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Disentangling Beta and Value Premium Using Macroeconomic Risk Factors

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In this paper, we study the time-varying total risk of value and growth stocks. The objective is to investigate the contention that the market factor's ability to explain the value premium is limited. Inspired by Ferson and Harvey [1999], we revisit the role of the market beta in the presence of aggregate economic factors. We discuss the incorporation of aggregate economic conditions in the context of multifactor risk models and provide cross-sectional evidence on the relationship between average returns and postranking betas for book-to-market (BE/ME) sorted portfolios. We show that the ineffective role of the market beta can be altered by incorporating aggregate economic risk factors in the cross-sectional asset pricing tests of size and BE/ME sorted portfolios. No previous study provides such a decomposition of the cross-sectional role of the market beta in the presence of macroeconomic risk factors.
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The most basic prediction of the capital asset pricing model of Sharpe [1964], Lintner [1965], and Black [1972] (the SLB model) is that average stock returns are positively related to market betas. The finance community has conducted a large number of studies that do not support this central prediction of the SLB model and refer to them as asset pricing anomalies.[1] In the wake of the seminal work of Fama and French [1992] and Lakonishok and others [1994], researchers have extensively used firm size (that is, market capitalization), book-to-market ratio (that is, the ratio of book equity (BE) to market equity (ME)), and other firm-level characteristics, in order to explain various anomalous cross-sectional patterns.

For example, it is widely recognized that portfolios of stocks with high BE/ME ratios—so-called value stocks—tend to have higher average returns than portfolios of stocks with low BE/ME ratios, or "growth" stocks [Chan and Lakonishok 2004]. The general consensus among financial economists is that a traditional market beta fails to explain any such existing anomalous patterns in average stock returns, and therefore some measure of risk related to financial performance of the firms that constitute the portfolio may complement the explanation.

Even though there is consensus on the existence of superior returns of value stocks, there is much less agreement on its possible explanations. The behavioral arguments, including the work of De Bondt and Thaler [1985, 1987], Lakonishok and others [1994], and Haugen [1995], suggest cognitive biases and investors' over-reaction as the main sources of the higher returns of value strategies. The risk-based explanations [Chan and Chen 1991; Fama and French 1995, 1996; and Chen and Zhang 1998] argue that the value premium is nothing but a proxy for a distress effect.[2] In contrast, some researchers—such as Liew and Vassalou [2000], Vassalou [2003], Hahn and Lee [2006], Petkova [2006], and Nguyen and others [2009]—have tried

[1]The list includes the size effect, the value effect, and numerous market anomalies.

[2]The works of Fama and French along this line specifically take the position of the efficient market hypothesis.

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to relate value premium with macroeconomic factors such as future GDP growth. Recently, Petkova and Zhang [2005] studied the relative risk of value stocks and identified one potential risk as time-varying risk.[3] Irrespective of the type and source of the explanations, one thing stands out from the accumulated evidence of the academic work on the value and growth effect: the limited role of the market beta.

In this paper, we investigate the contention that the market factor's ability to explain the value premium is limited. Inspired by Ferson and Harvey [1999], we revisit the role of the market beta in the presence of aggregate economic factors. We examine the predictive power of an alternative market beta, which incorporates information from a set of macroeconomic variables, and show the time and cross-sectional variations in value premium based on the suggested variables. We hypothesize that our proposed new beta, which we call the modified beta, contains important information for explaining the average returns of value and growth stocks.

Using a comprehensive sample of all NYSE, AMEX, and NASDAQ firms over the January 1972–December 2008 period, we study the risk premium associated with the modified beta and document the presence of persistent cross-sectional pattern in stock returns. We find that the modified beta not only proxies for time-variation in expected returns but also acts as significant cross-sectional predictors of returns.

Our approach assumes that portfolio risk is multidimensional and depends intricately on the state of the economy.[4] In doing so, we provide a linkage between financial markets and the macroeconomy. Overall, this paper contributes to the cross-sectional evidence on the relationship between average returns and market betas for value and growth portfolios. To the best of our knowledge, no previous study provides such a decomposition of the cross-sectional role of the market beta in the presence of macroeconomic risk factors.

The paper is organized as follows. In the next section, we briefly discuss our data and methodology. Section 2 contains the models of performance measurement used throughout the paper and our main empirical results. In Section 3, we conclude with some brief comments.

1. Data and Methodology

Our data consist of portfolios that include all nonfinancial NYSE, AMEX, and NASDAQ firms in the monthly Center for Research in Security Prices (CRSP) tapes, for the period of January 1972 through December 2008. We obtained the accounting information from the COMPUSTAT database and do not use firms with negative BE. We matched the accounting data for all fiscal year ends in calendar year $t-1$ with the returns for July of year t to June of year $t+1$. This ensures that the accounting data are known before we examine individual stock returns. The six-month gap between fiscal year end and the return helps us to avoid the look-ahead bias [Banz and Breen 1986]. Our BE/ME ratio is the ratio of COMPUSTAT book value for fiscal year end in calendar year $t-1$ to CRSP market value at the end of December of year $t-1$. We defined size as the natural logarithm of CRSP market value for June of year t. To be included in the sample, a firm must have a CRSP stock price for December of year $t-1$ and June of year t and book equity data for year $t-1$. Following the standard procedure of empirical research, we do not include firms until they have appeared on COMPUSTAT for two years. This helps us to avoid the survival bias [Banz and Breen 1986].

For the portfolio returns based on BE/ME, we use the BE/ME breakpoints for year t, which are the NYSE BE/ME quintiles at the end of June of year t. The stocks in the portfolios are value-weighted. Our dependent variable is based on the return of each of the 10 BE/ME and 25 double-sorted portfolios,[5] which are the intersections of five size portfolios and five BE/ME portfolios, from January 1972 through December 2008. By construction, in our one-dimensional sorts, a value (high) portfolio consists of the top 10 percent of stocks ranked by BE/ME ratio, and a growth (low) portfolio contains stocks in the bottom 10 percent.

[3]There exists another explanation based on methodological issues related to data selection bias [Kothari and others 1995]. However, works by Chan and others [1995] and Davis [1994] refute any such empirical claim.

[4]Similar methods have been used recently by Lewellen and Nagel [2006] and Petkova and Zhang [2005], who refer to the conditioning variables as "state variables," that is, variables that summarize the state of the economy.

[5]An alternative way to conduct a similar experiment is by evaluating sets of decile portfolios involving other common characteristics such as cash-flow/price, earnings/price, and so on. We leave them for future research.

As a result, the high-low represents the return of a long value and short growth portfolio, commonly known as the zero-net-investment (spread) portfolio.

We use the procedure described in Fama and French [1993] to construct mimicking risk factors. The mimicking risk factors in returns relating to size and BE/ME are based on the intersection of two sizes and three BE/ME groups. Basically, the risk factor in returns mimicking size (SMB—small minus big)[6] is a zero-net-investment (spread) portfolio that is long in small-firm stocks and short in large-firm stocks. Also, the risk factor in returns mimicking BE/ME (high-minus-low (HML)) is a zero-net-investment (spread) portfolio that is long in high BE/ME stocks and short in low BE/ME stocks. The values of the risk factors related to size and BE/ME equity are obtained from Kenneth French.[7] Finally, for the market proxy, we use the return of CRSP's value-weighted index on all NYSE, AMEX, and NASDAQ stocks.

2. Asset Pricing Tests and Empirical Results

Econometric framework

Following Cochrane [2005, ch. 12], we assume that the excess returns (over the risk-free rate) on assets are generated by a linear factor model. A description of the estimation methodology for the factor loadings is given in the Appendix. In the first stage, we obtain loadings for each portfolio from time-series regressions described in Section A1, and estimate the unconditional and conditional betas using equations (A.1) and (A.4). In the second stage, we estimate prices of risk using monthly cross-sectional regressions explained in Section A2. There are several approaches to estimate the conditional version of the linear factor model, and in this paper, we choose a relatively simple method pioneered by Ferson and Harvey [1999]. We model time-varying slope parameters as linear functions of the predetermined instruments and choose the instruments in such a way that they can proxy for economy-wide variables or business cycles. Our lagged instrumental variables follow from previous studies and include market dividend yield, default spread on corporate bond yields (Baa-Aaa rates), term structure spread (10 year – 1 year Treasury rates), and the lagged value of a one-month Treasury bill yield.

We utilize the modified betas in the cross-section results, which are based on the predicted version of equation (A.3). This approach enables us to use a proxy for the market risk that is not independent of the macroeconomic conditions. The assertion that aggregate economic variables, such as labor income and business conditions, affect market betas is nothing new and has been discussed by a number of well-known studies.[8] In the case of equation (A.1), the conditional information plays no role in determining the risk-return tradeoff, whereas in equation (A.4), the market betas are time-varying and responsive to conditioning information represented by four lagged instruments.

The setup enables us to utilize the market model, the regular Fama and French [1993] three-factor model, and an extended Fama–French model in our time-series analysis. For the extended Fama-French model, we add market skewness as an additional independent variable. The details are given in Section A1. Previous empirical evidence suggests that financial constraints play an important role in various aspects of asset returns and portfolio hedging. Following Adrian and Rosenberg [2008], we view the price of skewness risk as a proxy for the tightness of financial constraints. Overall, we use all three models and calculate the risk loadings of each portfolio with and without a time-varying beta specification.

Characteristics of the value and growth portfolios

For the empirical analysis, we start with simple summary statistics for the monthly returns of the BE/ME-sorted portfolios. It gives perspective on the range of average returns on our testing assets that competing sets of risk factors must explain. The results are reported in Table 1. Panel A reports the mean and standard deviation of all decile portfolios and the long-short portfolio. As one

[6]The difference each month between the simple average of the returns on small-stock portfolios and the simple average of the returns on big-stock portfolios.

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

[8]For example, Jegannathan and Wang [1996] estimated assets' betas with respect to labor income growth. Liew and Vassalou [2000] showed that size and BE/ME style portfolios can capture some aspects of business cycle risk. Lettau and Ludvigson [2001] used the log consumption-wealth ratio as a conditioning variable. For an overview on the literature, an excellent reference is Cochrane [2005].

Table 1. Characteristics and Factor Loadings of BE/ME Sorted Portfolios: January 1972 to December 2008, 433 Observations

Portfolios	Low	02	03	04	05	06	07	08	09	High	High-Low
Panel A: Portfolio characteristics and alphas of BE/ME sorted deciles											
Average											
Excess return (%)	0.21	0.43	0.48	0.55	0.47	0.50	0.60	0.59	0.70	0.81	0.60
Portfolio SD (%)	5.10	4.88	4.84	4.83	4.56	4.49	4.47	4.45	4.65	5.55	4.64
Alpha estimates											
CAPM	−0.21	0.04	0.10	0.18	0.13	0.16	0.28	0.27	0.37	0.44	0.65
	(−2.24)	(0.63)	(1.35)	(2.00)	(1.34)	(1.86)	(2.68)	(2.46)	(3.27)	(2.81)	(2.94)
						(Average $\bar{R}^2 = 0.45$)					
3-factor	0.10	0.10	0.07	0.03	−0.06	−0.04	−0.03	−0.13	−0.04	−0.12	−0.22
	(1.57)	(1.42)	(0.83)	(0.40)	(−0.70)	(−0.59)	(−0.35)	(−2.15)	(−0.50)	(−1.26)	(−2.04)
						(Average $\bar{R}^2 = 0.80$)					
4-factor	0.10	0.10	0.08	0.03	−0.05	−0.04	−0.08	−0.15	−0.08	−0.14	−0.24
	(1.54)	(1.45)	(0.97)	(0.35)	(−0.62)	(−0.47)	(−0.98)	(−2.37)	(−1.03)	(−1.43)	(−2.16)
						(Average $\bar{R}^2 = 0.81$)					
Panel B: Regression coefficients of 3-factor model											
$r_{m,t}$	0.98	1.01	1.03	1.05	1.00	1.00	1.00	1.00	1.04	1.17	0.19
	(49.44)	(55.35)	(33.75)	(47.22)	(37.96)	(51.66)	(35.20)	(58.84)	(44.38)	(44.58)	(6.67)
SMB_t	−0.16	−0.06	−0.06	−0.20	−0.05	−0.01	−0.00	0.12	0.15	0.34	0.49
	(−5.80)	(−1.99)	(−1.36)	(−0.60)	(−1.33)	(−0.30)	(−0.10)	(5.49)	(4.96)	(9.25)	(11.63)
HML_t	−0.53	−0.08	0.07	0.26	0.34	0.37	0.56	0.70	0.70	0.93	1.45
	(−15.30)	(−2.15)	(1.51)	(5.28)	(7.40)	(10.31)	(13.06)	(23.06)	(20.65)	(21.91)	(30.02)
Panel C: Regression coefficients of 4-factor model											
$r_{m,t}$	0.98	1.01	1.02	1.05	0.99	0.99	1.05	1.02	1.08	1.19	0.21
	(40.57)	(47.26)	(33.76)	(41.89)	(36.77)	(45.38)	(39.64)	(53.81)	(44.47)	(41.78)	(5.91)
SMB_t	−0.16	−0.06	−0.06	−0.02	−0.05	−0.01	0.00	0.12	0.15	0.34	0.50
	(−5.77)	(−2.00)	(−1.38)	(−0.58)	(−1.36)	(−0.33)	(0.13)	(5.55)	(5.14)	(9.30)	(11.63)
HML_t	−0.53	−0.08	0.07	0.26	0.34	0.37	0.57	0.70	0.71	0.93	1.45
	(−15.06)	(−2.16)	(1.49)	(5.18)	(7.42)	(10.07)	(13.64)	(23.12)	(21.69)	(21.79)	(29.58)
$SKEW_t$	0.00	0.00	0.01	−0.00	0.01	0.01	−0.04	−0.01	−0.04	−0.01	−0.01
	(0.09)	(0.13)	(0.31)	(−0.15)	(0.38)	(0.63)	(−4.11)	(−1.09)	(−2.73)	(−1.03)	(−1.20)

Note: r_m is the excess return of CRSP's value-weighted index on all NYSE, AMEX, and NASDAQ stocks. SMB (small minus big) is the difference each month between the simple average of the returns on the three small-stock portfolios and the simple average of the returns on the three big-stock portfolios. HML (high minus low) is the difference each month between the simple average of the returns on the two high-BE/ME portfolios and the average of the returns on the two low-BE/ME portfolios. Skew is based on the normalized estimate of the sample market skewness within each month. For all 10 portfolios, the dependent variable is value-weighted simple returns in excess of the one-month T-bill rate calculated for each month. Figures in brackets are the respective *t*-statistics.

would expect, the value portfolio has the highest average excess return of 0.81 percent per month, and the growth portfolio has the lowest mean excess return of 0.21 percent per month. The standard deviation of the value portfolio is higher than the standard deviation of the growth portfolio (5.55 percent per month vs. 5.10 percent per month). Even when we exclude the last two years of our sample period (namely 2007 and 2008), the overall trend in the average excess return does not change. The long-short portfolio yields an average excess return of 0.60 percent per month and a corresponding below-average standard deviation of 4.64 percent per month. In other words, even though there is strong value premium in our sample, it is associated with a moderate level of idiosyncratic risk.

Alpha, beta, and factor loadings of BE/ME sorted portfolios

In order to further analyze the returns of the BE/ME-sorted portfolios, we next look at the estimate of alpha and factor loadings from various linear factor models. The results from Panel A indicate that the CAPM alpha of our 10 decile portfolios varies between −0.21 and 0.44 over the entire sample period. The growth portfolio alpha is negative and the value portfolio alpha is positive. Notice that the alpha estimate is indistinguishable from zero for four out of the bottom seven deciles. This indicates that there has been no abnormal return from investing in those portfolios. In contrast, all four upper decile portfolios consistently generate high abnormal returns. The same is true for the long-short portfolio, since the associated alpha takes a statistically significant value of 0.64. The excess return on the market portfolio leaves much variation in stock returns that might be explained by other factors.

In Panel B of Table 1, we report the regression coefficients from the Fama–French three-factor model, and in Panel C, we do the same for the complementary four-factor model, with market skewness as the additional factor. For the sake of comparison, the corresponding alpha estimates are reported in Panel A. We observe that, compared with the market model, both the three-factor and four-factor models lead to only one significant alpha within all 10 decile BE/ME portfolios. The alpha estimates are consistently small and the associated F-test of Gibbons and others (GRS) [1989] never rejects the null hypothesis that a multifactor model captures the patterns in average returns. In other words, the value premium persists after adjusting for market risk, but does not persist after adjusting for SMB, HML, and aggregate economic risk.

It has been noted in the literature that the strong positive relationship between average returns and BE/ME ratio (that is, the lowest BE/ME portfolio has the lowest average return and the highest BE/ME portfolio has the highest average return) is not a beta effect in disguise [Fama and French 1992, p. 441]. Our results from Table 1 demonstrate the same. The market beta of value stocks is slightly higher than the market beta of growth stocks, but the coefficients on excess market return display very little variation across portfolios formed on BE/ME ratio. In contrast, both the SMB and HML factors capture the variability in average returns in BE/ME sorted portfolios. The growth stocks produce smaller SMB and HML slopes, whereas the value stocks display larger slopes on SMB and HML. Since the loadings on HML are particularly stronger for high BE/ME portfolios, we can call them relatively distressed stocks.

The addition of financial constraint in the model does not change the magnitude or sign of the SMB and HML factors, but it revalidates Fama and French's contention as to why SMB and HML work so well in the characterization of portfolios of stocks (a fact also noted by Cochrane [2005] and Zhang [2005]). For both the three-factor and four-factor models, the high loadings of SMB and HML transform regression intercepts that are insignificantly different from zero. Only two deciles display an economically significant loading on skewness, and the adjusted R^2 stays close to its mean value of 0.80.

Therefore, our preliminary results suggest that the regular market beta is insignificant in explaining average excess returns. The size and value factors on the other hand play a dominant role. In the next section, we introduce macroeconomic risk factors and test the time-series role of the conditional market beta based on the suggested risk factors.

Risk loadings under macroeconomic factors

Table 2 displays the factor loading of all BE/ME sorted portfolios under the presence of conditioning variables. The modified market model regressions from Panel A suggest that for only three out

Table 2. Factor Loading of BE/ME Sorted Portfolios Using Conditional Regressions: January 1972 to December 2008, 433 Observations

Portfolios	Low	02	03	04	05	06	07	08	09	High	High-Low
Panel A: Regression coefficients of CAPM + Ferson-Harvey model											
Alpha	−0.23	−0.01	0.05	0.16	0.10	0.15	0.21	0.25	0.29	0.39	0.61
	(−2.44)	(−0.10)	(0.62)	(1.83)	(1.06)	(1.76)	(2.09)	(2.56)	(2.79)	(2.65)	(2.90)
						(Average $\bar{R}^2 = 0.91$)					
$r_{m,t}$	0.95	0.94	0.84	0.84	0.79	0.78	0.74	0.57	0.88	0.99	0.04
	(13.3)	(16.24)	(12.82)	(8.97)	(9.72)	(10.11)	(7.14)	(5.23)	(8.99)	(9.07)	(0.22)
X_{1t}	−0.01	0.07	0.03	0.06	0.03	0.03	0.14	0.14	0.14	0.23	0.25
	(−0.39)	(2.42)	(1.05)	(1.27)	(0.86)	(0.75)	(2.95)	(2.83)	(2.45)	(3.85)	(2.80)
X_{2t}	0.00	0.01	0.04	−0.01	0.01	−0.03	0.02	−0.07	0.00	−0.04	−0.04
	(0.30)	(1.54)	(4.44)	(−0.91)	(1.39)	(−2.89)	(1.86)	(−6.09)	(0.05)	(−3.26)	(−2.16)
X_{3t}	0.03	0.02	0.02	0.01	0.01	0.04	−0.00	0.04	0.01	−0.04	−0.06
	(1.32)	(1.43)	(1.52)	(0.89)	(0.65)	(2.83)	(−0.14)	(1.88)	(0.33)	(−1.27)	(−1.37)
X_{4t}	0.31	−0.27	0.09	−0.09	−0.02	−0.01	−0.65	−0.30	−0.84	−1.28	−1.58
	(1.80)	(−2.05)	(0.67)	(−0.48)	(−0.10)	(−0.03)	(−2.76)	(−1.29)	(−3.67)	(−4.72)	(−3.94)
Panel B: Regression coefficients of 4-factor + Ferson-Harvey model											
Alpha	0.09	0.06	0.01	0.02	−0.08	−0.05	−0.13	−0.14	−0.13	−0.15	−0.24
	(1.49)	(0.97)	(0.20)	(0.19)	(−0.99)	(−0.62)	(−1.79)	(−1.74)	(−1.76)	(−1.52)	(−2.18)
						(Average $\bar{R}^2 = 0.93$)					
$r_{m,t}$	0.79	0.91	0.87	0.95	0.94	0.92	1.00	0.81	1.14	1.25	0.46
	(16.25)	(16.22)	(13.67)	(11.21)	(14.61)	(17.94)	(12.03)	(13.81)	(18.30)	(17.89)	(5.71)
X_{1t}	0.08	0.08	0.01	0.02	−0.03	−0.03	0.05	0.03	0.02	0.09	0.00
	(4.75)	(3.20)	(0.32)	(0.41)	(−1.20)	(−1.21)	(2.01)	(1.64)	(1.02)	(3.27)	(0.08)
X_{2t}	−0.03	0.00	0.04	0.01	0.03	−0.01	0.05	0.04	0.04	0.01	0.04
	(−3.52)	(0.68)	(6.58)	(0.48)	(5.53)	(−0.85)	(4.71)	(3.71)	(6.41)	(1.44)	(3.01)
X_{3t}	0.03	0.02	0.02	0.01	0.00	0.04	−0.01	0.04	0.01	−0.03	−0.06
	(2.54)	(1.37)	(1.34)	(0.61)	(0.28)	(3.54)	(−0.53)	(3.02)	(0.40)	(−2.17)	(−3.06)
X_{4t}	−0.13	−0.36	0.15	0.09	0.24	0.27	−0.26	0.20	−0.32	−0.59	−0.46
	(−1.27)	(−2.70)	(1.17)	(0.57)	(1.64)	(2.01)	(−1.36)	(1.60)	(−2.40)	(−4.35)	(−2.77)
SMB_t	−0.16	−0.06	−0.05	−0.01	−0.04	0.00	0.01	0.12	0.15	0.33	0.49
	(−5.65)	(−1.84)	(−1.13)	(−0.39)	(−1.06)	(0.11)	(0.34)	(5.72)	(5.38)	(9.01)	(11.33)
HML_t	−0.57	−0.12	0.10	0.27	0.38	0.38	0.58	0.68	0.71	0.89	1.46
	(−17.98)	(−3.32)	(2.35)	(5.28)	(8.83)	(10.26)	(17.05)	(24.92)	(23.38)	(20.01)	(29.84)
$SKEW_t$	−0.01	0.00	0.02	−0.00	0.01	0.01	−0.04	−0.02	−0.03	−0.02	−0.01
	(−0.75)	(0.06)	(2.00)	(−0.08)	(1.39)	(1.03)	(−4.45)	(−1.78)	(−4.00)	(−1.32)	(−0.89)

Note: Here $X_{1t} = r_{m,t} * DIV_{t-1}$, $X_{2t} = r_{m,t} * \mathrm{DEF}_{t-1}$, $X_{3t} = r_{m,t} * TERM_{t-1}$, $X_{4t} = r_{m,t} * RF_{t-1}$, where DIV is market dividend yield, DEF is default spread on corporate bonds, TERM is term structure spread, RF is 1-month T-bill rate, and r_m is the excess return of CRSP's value-weighted index on all NYSE, AMEX, and NASDAQ stocks. Also, SMB is the size factor and HML (high minus low) is the value factor as defined in the text. For all 10 portfolios, the dependent variable is value-weighted simple returns in excess of the one-month T-bill rate calculated for each month.

of 10 deciles, the addition of aggregate economic risk factors alone is not sufficient to generate statistically significant alpha estimates. In fact, for the extreme growth portfolio there exists a large negative unexplained return, and for the four highest BE/ME portfolios (which include the value stocks) there exists a large positive unexplained return. The model does capture some of the variation in the average excess returns of the BE/ME portfolios, and this is mainly because of the interaction variable between excess market return and lagged market dividend yield (which we referred to as X_{1t}). The estimated slope coefficients of X_{1t} start with very low values but increase monotonically as we move from low BE/ME portfolios to high BE/ME portfolios. Overall, even though our modified CAPM is not entirely successful in capturing the time-series variation in average portfolio returns of BE/ME stocks, it allows time variation of the market betas in the presence of macroeconomic risk factors. Similar to various industries, an economy wanders through growth and distress, and an incorporation of the additional dimension of aggregate economic risk is warranted. Otherwise, we may end up in a situation of irreversible investment— an erroneous positive correlation between the betas of value firms and the market risk premium [Zhang 2005].

Results from Panel B portray a similar picture. Here we include aggregate economic factors in the presence of SMB, HML, and financial constraints, and observe a drastic change in the alpha estimates of all decile portfolios. Unlike Panel A, none of the intercepts in Panel B are significantly different from zero, and the associated GRS statistics are statistically insignificant. It seems that the addition of Fama–French risk factors complements the performance of the interaction variables involving lagged market dividend yield and default spread on corporate bonds. Also, compared with Panel A, both the growth and value portfolios now display statistically significant loading on the interaction between excess market return and lagged term structure spread. Overall, the presence of aggregate economic factors slightly improves the role of the market betas; they now monotonically increase from low BE/ME to high BE/ME portfolios (except decile 8 when it goes down to 0.81). The average SMB and HML slope estimates decrease slightly (as compared with Panel B and C of Table 1), but their risk loadings are strong enough to produce an intuitive characterization of the BE/ME sorted portfolios.

Cross-sectional results

The central message that we have gleaned thus far is that there is a strong positive correlation between average returns and the BE/ME ratio, and that the market factor on its own fails to explain any time-series variation of BE/ME-sorted portfolios. The aggregate economic factors play a supplementary role in improving the market risk's characterization, but the role is rather limited in time-series applications. In this section, we provide a framework for measuring the effectiveness of our methodology in a cross-sectional analysis. We conduct such analysis using two sets of testing portfolios. We first use double-sorted portfolios in this section that are based on BE/ME and beta, and in the next section we use size and BE/ME.

We construct the double-sorted portfolios based on BE/ME and beta using the following steps. For the entire sample period, we select stocks selected from the NYSE-AMEX-NASDAQ universe every June if they have at least 24 months of returns over the past five years and have a valid return in June. We form 10 portfolios on the basis of BE/ME breakpoints, using all stocks on CRSP; and then within each BE/ME decile, we form two sets of decile portfolios. The first set is based on preranking beta, which is the slope coefficient from our regression of monthly portfolio excess returns on the current and prior month's return of the CRSP value-weighted market index. The second set is based on the preranking beta which we calculate by equation (A.3). We call these two sets regular preranking beta and modified preranking beta, respectively. The value-weighted monthly returns for each 100 portfolios are then computed from July to June in the following year. The regular postranking and modified postranking betas are then estimated.

It is important to note that both the modified preranking and postranking betas are estimated using the time-varying structure of betas. The modified preranking betas are estimated on 24 to 60 monthly returns (as available) using equation (A.3). The modified postranking betas are estimated through (A.3) and use the full sample (that is, 432 months for each of 100 portfolios) of postranking monthly portfolio returns. As we mentioned before, because of our conditioning process, the modified postranking betas are based on the estimated regression parameters and the values of the state variables from the previous period.

Panel A of Table 3 presents the average monthly excess returns for the 100 BE/ME-beta

Table 3. Average Excess Returns and Postranking Betas for Portfolios Formed on BE/ME and Regular Beta (January 1972 to December 2008)

	Beta1	Beta2	Beta3	Beta4	Beta5	Beta6	Beta7	Beta8	Beta9	Beta10	All
Panel A: Average monthly excess returns (in percent)											
BE/ME1	0.22	0.34	0.37	0.35	0.40	0.43	0.33	0.37	0.32	0.42	0.37
BE/ME2	0.23	0.28	0.36	0.38	0.39	0.44	0.48	0.52	0.49	0.43	0.40
BE/ME3	0.23	0.35	0.39	0.45	0.42	0.53	0.53	0.62	0.58	0.58	0.47
BE/ME4	0.25	0.31	0.41	0.46	0.51	0.62	0.64	0.87	0.76	0.61	0.54
BE/ME5	0.24	0.38	0.40	0.52	0.63	0.89	0.68	0.79	0.83	0.65	0.60
BE/ME6	0.29	0.40	0.55	0.51	0.75	0.91	0.73	0.87	0.86	0.78	0.66
BE/ME7	0.31	0.53	0.67	0.59	0.81	0.95	0.79	0.93	0.90	0.84	0.73
BE/ME8	0.35	0.55	0.71	0.62	0.88	0.99	0.88	0.96	0.95	0.92	0.78
BE/ME9	0.46	0.63	0.76	0.79	0.90	0.98	0.93	0.99	0.97	0.99	0.84
BE/ME10	0.51	0.80	0.85	0.75	1.02	0.99	1.09	1.07	1.05	1.08	0.92
All	0.32	0.46	0.55	0.54	0.67	0.77	0.71	0.80	0.77	0.73	—
Panel B: Postranking betas											
BE/ME1	0.98	1.05	1.09	1.06	1.07	1.11	1.05	1.13	1.07	1.10	1.07
BE/ME2	0.94	1.08	1.07	1.09	0.99	1.08	1.15	1.24	1.37	1.25	1.13
BE/ME3	0.96	1.12	1.18	1.07	0.98	1.17	1.24	1.25	1.29	1.23	1.15
BE/ME4	0.92	1.02	1.29	1.11	1.11	1.24	1.27	1.37	1.30	1.29	1.19
BE/ME5	0.96	0.91	1.28	1.15	1.22	1.28	1.17	1.23	1.32	1.30	1.18
BE/ME6	0.91	1.25	1.31	1.14	1.18	1.32	1.29	1.36	1.24	1.26	1.23
BE/ME7	0.88	1.29	1.35	1.00	1.17	1.39	1.33	1.32	1.23	1.29	1.23
BE/ME8	1.02	1.32	1.38	1.11	1.23	1.34	1.37	1.42	1.35	1.33	1.29
BE/ME9	1.14	1.38	1.42	1.24	1.29	1.40	1.33	1.47	1.40	1.36	1.34
BE/ME10	1.07	1.35	1.46	1.31	1.35	1.43	1.40	1.35	1.42	1.44	1.36
All	0.98	1.18	1.28	1.13	1.16	1.28	1.26	1.31	1.30	1.29	—

Note: BE/ME is the ratio of the sum of book equity (BE) and the sum of market equity (ME). For the entire sample period, stocks are selected from the NYSE, AMEX, and NASDAQ universe every June if they have at least 24 months of returns over the past five years and have a valid return in June. Ten portfolios are formed on the basis of BE/ME breakpoints (using all stocks on CRSP) and within each BE/ME decile, 10 portfolios are formed on regular prebeta using the market model as described in the text. The value-weighted monthly returns for each 100 portfolios are then computed from July to June in the following year. The estimated preranking and postranking betas are the estimated slope coefficients from regressions of monthly excess returns on the current and prior month's return of the CRSP value weighted market index.

sorted portfolios for the entire sample period. Here, BE/ME1 (BE/ME10) includes the deciles of the lowest BE/ME (highest BE/ME) portfolios of stocks, and Beta1 (Beta10) includes the smallest (largest) beta portfolios within each BE/ME portfolio. Scanning down any column shows that the portfolio with the highest BE/ME ratio earns the largest average excess returns (0.92 percent on average), whereas the lowest BE/ME ratio portfolio earns the smallest returns (0.37 percent on average). If we scan across the rows, we hardly observe any systematic patterns in the variability of the average excess returns. The lowest beta portfolio has the lowest average excess monthly return (0.32 percent per month); but after that, there is no clear association between beta and average returns. To put it simply, the average excess returns are somewhat flat or display no clear tendency to increase across the beta deciles.

In Panel B, we report the postranking betas of our 100 BE/ME-beta sorted portfolios. Sorted on BE/ME alone, the postranking betas range from 1.07 for the smallest BE/ME portfolio to 1.36 for the largest BE/ME portfolio. The smallest and the largest beta portfolios have average betas of 0.98 and 1.29 respectively. Within a BE/ME decile, when we move across a row of the average return matrix, there is very little spread in the estimated betas. For the lowest BE/ME decile portfolios, the average postranking betas increase from 0.98 for the beta1 portfolio to 1.13 for the beta8 portfolio, and then goes down to 1.10 for the beta10 portfolio. In contrast, within the columns, the postranking betas increase monotonically (similar to average monthly excess returns from Panel A) with the increase in the BE/ME ratio. Overall, these results are consistent with Fama and French [1992, 1996] and support the view that there is a strong positive relationship between average return and BE/ME. But if we control for BE/ME, there is little evidence about the relationship between traditional market beta and average return; a clear contradiction of the prediction of the SLB model. Our postranking betas in Panel B capture very little variation (if any) of the average returns for BE/ME sorted portfolios.

The question is what can explain such a discrepancy. Can we disentangle the effect of postranking betas and average returns of BE/ME sorted portfolios using a different sorting procedure? In our analysis, we suggest one such alternative. As we discussed in subsection above, it is done by the incorporation of macroeconomic risk factors in our modified market beta calculation, and through a sort of the portfolios on the basis of the modified beta. In Table 4, we provide such results for our new set of 100 portfolios formed on BE/ME and the modified beta. In panel A, we display the average monthly returns for 100 double-sorted portfolios. We see that across the columns, the results are very similar to those from Panel A in Table 3. However, scanning along any row shows that sorting by modified beta yields a wide dispersion in average returns. It is clear that the average returns increase strongly in each beta decile. The largest and smallest beta portfolios have average returns of 0.87 and 0.40 percent per month, respectively. Interestingly, the portfolio returns are now much more widely spread across modified beta deciles than across BE/ME deciles.

Panel B of Table 4 also suggests some empirical evidence that we have not seen before. The

Table 4. Average Excess Returns and Postranking Betas for Portfolios Formed on BE/ME and Modified Preranking Beta (January 1972 to December 2008)

	Beta1*	Beta2*	Beta3*	Beta4*	Beta5*	Beta6*	Beta7*	Beta8*	Beta9*	Beta10*	All
Panel A: Average monthly excess returns (in percent)											
BE/ME1	0.39	0.36	0.39	0.36	0.43	0.48	0.51	0.51	0.55	0.56	0.45
BE/ME2	0.27	0.31	0.33	0.37	0.45	0.49	0.53	0.57	0.61	0.63	0.46
BE/ME3	0.32	0.39	0.43	0.48	0.51	0.54	0.58	0.63	0.66	0.69	0.52
BE/ME4	0.33	0.42	0.47	0.49	0.51	0.62	0.59	0.69	0.69	0.82	0.56
BE/ME5	0.36	0.44	0.52	0.54	0.53	0.60	0.63	0.76	0.79	0.85	0.60
BE/ME6	0.39	0.48	0.56	0.59	0.65	0.66	0.70	0.84	0.93	0.91	0.67
BE/ME7	0.38	0.49	0.59	0.63	0.68	0.71	0.82	0.87	0.96	1.00	0.71
BE/ME8	0.42	0.51	0.62	0.67	0.72	0.74	0.89	0.91	0.99	1.02	0.75
BE/ME9	0.51	0.54	0.66	0.69	0.85	0.85	0.95	0.99	1.03	1.09	0.82
BE/ME10	0.62	0.63	0.70	0.73	0.88	0.92	1.01	1.05	1.10	1.15	0.88
All	0.40	0.46	0.53	0.56	0.62	0.66	0.72	0.78	0.83	0.87	—
Panel B: Postranking betas											
BE/ME1	0.89	0.94	0.96	0.99	0.99	1.03	1.05	1.09	1.12	1.13	1.02
BE/ME2	0.87	0.95	0.99	1.03	1.04	1.07	1.08	1.14	1.14	1.18	1.05
BE/ME3	0.90	0.97	1.01	1.06	1.08	1.10	1.11	1.19	1.22	1.23	1.09
BE/ME4	0.91	0.99	1.04	1.07	1.11	1.13	1.13	1.18	1.25	1.28	1.11
BE/ME5	0.95	1.02	1.09	1.13	1.15	1.18	1.20	1.21	1.29	1.30	1.15
BE/ME6	0.99	1.06	1.12	1.19	1.22	1.22	1.25	1.31	1.33	1.39	1.21
BE/ME7	1.01	1.07	1.11	1.21	1.23	1.26	1.32	1.35	1.38	1.44	1.24
BE/ME8	1.04	1.07	1.17	1.22	1.27	1.33	1.35	1.36	1.40	1.43	1.26
BE/ME9	1.07	1.11	1.18	1.26	1.31	1.35	1.42	1.42	1.46	1.49	1.31
BE/ME10	1.08	1.15	1.20	1.29	1.34	1.40	1.43	1.47	1.48	1.52	1.34
All	0.97	1.03	1.09	1.15	1.17	1.21	1.23	1.27	1.31	1.33	—

Note: BE/ME is the ratio of the sum of book equity (BE) and the sum of market equity (ME). For the entire sample period, stocks are selected from the NYSE, AMEX, and NASDAQ universe every June if they have at least 24 months of returns over the past five years and have a valid return in June. Ten portfolios are formed on the basis of BE/ME breakpoints (using all stocks on CRSP) and within each BE/ME decile, 10 portfolios are formed on modified prebeta (that is, beta1* to beta10*) using equation (A.3) as described in the appendix (Section A1). The value-weighted monthly returns for each 100 portfolios are then computed from July to June in the following year. The estimated modified postranking betas are the estimated slope coefficient using equation (A.3) of Section A1. That is, the modified postranking betas are based on the estimated regression parameters and the values of the state variables from the previous period.

postranking betas now not only increase strongly in each BE/ME decile, but also show a tendency to increase across modified beta decile portfolios. The smallest BE/ME decile has an average beta of 1.02, while the largest BE/ME decile has an average beta of 1.34. In contrast, the postranking betas for the 10 portfolios in the highest BE/ME decile fall within the range of 1.13 to 1.52. Therefore, when we reproduce the ordering of the preranking betas by our modified beta, we arrive at the provocative conclusion that there is an association between average return and postranking beta. Across all the BE/ME deciles, the pattern in the variability of the average monthly returns and postranking betas is similar. In other words, there is some variation in beta that is unrelated to the portfolio formation style (BE/ME ratio in our case) and positively related to the average returns. Allowing a two-pass sort on BE/ME and our modified beta resolves the discrepancy of the positive relationship between beta and average portfolio return.

Extension of our results to size and BE/ME-based double-sorted portfolios

So far our results are one-dimensional, as they are based on only one firm characteristic. The obvious question is: what happens if we extend our results to double-sorted portfolios based on size and BE/ME at the same time? In this subsection we explore this.

We start with the summary statistics for SMB, HML, and the monthly market excess returns of 25 size-BE/ME sorted portfolios (given in Table 5). The size premium (proxied by SMB) in average return is a statistically insignificant 0.18 percent per month, whereas the value premium (proxied by HML) in average return is 0.47 percent per month, which is statistically distinguishable from zero. The summary of the means of 25 double-sorted portfolios shows that there is a significant value premium, as portfolios with a higher BE/ME ratio consistently generate higher average returns. The average monthly portfolio returns always increase in higher BE/ME quintiles. The average value premium for high BE/ME stocks is 1.30 percent per month compared with the average growth premium of low BE/ME stocks of 0.71 percent per month. The value premium is larger for small-size stocks than for the big-size stocks (1.12 percent per month compared with 0.92 percent per month). All five of the median size, and all five of the median BE/ME-sorted stocks, generate almost identical average returns of 1.12 percent per month. When we combine the portfolio mean and standard deviation (not reported), the Sharpe ratio tends to be consistently higher for small-size and high-BE/ME portfolios.

The simple CAPM alpha estimates suggest that the value premium persists even after controlling for market risk. The small size and high BE/ME portfolios continue to generate economically significant alpha estimates. But when we add SMB, HML, and aggregate economic risk factors to the model, the value premium ceases to persist, as the alpha estimates become statistically insignificant. We see that four out of our five high-BE/ME portfolios have intercepts that are small and statistically indistinguishable from zero. The same is true for the smallest size quintile portfolios. This implies that even though market risk itself cannot explain the value premium, aggregate economic factors may complement the story, even in the presence of SMB and HML factors. This also suggests that there are some types of risk other than market risk associated with small size and high-BE/ME stocks (as predicted by Fama and French [1992, 1993, and 1996] and a large number of other authors). Thus, portfolio evaluation techniques that do not incorporate these risks can be misleading.

Finally, in order to supplement our previous findings, we perform 433 monthly cross-sectional regressions employing Fama and MacBeth's [1973] methodology (explained in Section A2 of the Appendix) and report the results in Table 6. We utilize all 25 double-sorted portfolios formed on size and BE/ME (described in Table 5) and two different sets of beta estimates for cross-sectional regressions. The regular beta estimates are calculated using only the slope coefficients of the excess market return for each month, and the modified betas are based on equation (A.3) and its predicted value for each month. The estimation results suggest that the market price of risk is small and negative when it is based on the traditional linear factor model. Compared with the subperiod between January 1972 and December 2006, and for the whole sample period between January 1972 and December 2008, the effect of the market betas shows negligible discrepancy. When we add firm size and BE/ME ratio, the adjusted R^2 shows some improvement; but the market beta remains statistically insignificant. As expected, size has a negative effect and BE/ME has a positive effect on the variability of average excess returns. For the full

Table 5. Summary Statistics for the Monthly Dependent and Explanatory Returns (in percent) in the Regression: January 1972 to December 2008, 433 Observations

				Autocorrelation For Lag			Correlations		
Name	Mean	SD	t	1	2	12	r_m	SMB	HML
Explanatory returns									
r_m	0.38	4.59	1.74	0.08	−0.04	0.02	1.00		
SMB	0.18	3.23	1.18	0.02	0.05	0.08	0.26	1.00	
HML	0.46	3.03	3.18	0.13	0.05	0.00	−0.42	−0.27	1.00

Dependent Variable: Excess Returns on 25 Stock Portfolios Formed on Size and BE/ME

Book-to-Market Equity (BE/ME) Quintiles

Size Quintile	Low	2	3	4	High	Low	2	3	4	High
			Means					CAPM alpha		
Small	0.43	1.13	1.20	1.39	1.47	−0.59*	0.21	0.33*	0.56*	0.62*
2	0.71	1.03	1.26	1.34	1.38	−0.30	0.12	0.41*	0.51*	0.52*
3	0.78	1.08	1.16	1.19	1.46	−0.20	0.19	0.33*	0.37*	0.62*
4	0.88	0.94	1.08	1.16	1.21	−0.08	0.05	0.22*	0.34*	0.37*
Big	0.78	0.98	0.90	0.96	1.01	−0.08	0.15	0.09	0.19	0.23
					(Average $\bar{R}^2 = 0.48$)					
			3F + FH alpha					4F + FH alpha		
Small	−0.54*	0.02	0.02	0.16*	0.11	−0.56*	0.00	0.02	0.18*	0.12
2	−0.23*	−0.11	0.06	0.09	−0.07	−0.26*	−0.11	0.06	0.10	−0.09
3	−0.01	−0.03	−0.03	−0.10	0.03	−0.03	−0.02	−0.05	−0.11	0.04
4	0.11	−0.13	−0.09	−0.06	−0.15	0.09	−0.12	−0.09	−0.10	−0.17
Big	0.15*	0.05	−0.07	−0.16*	−0.24*	0.15*	0.05	−0.05	−0.19*	−0.28*
	(Average $\bar{R}^2 = 0.92$)					(Average $\bar{R}^2 = 0.93$)				

Note: r_m is the excess return of CRSP's value-weighted index on all NYSE, AMEX, and NASDAQ stocks. SMB (small minus big) is the difference each month between the simple average of the percent returns on the three small-stock portfolios and the simple average of the returns on the three big-stock portfolios. HML (high minus low) is the difference each month between the simple average of the returns on the two high-BE/ME portfolios and the average of the returns on the two low-BE/ME portfolios. (*) implies the coefficient is significant at the 5 percent level.

Table 6. Fama and MacBeth (1973)Cross-Sectional Results using 25 Size and BE/ME-sorted Portfolios

Model	Sample Period	Intercept	β_t	β_t*	1n (ME_t)	1n (BE/ME_t)	*Adj* R^2
1	Jan, 1972–Dec, 2006	1.42*	−0.81	—	—	—	0.18
		(3.01)	(−1.79)	—	—	—	—
	Jan, 1972–Dec, 2008	1.47*	−0.75	—	—	—	0.16
		(3.22)	(−1.81)	—	—	—	—
2	Jan, 1972–Dec, 2006	0.91*	−0.10	—	−0.21*	0.29*	0.29
		(2.82)	(−1.03)	—	(−2.26)	(2.53)	—
	Jan, 1972–Dec, 2008	0.95*	−0.09	—	−0.25*	0.09	0.25
		(2.97)	(−0.96)	—	(−2.43)	(1.68)	—
3	Jan, 1972–Dec, 2006	0.85	—	0.20*	—	—	0.32
		(1.89)	—	(2.09)	—	—	—
	Jan, 1972–Dec, 2008	0.90*	—	0.18*	—	—	0.30
		(1.98)	—	(2.01)	—	—	—
4	Jan, 1972–Dec, 2006	1.02*	—	0.24*	−0.28*	0.24*	0.43
		(2.10)	—	(2.15)	(−2.77)	(2.43)	—
	Jan, 1972–Dec, 2008	1.10*	—	0.15*	−0.30*	0.27*	0.39
		(2.21)		(1.98)	(−2.91)	(2.55)	—

Note: This table reports Fama and MacBeth (1973)cross-sectional regression estimates. Here β_t is our regular beta from the market model, and β_t* is our modified beta using aggregate economic risk factors. ME is market equity (stock price times shares outstanding). BE/ME is the ratio of the sum of book equity (BE) and the sum of market equity (ME). *Test portfolios are 25 size and book-to-market Fama-French portfolios*. Regression parameters are calculated from monthly Fama-Macbeth cross-sectional regressions. In the first stage, we estimate factor loadings using full-sample regressions as described in the appendix. The first row of the table presents the second-stage cross-sectional regressions including the intercepts and slopes in percent per month. Figures in parentheses are the respective Fama-Macbeth t-statistics. All the regression R^2 values are adjusted for degrees of freedom. (*) implies the coefficient is significant at the 5% level.

sample, the estimated BE/ME coefficient yields a very small value of 0.09 (with $t = 1.68$) and loses its statistical significance at the 5 percent level. We conjecture that the economic recession has something to do with this loss of statistical significance.

When we include the modified betas in our cross-sectional regressions, they do a better job of explaining the average variability of excess returns for our double-sorted portfolios. Whether it is for the subperiod of January 1972 to December 2006, or for the whole sample period (that is, including the recession years 2007 and 2008), the modified market betas show a positive and statistically significant coefficient at the 5 percent level, with a value of 0.20 ($t = 2.09$) and 0.18 ($t = 2.01$), respectively. This result demonstrates that the price of market risk is positive when we modify it with respect to macroeconomic risk factors. Even when we add firm size and the BE/ME ratio to the cross-sectional regressions, the modified market betas never lost their explanatory power. For the full sample, there is positive risk premium on the modified betas, even in the presence of two firm characteristics. Also, the modified betas always lead to a much higher adjusted R^2. The average $\bar{R}^2$ for models 3 and 4 is 0.36 compared with 0.20 from models 1 and 2. Therefore, consistent with rational asset pricing, for the portfolios sorted by size and BE/ME ratio, the price for higher exposure to market risk is positive as long as we incorporate aggregate economic risk factors.

3. Conclusions

It is widely known that the value premium is one of the traditional asset pricing anomalies that cannot be explained by the market beta. In this paper, we investigate whether there exists some type of complementary risk—other than the widely used market factor—that is not independent of the state of aggregate economic conditions and that can explain the premium between the returns on high and low BE/ME portfolios. We show that this additional dimension of risk is related to four aggregate macroeconomic factors, based on the fact that their presence can improve the nontrivial role of the market beta. Our framework in this paper allows us to demonstrate that in the cross-section, aggregate risk factors may play an independent and economically meaningful role, as they help to explain a portion of the spread in returns between value and growth stocks.

Our work can be extended in many directions. One immediate issue that needs to be resolved is whether our arguments hold for value and growth portfolios based on firm characteristics such as cash-flow/price, earnings/price, and so on. Incorporation of additional macroeconomic predictive variables such as industrial production or inflation is another interesting research topic.

APPENDIX

Section A1 presents asset pricing tests in a time-series context, while Section A2 discusses cross-sectional asset pricing tests.

A1. Time-Series Tests

Following Cochrane [2005, ch. 12], we consider a linear multifactor model with observable factors and start with the linear return-generating process:

$$r_{i,t+1} = \alpha_i + \beta_i' r_{p,t+1} + \varepsilon_{i,t+1}, \quad i = 1, \ldots, N \text{ and } t = 1, \ldots, T. \quad \text{(A.1)}$$

Our notation is the following: $r_{i,t+1}$ is the difference between the observed return on asset i and the observed return on the risk-free asset at time $t+1$; $r_{p,t+1}$ is a vector of excess returns on the risk factor-mimicking portfolios; α_i is the population intercept coefficient, and β_i is the population slope coefficient. For the simple market (or Sharpe-Lintner-Black) model, $r_{p,t+1}$ is the difference between the observed return on the market portfolio and the observed return on the risk-free asset at time $t+1$. In that case, the index of systematic risk of asset $i-\beta_i$, popularly referred to as beta—is the degree to which an asset co-varies with the market portfolio.

Several recent studies suggest that a conditional version of (A.1) dramatically improves the overall performance of the market model; and a time-varying beta may, in fact, help explain the size and value effects [Jagannathan and Wang 1996; Lettau and Ludvigson 2001; Lustig and Van Nieuwerburgh 2005; Santos and Vernosi 2006 and Kang and others 2011]. Those studies argue that it is worthwhile to think that the covariances of asset returns can be time-varying. So, one needs to test conditional versions of the market model by using a time-varying beta that captures a proxy for time-varying market risk exposures, such as:

$$\beta_{i,t} = Cov(r_{i,t}, r_{p,t} | I_t)[Var(r_{p,t} | I_t)]^{-1}. \quad \text{(A.2)}$$

It is important to note that I_t represents the information set available at time t which econometricians cannot observe. Following Ferson and Harvey [1999], we model time-varying parameters as linear functions of the predetermined instruments, and calculate the risk loadings of each portfolio using the modified version of (A.1) in conjunction with:

$$\beta_{i,t} = \beta_{0,i} + \beta_{1,i}' Z_t, \quad \text{(A.3)}$$

Z_t is an $L \times 1$ vector of mean zero information variables known at time t and the parameters of the model are $\beta_{0,i}$ and $\beta_{1,i}$. When we utilize the modified beta in the cross-sectional regression, they are based on the predicted version of (A.3), given by:

$$r_{i,t+1} = \alpha_i + (\hat{\beta}_{i0} + \hat{\beta}_{1,i}' Z_t) r_{p,t+1} + \varepsilon_{i,t+1}. \quad \text{(A.4)}$$

Overall, we calculate the alpha and betas of each portfolio using the market model, and two versions of the Fama and French [1993] model. In the simple Fama-French three-factor model $r_{p,t+1}$ is a 3×1 vector containing the excess market return, SMB (size factor), and HML (value factor); $\beta_{0,i}$ is 3×1, and $\beta_{1,i}$ is $3 \times L$. For the extended Fama-French model, we use skewness of excess market return as an additional explanatory variable. Following Adrian and Rosenberg [2008], we use daily return data to estimate market skewness and utilize the normalized estimate of the sample skewness within each month. For example, for daily data $\{y_1, \ldots\ldots, y_n\}$, the formula for skewness is

$$Skew_t = \frac{\mu(y_t)_3}{\mu(y_t)_2^{3/2}},$$

where $\mu(y_t)_2$ and $\mu(y_t)_3$ are the second and third central moment of y_t. Using the lagged value of skewness solves its orthogonality problem with excess market return.

A2. Cross-Sectional Test Methodology

We use the Fama and MacBeth [1973] methodology in our cross-sectional asset pricing tests. In this approach, returns are regressed each month ($t = 1, \ldots T$), cross-sectionally, on a set of predetermined attributes of the portfolios by the following:

$$r_i = \alpha' e + \gamma_t \beta_i + \delta_t Q_i + \eta_i, \quad \text{(A.5)}$$

where $r_i = (r_i, \ldots\ldots, r_N)$ is an $N \times 1$ vector of cross-section excess returns, $\beta_i = (\beta_1, \ldots\ldots, \beta_N)$ is $N \times 1$ estimated betas, Q_i is additional cross-sectional variables, η_i is an $N \times 1$ vector of a cross-section of error terms, α is an $N \times 1$ vector of intercepts, e is an $N \times 1$ vector of ones, and γ_t and δ_t are scalar cross-sectional coefficients at time t. In our case, these attributes include beta estimates or firm characteristics such as logarithm of size and book-to-market ratio of the portfolio, as in Fama and French [1992]. The standard Fama and MacBeth [1973] estimators are the time-series averages of the parameter estimates from equation (A.5). To test the hypothesis that the excepted coefficient is zero, we form t-statistics defined as the time-series average of the monthly cross-sectional coefficients divided by the standard error of the mean. For example, we test H_0: $\gamma \equiv E(\gamma_t) = 0$ (that is, zero risk premium on the betas) against the alternative that H_1: $\gamma \equiv E(\gamma_t) > 0$ (that is, positive risk premium on the betas) using the following t-statistic

$$t_\gamma = \frac{\tilde{\gamma}}{s.e(\tilde{\gamma})},$$

where

$$\tilde{\gamma}=\frac{1}{T}\sum_{t=1}^{T}\hat{\gamma}_t$$

and

$$s.e(\tilde{\gamma}) = \sqrt{\frac{1}{T(T-1)}\sum_{t=1}^{T}(\hat{\gamma}_t - \tilde{\gamma})^2}\,.$$

A similar procedure holds for δ.

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