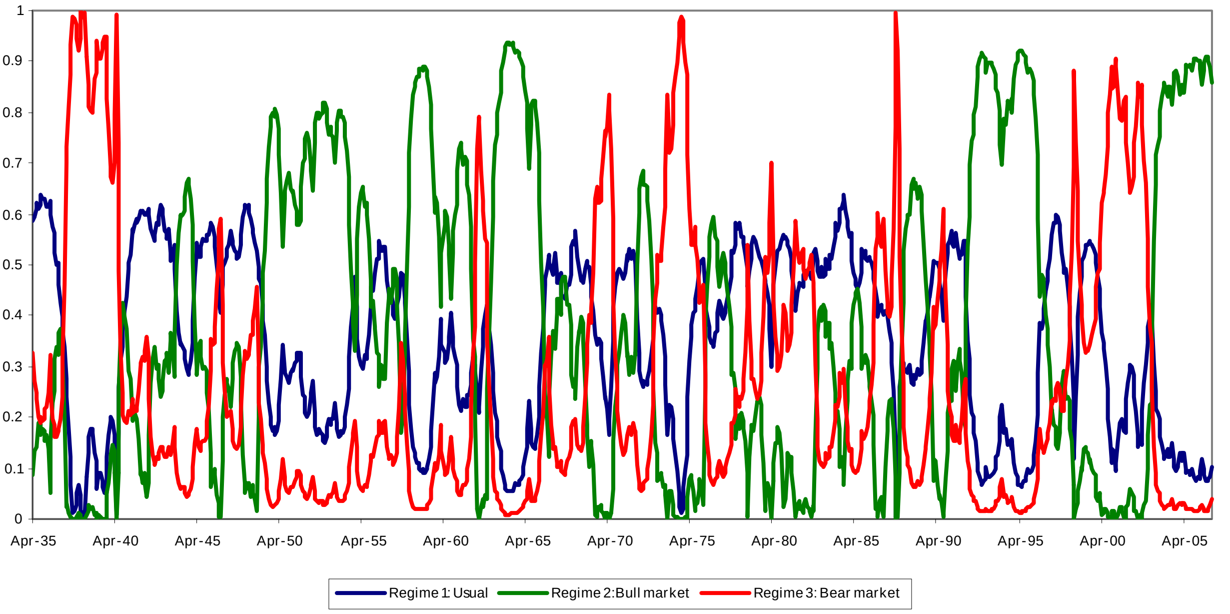

Figure 1 (continued)

Figure 1.C – Post-1963 sample (1963-2006)

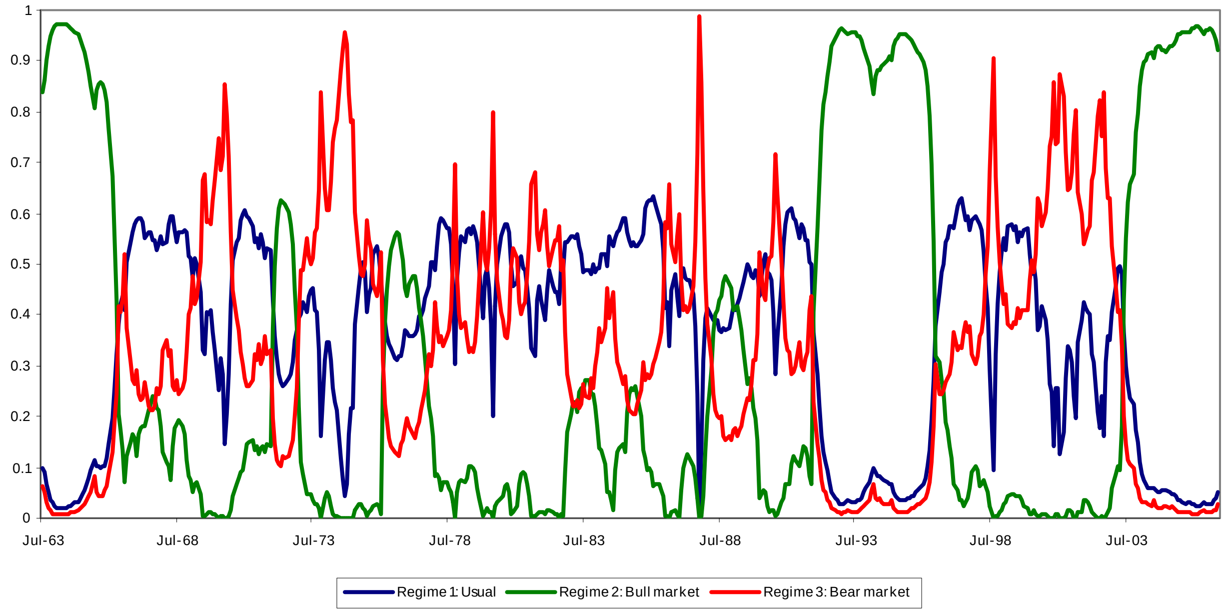

Figure 1.D – Pre-1963 sample (1927-1963)

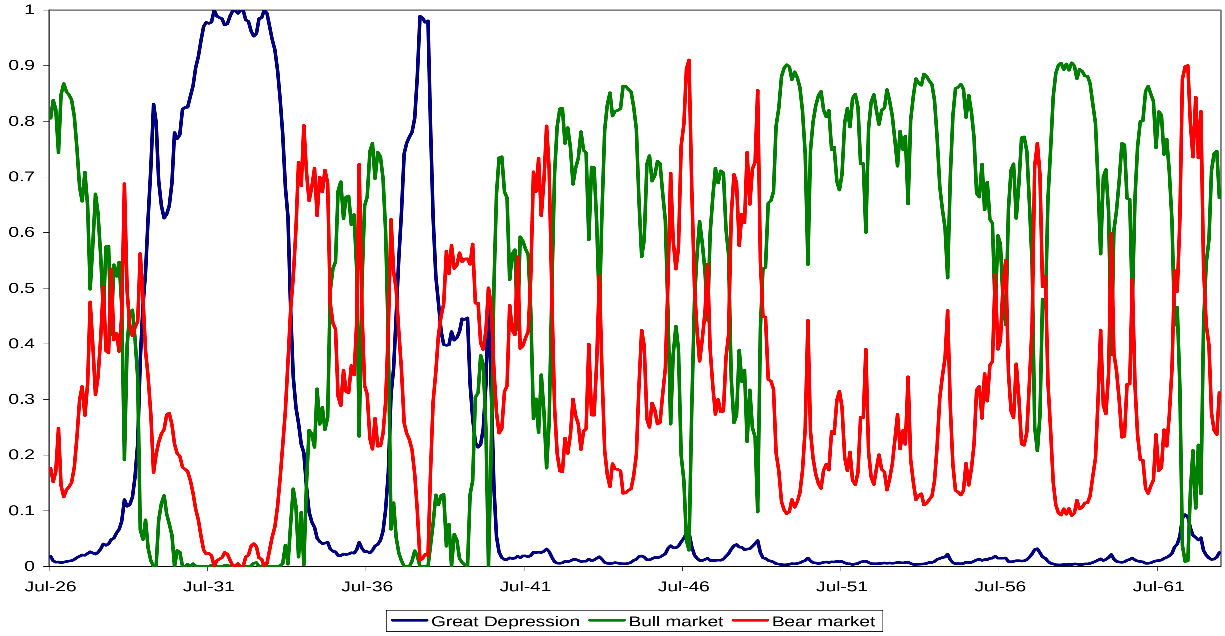

Figure 2 - Inferred probabilities of each model for several growth, value and value-minus-growth portfolios

We plot the smoothed probabilities of the regimes corresponding to the CAPM, the LCAPM and HCAPM for the H, L, HML, Hs, Ls and HMLs portfolios. H and L are the value and growth portfolios obtained with a 2 by 3 sort on size and book to market. Hs and Ls are the small-value and small-growth portfolios obtained with a five-by-five sort on size and book-to-market, and HMLs is the Hs portfolio subtracted from the Ls portfolio.The sample is from January 1963 to December 2006. The probabilities are estimated with 10000 iterations of the Gibbs-sampling algorithm.

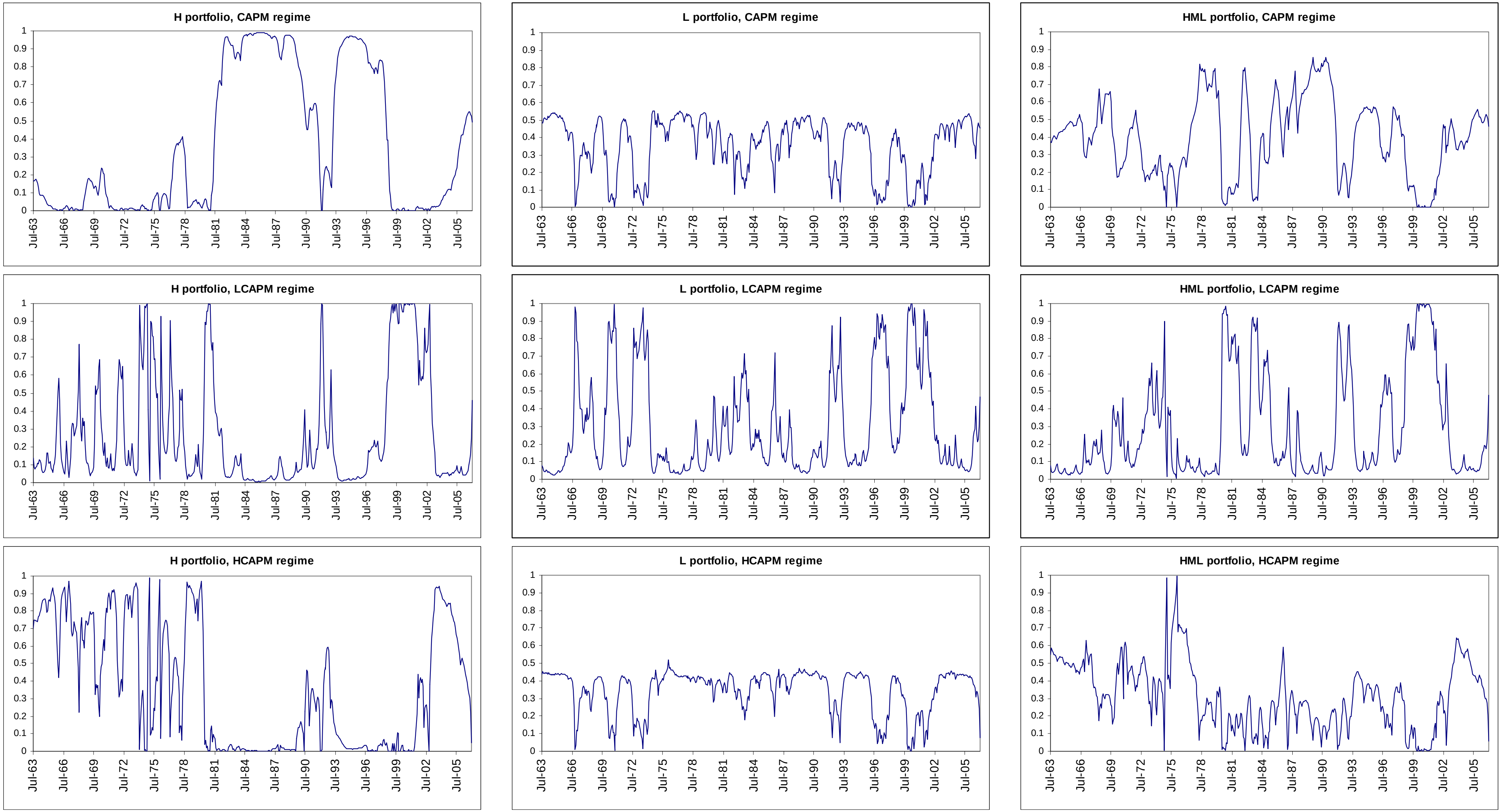

Figure 2 (continued)