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International Asset Pricing Models: A Forecasting Evaluation

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Abstract

This paper assesses the ability of several international asset pricing models in forecasting the cross-sectional variation in expected returns. With national market portfolios, only the International CAPM with exchange risk can pass the test and performs the best. However, my empirical work suggests that the hypothesis of zero pricing errors can be rejected for any specification when the country value-minus-growth portfolios are taken to be the test assets. To reach this conclusion I use the Fama-MacBeth two-pass regression approach, with Shanken corrected standard errors.

Keywords: International Asset Pricing; Value Factor; Exchange Rate Risk; Production Risk; Time-Varying Betas; Out-of-Sample Forecasting; Fama-MacBeth Two-Stage Regression Method.
JEL Classification Codes: G12; F21; F31.

1. Introduction

In an international context, if purchasing power parity (PPP) does not hold continuously, investing in foreign markets entails exposure to exchange rate risks. Any investment in a foreign asset is a combination of an investment in the performance of the foreign asset and an investment in the performance of the domestic currency relative to the foreign currency. The presence of this additional source of risk should be considered in the asset pricing models (Solnik, 1974; Stulz, 1981; and Adler and Dumas, 1983). Empirically, Dumas and Solnik (1995) support the existence of a foreign exchange risk premium by using a conditional approach that allows for time variation in the rewards for exchange rate risk. De Santis and Gerard (1998) estimate the conditional version of an International Asset Pricing Model. Their findings strongly support a model that includes both market and foreign exchange risk.

Outside the direct context of the CAPM, the Fama and French (1992, 1993, 1996) three-factor model has been used in the international environment. Fama and French (1998) argue that the standard CAPM cannot explain returns in a cross-section of national value portfolios while their multi-factor model can capture the value premium in international returns. However they assume a world in which capital markets are integrated and investors are unconcerned with deviations from purchasing power parity. Thus, they ignore other risk factors that might affect expected returns.

Dahlquist and Sallstrom (2002) examine whether an International CAPM outperforms an international version of the empirical three-factor model. They estimate and evaluate the models for the national market portfolios, the global portfolios sorted according to earnings-price ratios and market values, and the global industry portfolios by applying the generalized method of moments (GMM).

They find that all the models considered seem to capture national market returns fairly well. An International CAPM without foreign exchange risk cannot explain the variation in average returns of the characteristic-sorted industry portfolios, even when allowing for time-varying expected returns. While an asset pricing model, which includes foreign exchange risk, is able to explain nearly 60% of the variation in average returns. Their empirical work suggests that the International CAPM with exchange risk has at least the same explanatory ability as the international three-factor model.

Zhang (2006) evaluates the cross-sectional pricing performance of the aforementioned international asset pricing models— the International CAPM without exchange risk, the International CAPM with exchange risk, and the international version of the Fama-French three-factor model with size effect. The comparison metric is the Hansen-Jagannathan (1997) distance, and the base assets are size and book-to-market portfolios from the US, the UK and Japan. By allowing time-varying betas and risk premiums, most of the conditional models can capture the cross-sectional return spreads and can pass the test. The Fama-French factors are redundant in conditional models. Exchange risk exposures contribute significantly to the international asset returns, and the conditional International CAPM with exchange risk performs the best.

As identifying the systematic risk factors for cross-sectional average returns is still an ongoing project, one can see from above that current international asset pricing models have received considerable support in terms of their in sample explanatory ability. Nevertheless, the literature gives very little information regarding these models' out-of-sample forecasting power. The forecasting capability of the asset pricing models can provide crucial guidance for investors' portfolio formation decisions and for firms' capital structure, capital budgeting decisions. It also makes the assessment of the asset pricing models more complete. Hence, in this paper, I focus on evaluating the forecasting performance of the following international asset pricing models— the standard CAPM (without exchange rate risk), the international CAPM (with exchange rate risk), the Fama-French three-factor model and the international version of the Lucas (1978) production-based CAPM. I employ the Fama and MacBeth (1973) two-stage regression approach (hereafter FM). The FM method allows for time-varying risk exposures [1] and more importantly, it provides a direct and applicable assessment of a model's out-of-sample predictability while methods used in other studies such as the GMM, the Hansen-Jagannathan distance and the maximum likelihood does not.

This paper is organized as follows. Section 2 presents the international asset pricing models that are being assessed. Section 3 explains the methodology employed and the evaluation criteria. Section 4 describes data and the preliminary statistics. Section 5 provides the empirical results. Section 6 concludes.

2. International Asset Pricing Models

2.1. The Standard CAPM

Suppose the relevant model is the Standard CAPM. Then the global market portfolio is mean-variance efficient, and the dollar expected return on any security or portfolio, R, is fully explained by its loading on the dollar global market return, M. Employing the U.S. one-month Treasury bill as the risk free asset (with return F), equation (1) provides the form of the Standard CAPM model:

$$R\text{-}F= \alpha + \beta\,[M\text{-}F] + \varepsilon, \qquad (1)$$

2.2. The Two-Factor Model (Fama and French, 1998)

Equation (2) reflects the Fama and French two-factor model in an international context. The two factors are the global market return and the difference between the returns on global value (high book-to-market: H) portfolios and global growth (low book-to-market: L) portfolios.

$$R\text{-}F = \alpha + \beta_1[M\text{-}F] + \beta_2[H\text{-}L] + \varepsilon, \qquad (2)$$

[1] So I assume the model holds conditionally in terms of rolling betas. However, in this study, time-varying risk premiums are not considered.

I ignore the size factor and use here a two-factor model as in Fama and French (1998) because my base international asset returns from MSCI include only large firms. A set of indexes consisting of large firms only does not allow meaningful inclusion of a size effect. See Banz (1981) for US returns and Heston, Rouwenhorst, and Wessels (1995) for international returns. Fama and French argue that the two-factor model in equation (2) provides a better description of country value portfolios. The GRS F-test [2] clearly rejects equation (1), the standard CAPM when exchange rate risk is not considered.

2.3. The International CAPM

"*When PPP does not hold, the heterogeneity of portfolio-choice behaviors limits the aggregation of individual demands into a CAPM*" (Adler and Dumas 1983, p. 928). Equation (3) is obtained based on equation (16) from Adler and Dumas (1983), except that I only include three key exchange risks here.

$$R\text{-}F = \alpha + \beta_1[M\text{-}F] + \beta_2[Pound\text{-}F] + \beta_3[Mark\text{-}F] + \beta_4[Yen\text{-}F] + \varepsilon, \quad (3)$$

The extension of the CAPM to a multi-country case leads to a multi-factor solution for the pricing of assets. The new factors are the excess returns on assets that are perfectly correlated with the exchange rate appreciations for each currency but the benchmark currency. For efficiency purpose, Dumas and Solnik (1995), De Santis and Gerard (1998), Dahlquist and Sallstrom (2002) and Zhang (2006) use three important currencies to test the existence of an exchange risk premium. This paper considers the same three currencies: the British Pound, the German Mark, and the Japanese Yen (the United States is the reference country). Pound, Mark, and Yen in equation (3) represent the returns of the assets that are perfectly correlated with the exchange rate appreciations for these three currencies.

To find these returns, practically, let's select one existing zero-net-investment choice: borrowing in the reference country and investing in a foreign country's risk free asset, for example, German Treasury bills. Then the actual Dollar return for this asset would be the return on the German Treasury bill minus the appreciation of the Dollar over the Mark (or plus the appreciation of the Mark over the Dollar).

In more detail, suppose one investor borrows a dollar at the end of January, exchanges this one dollar to the German Mark at the nominal exchange rate s_1 (German Mark/US dollar) and invests s_1 German Marks in the German Treasury bill. Suppose the February German Treasury bill rate is i_2. Then at the end of February, the investor ends up with $s_1(1+i_2)$ German Marks. To convert to a dollar return, divide this amount $s_1(1+i_2)$ by the end-of-February nominal exchange rate s_2. So the February dollar return is given by $\frac{s_1(1+i_2)}{s_2}$. Take the natural logarithm to obtain the continuous net return. Note that when $\ln(s_1/s_2)$ is positive (the US dollar depreciated during the period), the investor gains more than the risk free rate from investing in the foreign asset. When $\ln(s_1/s_2)$ is negative (the US dollar appreciated during the period), the actual return is lower than the risk free rate because the payoff is worth less in terms of the dollar. If we consider the risk free rate to be relatively constant, the return on this investment mostly reflects the exchange rate risk. With the same procedure, I find the factor returns for the Japanese Yen and the British Pound.

Why are these extra factors affecting expected returns? From a foreign consumer's perspective, utility varies not just because of variation in wealth but also because of variation in the purchasing power of the wealth. For given returns denominated in the foreign currency their purchasing power would be less when the domestic currency appreciates. Investors in the foreign market may hedge against this kind of risk by holding their own currency.

2.4. The Production-Based CAPM

The Lucas production-based asset pricing formula can be described by equation (4), where Y represents the growth rate of aggregate production. The return on an asset perfectly correlated with

[2] Gibbons, Ross and Shanken (1989) analyze a test for the ex ante efficiency of a given portfolio of assets. The null hypothesis of joint significance of the estimated intercepts across a set of equations is tested based on a central F distribution.

aggregate production is measured by a + b Y; a and b are parameters that transform the growth rates of aggregate production to returns.

$$R - F = \gamma + \theta\,[(a + b\,Y) - F] + \varepsilon = \alpha + \beta_1 Y + \beta_2 F + \varepsilon, \quad (4)$$

where $\alpha = \gamma + a\,\theta$, $\beta_1 = b\,\theta$, $\beta_2 = -\theta$.

3. Methodology

I employ the Fama and MacBeth (1973) two-stage regression methodology. Because my focus is on already well-specified international portfolios with considerable return variation, there is no need for portfolio formation. Consider the example of the International CAPM model. In the "first pass", I regress equation (3) with time series data of R, F, M, Mark, Yen and Pound to get the estimated factor loadings $\hat{\beta}_1$, $\hat{\beta}_2$, $\hat{\beta}_3$ and $\hat{\beta}_4$ for each selected portfolio. Fama and French (1992) estimate betas in the first pass based on the full sample time period (from July 1963 to December 1990, 330 months). By doing so they assume the true betas of the portfolios do not vary over time, or are, at least, stationary. Here I discard this assumption and allow betas to vary over time. So in my first pass, I estimate betas based on only 5 years of monthly data.[3] In more detail: the first set of betas for each country portfolio was obtained with time series data from January 1977 to December 1981 (60 months). The second set of betas was obtained with time series data, one month forward, from February 1977 to January 1982, again 60 months. The third beta estimation series starts with March 1977 and the rolling process repeats until I reach the last month, December 2006.

In the "second pass", Fama and French (1992) regress the cross-section of stock returns on the unique set of betas they estimate in the first pass month-by-month then calculate the average slopes that provide the standard FM tests. In my second pass I do the same except that my betas vary over time. To assess the model's out-of-sample forecasting ability, lagged estimated betas are used to explain future stock returns. I regress the January 1982 cross-sectional stock returns (the 61st month of the full time period, or one month ahead right after the first time series sample period used to estimate betas) on the first set of betas ($\hat{\beta}_1$, $\hat{\beta}_2$, $\hat{\beta}_3$ and $\hat{\beta}_4$), see equation (5). And I regress the February 1982 cross-section of stock returns (the 62nd month among the whole time period, or one month ahead right after the second time series sample period used to estimate betas) on the second estimated set of betas. Continuing this process month by month I end up with a series of "second pass" intercepts and regression slopes for each hypothesized explanatory variable.

$$R - F = a_0 + a_1\,\hat{\beta}_1 + a_2\,\hat{\beta}_2 + a_3\,\hat{\beta}_3 + a_4\,\hat{\beta}_4 + e, \quad (5)$$

where $\hat{\beta}_1$, $\hat{\beta}_2$, $\hat{\beta}_3$ and $\hat{\beta}_4$ are the coefficient estimates from the first pass based on equation (3).

The estimated series of $\hat{a}_0$, $\hat{a}_1$, $\hat{a}_2$, $\hat{a}_3$ and $\hat{a}_4$ are then averaged over all time periods in the second pass (300 months in my sample) to provide the criteria for evaluating the model. If the pricing error, measured by the intercept $\hat{a}_0$, deviates significantly from zero then the model cannot price assets well on average. The model is also assessed by seeing if $\hat{a}_1$, $\hat{a}_2$, $\hat{a}_3$ and $\hat{a}_4$ deviate significantly from their corresponding actual mean risk premiums $\overline{M} - \overline{F}$, $\overline{Pound} - \overline{F}$, $\overline{Mark} - \overline{F}$, $\overline{Yen} - \overline{F}$ and by a cross-sectional adjusted R-square. Significance here is based on the t-statistic, dividing each average estimated coefficient by its standard error. The problem of generated regressors in the second stage can be resolved by using Shanken (1992) corrections.

The same methodology and evaluation criteria apply to the other asset pricing models with the exception of the production-based CAPM. Note that in equation (4), Y represents the growth rates of aggregate production, not actual returns. Hence in the second pass, one can not assess the model based

[3] There is a trade off between more accurate beta estimation by using a longer time period and misestimation due to drift in beta over time. Five years of monthly data (60 observations) is the norm in estimating betas (see Alexander and Chervany, 1980).

on the mean estimated intercept. But we can still compare the estimated average slopes on betas with the actual means of Y and F.

4. Data and Preliminary Statistics

In this paper I investigate returns on the market, value, and growth portfolios from the following 16 countries— Australia, Belgium, Canada, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Singapore, Spain, Sweden, Switzerland, the UK and the US. All the portfolio returns and the US one-month T-bill rates are directly from Kenneth French's homepage.[4] I use the monthly end-of-period exchange rates for Mark, Yen, and Pound (Dollar is the base currency) from International Financial Statistics (IFS). I further use the appropriate IFS Treasury-bill rates as risk free returns for Germany and the United Kingdom. For Japan I use IFS "money market rates" as the risk free asset returns. All dollar returns are monthly. The time period is from January 1977 to December 2006 (the longest available time period common to all my variables).

Table 1 shows a significant positive global market excess return, 0.65% monthly, and a value premium, 0.55% monthly, during the period from January 1982 to December 2006 (300 months in the second pass). No significant excess returns are observed for the assets that are perfectly correlated with country exchange rates.

Table 1: Statistics for the Hypothesized Explanatory Variables
M is the global market return. F is the one-month U.S. Treasury bill rate. H-L is an international version of HML, the distress factor in the three-factor model in Fama and French (1993). H-L represents the difference between the returns on global value (high book-to-market: H) portfolios and global growth (low book-to-market: L) portfolios. M, F and H-L are from Kenneth French's homepage (see footnote 4). Mark, Yen, and Pound represent the returns on investing in the German, Japanese, and United Kingdom risk free assets respectively in dollar terms. The exchange rate information and the risk free asset return for Germany, Japan and the United Kingdom are from IFS. The world industrial production Y, is from IFS too. Mean is the average monthly excess return over the 300 months (second pass) in my sample; Std. is the standard deviation of each excess return; t is the ratio of the average return to its standard error. All dollar returns are monthly. The time period is from January 1982 to December 2006.

Excess Return	Mean	Std.	t value
M-F	0.65	4.81	2.34
H-L	0.55	2.76	3.43
Pound-F	0.19	3.00	1.08
Mark-F	0.08	3.12	0.44
Yen-F	0.0027	3.25	0.01
Y	0.17	5.60	0.54
F	0.43	0.21	36.43

Table 2 provides excess return statistics for the 16 country market portfolios and the 16 country value-minus-growth portfolios. The value-minus-growth portfolios were chosen for more dispersion in the cross-sectional returns. The global market excess return and the global

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

Table 2: Statistics for Country Portfolio Excess Returns
Excess returns here refer to the excess returns on market, high book-to-market (value), and low book-to-market (growth) portfolios for individual countries and the world. Mean is the average monthly excess return over the 300 months in the second pass in my sample; Std. represents the standard deviation; t is the ratio of the average return to its standard error. These portfolio excess returns are denoted by R-F in equations (1), (2), (3) and (4). The time period is from January 1982 to December 2006. The individual countries are (in order): Australia, Belgium, Canada, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Singapore, Spain, Sweden, Switzerland, the United Kingdom and the United States.

	Market Portfolios			Value-Minus-Growth Portfolios		
	Mean	**Std.**	**t**	**Mean**	**Std.**	**t**
AUS	0.77	6.46	2.07	0.55	3.82	2.51
BEL	1.13	5.37	3.65	0.64	4.59	2.43
CAN	0.59	5.11	2.00	0.21	4.90	0.75
FRA	0.99	5.84	2.93	0.55	4.73	2.00
GER	0.83	6.08	2.36	0.53	4.50	2.06
HKG	0.99	8.57	2.01	0.27	5.89	0.79
ITA	0.80	7.08	1.95	0.26	4.66	0.96
JPN	0.45	6.78	1.15	0.84	5.28	2.75
NLD	1.01	5.05	3.45	0.42	5.56	1.30
NOR	0.99	7.07	2.43	0.33	7.45	0.78
SIG	0.51	7.19	1.24	0.67	6.06	1.90
SPN	1.08	6.47	2.90	0.55	6.03	1.57
SWE	1.16	6.88	2.91	0.56	6.44	1.50
SWT	0.82	4.88	2.90	0.38	4.42	1.48
UKM	0.79	4.94	2.78	0.28	3.57	1.35
USA	0.68	4.34	2.70	0.46	3.11	2.56
World	0.65	4.81	2.34	0.55	2.76	3.43

value premium are also provided. Note that all country market excess returns are significantly positive except only two countries, Japan and Singapore. The value premium appears to be positive in all countries but it is significantly so in only 6 countries— Australia, Belgium, France, Germany, Japan and the US.

5. Results

5.1. Country Market Portfolios

Overall, the results in the literature suggest that an international asset-pricing model with or without foreign exchange risk captures national market returns fairly well.[5]

Table 3 lists the empirical results obtained via the methodology explained in section 3. The intercept represents the return after risk adjustment and should be insignificantly different from zero. Note that from Table 3, the intercept of the standard CAPM model is 0.93 with a t-value of 2.48, significantly different from zero both statistically and economically (11.75% annualized); the two-factor model generates an intercept of 0.68 with a t-value of 1.78, significantly different from zero both statistically (at the 10% level) and economically (8.47% annualized) while the intercept from the International CAPM is only 0.37 with a t-value of 0.89 (statistically insignificant). Hence, only the international CAPM with exchange rate risk can pass the FM test. The intercept from the production-based CAPM does not represent the pricing error as the growth rates of aggregate production (Y) are not returns therefore we can not assess this particular model based on the intercept.

5 See, for instance, Harvey (1991), Ferson and Harvey (1993), Dumas and Solnik (1995), Fama and French (1998) and Dahlquist and Sallstrom (2002). Karolyi and Stulz (2001) provide an overview.

Table 3: Two-Pass Regression Results for the Country Market Portfolios
The dependent variables are the 16 country market portfolio excess returns. The explanatory variables are the return on the global market portfolio in excess of the one-month U.S. Treasury bill return (M-F), the difference between the global high and low book-to-market returns (H-L), the excess returns obtained by borrowing dollars and investing in German, Japanese, and U.K. risk free assets (Mark-F, Yen-F, Pound-F) and the growth rates of aggregate production Y. Mean is the time series average of the intercepts, slopes and adj. R^2 from the month-by-month Fama-MacBeth (FM) regressions over the 300 months in my sample; Std. is the standard deviation of the coefficient estimates; t is the ratio of the average value to its Shanken corrected standard error. All dollar returns are monthly. The time period is from January 1977 to December 2006.

The Standard CAPM			
	mean	**std**	**t**
intercept	0.93	6.50	2.48
M-F	-0.18	7.27	-0.43
Adj. r square	0.05	0.13	
The Two-Factor Model			
	mean	**std**	**t**
intercept	0.68	6.62	1.78
M-F	0.02	7.25	0.04
H-L	0.22	4.81	0.79
Adj. r square	0.07	0.18	
The International CAPM			
	mean	**std**	**t**
intercept	0.37	7.21	0.89
M-F	0.38	8.00	0.82
Pound-F	0.36	5.26	1.19
Mark-F	0.18	4.90	0.64
Yen-F	-0.14	5.60	-0.43
Adj. r square	0.15	0.26	
The Production-Based CAPM			
	mean	**std**	**t**
intercept	0.82	4.70	3.02
Y	1.01	13.83	1.26
F	0.01	0.39	0.44
Adj. r square	0.07	0.18	

None of the hypothesized explanatory factors are significant in all models including the value factor which Fama and French strongly supported (t = 0.79). The international CAPM provides the closest estimated world excess return, 0.38 (the actual global market premium is 0.65, see table 1). It also has the highest adjusted r-square of 15%, though still notably low. When lagged betas are used to forecast future returns, the standard CAPM and the Fama-French two-factor model are no longer able to explain cross-sectional variations in national market portfolios. Neither is the production-based CAPM. Only the international CAPM with foreign exchange risk can pass the zero pricing error test and performs the best among all models examined.

5.2. Country Value-Minus-Growth Portfolios

Dahlquist and Sallstrom (2002) demonstrate that it is difficult to evaluate the ability of the asset pricing models to explain the cross-section of expected returns using national market portfolios. The reason for this is the low dispersion in the returns. To deal with this issue, country value-minus-growth portfolios[6] are also used as test assets in this paper. Results in Table 4 indicate that these portfolios pose a special challenge.

[6] Returns on these portfolios are obtained by subtracting each country's growth portfolio return from the same country's value portfolio return. Instead of using growth portfolios, value-minus-growth portfolios may have more return dispersion and therefore be good base assets to assess the ability of various asset pricing models.

Table 4: Two-Pass Regression Results for the Country Value-minus-Growth Portfolios
The dependent variables are the 16 country value-minus-growth portfolio returns. The explanatory variables are the return on the global market portfolio in excess of the one-month U.S. Treasury bill return (M-F), the difference between the global high and low book-to-market returns (H-L), the excess returns obtained by borrowing dollars and investing in German, Japanese, and U.K. risk free assets (Mark-F, Yen-F, Pound-F) and the growth rates of aggregate production Y. Mean is the time series average of the intercepts, slopes and adj. R^2 from the month-by-month Fama-MacBeth (FM) regressions over the 300 months in my sample; Std. is the standard deviation of the coefficient estimates; t is the ratio of the average value to its Shanken corrected standard error. All dollar returns are monthly. The time period is from January 1977 to December 2006.

The Standard CAPM			
	mean	**std**	**t**
intercept	0.40	2.09	3.31
M-F	-0.13	8.97	-0.25
Adj. r square	0.04	0.13	
The Two-Factor Model			
	mean	**std**	**t**
intercept	0.34	2.24	2.63
M-F	-0.15	9.22	-0.28
H-L	0.16	3.15	0.88
Adj. r square	0.05	0.19	
The International CAPM			
	mean	**std**	**t**
intercept	0.46	2.33	3.42
M-F	-0.53	9.11	-1.01
pound	0.25	7.14	0.61
mark	-0.31	8.02	-0.67
yen	-0.19	7.07	-0.47
Adj. r square	0.10	0.24	
The Production-Based CAPM			
	mean	**std**	**t**
intercept	0.47	1.93	4.22
Y	0.39	13.15	0.51
F	0.00	0.31	0.00
Adj. r square	0.05	0.16	

All four specifications considered here are unable to capture reasonably the cross-section of returns on the country value-minus-growth portfolios. The null hypothesis of zero pricing errors is rejected (all intercepts are significantly different from zero). None of the hypothesized risk factors are significant. All the estimated market risk premiums are negative. The adjusted R-square is somewhat higher for the international CAPM but still quite low. In contrast to the encouraging in sample performance, the models work poorly in forecasting.

6. Concluding Remarks

In the international asset pricing literature, the world market risk premium, the foreign exchange risk premium and the Fama-French value premium seem to capture variations in expected returns reasonably well. How reliable are these factors when applied to predict and explain future returns?

This paper assesses the ability of several international asset pricing models in forecasting the cross-sectional variation in expected returns including the standard CAPM without exchange risk, the international CAPM with exchange risk, the Fama-French multifactor model and the Lucas production-based CAPM.

With national market portfolios, only the International CAPM with exchange risk can pass the test and performs the best. However, my empirical work suggests that the hypothesis of zero pricing errors can be rejected for any specification when the country value-minus-growth portfolios are taken to be the test assets. To reach this conclusion I use the Fama-MacBeth two-pass regression approach, with Shanken corrected standard errors.

The failure of the models may result from the fact that the constant risk premiums implied in the FM method misspecify the behavior of the underlying risks.[7] It may well be possible that the strict application of the FM procedure, requiring adequate out-of-sample performance, provides too high a hurdle for the current generation of asset pricing models.

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