The Extreme Bounds of the Cross-Section of Expected Stock Returns

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Abstract

Several empirical studies report violations of the asset-pricing model of Sharpe (1964), Lintner (1965), and Black (1972). But, there is no consensus on specification in this literature, as such studies typically consider only a limited number of explanatory variables and do not satisfactorily control for previous findings. Extreme bound analysis (EBA), an imperfect but useful remedy for model uncertainty, suggests that comparatively few factors are robust. Given the cross-section of expected stock returns from July 1963 through December 2000, three of 23 variables – market size as well as short and medium run lagged return – pass the traditional EBA decision rule given all possible 3-, 4-, and 5-factor models of monthly stock returns. This paper also explores several potential improvements to EBA, including explicit consideration of possible multicollinearity, which largely does not affect the results, as well as sample divisions, which suggest that fewer variables are sturdy correlates of returns.

* The views expressed in this paper do not necessarily reflect those of the Board of Governors of the Federal Reserve System or any member of its staff.

Introduction

A vast literature produces empirical findings that violate the asset-pricing model of Sharpe (1964), Lintner (1965), and Black (1972) (SLB). Rather than endeavour to classify such violations as either risk factors consistent with the efficient markets hypothesis or anomalies inconsistent with market efficiency, this study focuses on the statistical significance of previous findings. In short, the issue is that researchers too commonly consider only a very limited number of explanatory variables and do not satisfactorily control for previous work. This specification bias and model uncertainty raise suspicion that there are few commensurable results in the literature, and our understanding of the determinants of stock returns is therefore limited.

This study attempts to advance the literature on model uncertainty and empirical asset pricing studies in several ways. For example, previous applications of "extreme bound analysis" (EBA) use index-level return data (Durham (2000, 2001)), but the initial tests of the capital asset pricing model (CAPM) and the vast proportion of subsequent studies that report anomalies use firm- or portfolio-level data. Therefore, this study closely follows the research design of Fama and French (1992) and uses the cross-section of expected stock returns of NYSE, AMEX, and NASDAQ firms from the CRSP and COMPUSTAT data files from July 1963 through December 2000 (450 months). In addition to the application of EBA to more relevant data, this study explores several possible improvements to EBA. For example, EBA justifiably provokes concern about multicollinearity, and the following analyses incorporate a simple diagnostic indicator, the variance inflation factor (VIF), directly to the decision rules. Also, previous applications of EBA do not satisfactorily consider sample divisions, which is particularly germane to this research question. Division of the sample address two issues – the significance of robust factors in the complete sample to sub-samples and, conversely, whether "true"

anomalies are robust in sub-samples but arbitraged away over the 450-month total sample to produce an overall fragile result. Moreover, this paper addresses the concern in the EBA literature regarding the a priori distinction between "free" and "doubtful" variables (McAleer et al. (1985)), and the EBA in this paper also considers alternative dimensions of the model space and includes 3-, 4-, and 5-factor models for all variables and 6-factor models for those variables that are robust to smaller specifications.

The results suggest that few results are robust to alternative specification assumptions. Using the complete sample from July 1963 through December 2000, only three of 23 variables pass the traditional EBA criterion with the hypothesized signs, including short run lagged return, medium run lagged return, and market size. More lenient EBA criterion suggest that long run lagged return and sales to market equity (S/ME) are robust, and, given a subset of specifications that considers a simple measure of multicollinearity, book equity to market equity (BE/ME) and total assets to market equity (A/ME) passes the least restrictive EBA decision rule. With respect to sample divisions, the five 90-month sub-periods indicate that only one factor, short run lagged return, is robust in each sample division. Also, very few factors that are insignificant in the complete 450-month sample are robust to any EBA decision rule in any 90-month sub-sample, which generally suggests that few factors are arbitraged away. Consideration of the McAleer et al. (1985) critique produces mixed results, and expansion of the model space to 6-factor models indicates that short run lagged return, medium run lagged return, and market size are still robust to the traditional EBA decision rule.

The next section outlines the motivation for EBA and cites the model uncertainty across the empirical literature on stock market anomalies. Section II reviews EBA decision rules, and

Section III discusses the data design and identifies the variables used in the EBA. Section IV presents the traditional EBA results and discusses modifications to EBA. Section V concludes.

I. Model Uncertainty in Asset Pricing Studies

As Leamer (1983, 1985) suggests, the choice of right-hand side variables in a multivariate regression equation is necessarily based on an assumption.[1] Leamer argues that inferences are robust only if the specification assumptions are broad enough to be credible – that is, the assumptions include a wide set of possible independent variables based on previous literature – and the interval of inferences is narrow enough to be useful – that is, the coefficient estimates should be statistically significant given some conventional decision rule. Of course, a parameter estimate, however statistically significant, does not advance understanding of the dependent variable if the researcher must unduly narrow the conditioning information set and neglect alternative explanations. A finding that is statistically significant only under limited specifications assumptions is subject to specification bias.

As argued elsewhere, most empirical asset pricing studies that attempt to establish an empirical relation between a particular factor of interest and stock returns only consider a small number of select explanatory variables. In fact, the practitioner literature on index level returns includes several studies that do not control for any competing explanation (Durham (2000, 2001)). Academic and practitioner studies that use multivariate models but nonetheless exclude other key variables are still potentially susceptible to specification bias. These narrow

[1] The motivation for EBA appeals to the design of scientific experiments. Establishment of the ceteris paribus condition is crucial. If all things are not equal in an experimental design, then researchers cannot draw compelling inferences. Financial econometricians of course cannot conduct controlled experiments, but partial statistical correlations, controlling for competing explanations, approximate ceteris paribus.

specification assumptions have produced a diverse and confusing literature that collectively reports that a legion of variables violates the SLB model using firm- or portfolio-level data.

A thorough review of the conditioning information sets of every study that reports such significant results is not feasible, but perhaps a specific example among the vast number of studies will suffice to illustrate the issue. Consider, say, the path-breaking and careful study of Fama and French (1992, p. 439). They examine the statistical significance of six factors – market β, size, BE/ME, A/ME, leverage, and earnings-to-price – and test univariate to 5-factor models. A sizeable empirical literature addresses these six variables, but nevertheless, Fama and French still omit other variables that previous studies indicate affect stock returns. For example, they do not consider, among other variables, any price-history factors (DeBont and Thaler (1985)), and a researcher sympathetic to the contrarian view of stock market behaviour would therefore likely find their results incommensurable and thus unconvincing. In turn, subsequent studies that report statistically significant coefficients for price history variables also do not control for some key factors. For example, in another influential study, Jegadeesh and Titman (1993) control for size, market β, calendar phenomenon, and earnings announcement effects, but they do not consider, again among other factors, accounting-based variables such as BE/ME, which Fama and French (1992) find to be significant. Moreover, some variables are absent from both studies. For example, neither Fama and French (1992) nor Jegadeesh and Titman (1993) control for economic variables in the arbitrage pricing theory (APT) literature (Chen et al. (1986)). In short, the varying specification assumptions across these two studies,[2] and indeed the

[2] Fama and French (1996) subsequently consider a broader set of factors, including those in Jegadeesh and Titman (1993) but nonetheless do not consider a number of variables included in χ. (Again, a complete review of every conditioning information set in the literature is not possible.)

general literature as a whole, limits the confidence researchers can have in either of them, or indeed in any single study in the literature.[3]

II. The Mechanics of EBA

The rudiments of EBA can be found elsewhere (Levine and Renelt (1992)), Sala-i-Martin (1997a, 1997b)), but a brief review of the basic decision rules is necessary. EBA evaluates the sensitivity of a variable in question to alternative conditioning information sets. The procedure entails regressions of the form

(1)

$$Y = \alpha_j + \beta_{zj} z + \beta_{fj} \mathbf{f} + \beta_{xj} \mathbf{x}_j + \varepsilon$$

where Y is the dependent variable, z is the "doubtful" variable of interest, $\mathbf{f}$ is the set of "free" variables that appear in every regression, and $\mathbf{x}$ includes k variables from a set of other doubtful variables, χ. The EBA entails running M regressions covering every possible linear combination of a set number of variables from χ in $\mathbf{x}$, as the researcher must stipulate the total number of factors in the underlying regression equations following (1). For each model j, there is an estimate, β_{zj}, and a standard error of the estimate, σ_{zj}. Assuming that all models are of the same factor size, n, the total possible number of regressions for the M n-factor models is

(2)

$$\frac{k!}{(k-n)!\times n!}$$

[3] All scientific disciplines subject inferences to fragility tests (Leamer (1983, 1985)), and of course, specification bias besets empirical studies in other areas of economics. Economists have routinely applied EBA to the study of the demand for money (Cooley and LeRoy (1981), Hess et al. (1998)) and economic growth (Levine and Renelt (1992), Sala-i-Martin (1997a, 1997b)).

Given the estimates from (1), this paper uses three alternative decision rules. The traditional criterion (Levine and Renelt (1992)) essentially states that each β_{zj} should have the same sign, and each t-statistic among the *M* regressions should be greater than some predetermined value for a variable to be "robust." Otherwise, the "doubtful" variable is "fragile." Equivalently, the upper and lower extreme bounds among the *M* regressions follow

(3)

$$\beta_{zj} \pm \tau\sigma_{zj}$$

where τ is the stipulated t-statistic, and the extreme bounds must have the same sign. The precise value of τ is somewhat arbitrary but follows conventions in hypothesis testing. Levine and Renelt set τ equal to 2 (confidence at 4.55 percent), and this study also refers to 1.645 (confidence at 10 percent).

A more lenient criterion (Granger and Uhlig (1990)), the "R^2 decision rule," stipulates that the extreme bounds be chosen from a subset of the *M* models that meet some threshold of overall fit. The motivation for this alternative is that the particular models that produce the extreme bounds in the traditional criterion (3) might be inferior or flawed in some way to other specifications among all possible *M* regressions. The rule stipulates that only models that satisfy

(4)

$$R^2_j \geq (1-\alpha) \times R^2_{max}$$

– where R^2_{max} is the highest R^2 value among all M regressions, and $0 \leq \alpha < 1$ – inform the determination of the extreme bounds. The chosen parameter, α, determines the particular threshold but is ultimately arbitrary. Of course, if α is equal to zero, then only the model with the best fit among the *M* regressions informs the estimate. The following application follows

Granger and Uhlig (1990) and sets α equal to 0.1, and the bounds follow (3) given the subset of models that satisfy (4).

In addition to the arbitrary specification of α, another potential problem with narrowing the bounds based on overall fit measures concerns multicollinearity, discussed in greater detail in Section IV. Regressions that have comparatively high R^2 values but no statistically significant independent variables often exhibit multicollinearity. The R^2 decision rule, based simply on the overall fit measure, would by definition include such regressions in the subset of models that inform the bounds and therefore increase the likelihood of fragile results.

Finally, the "CDF decision rule" closely follows the test outlined in Sala-i-Martin (1997a, 1997b). This alternative also considers the overall fit of the j^{th} model, but all M regressions still inform the estimates of the bounds. Sala-i-Martin weights the M estimates of β_z and σ_z by some measure of overall fit for the underlying j^{th} regression and uses the cumulative distribution function (CDF), a confidence interval for robustness. The weights, w_{zj}, in this study follow use the (adjusted) R^2, as in

(5)

$$w_{zj} = \frac{R^2{}_{zj}}{\sum_{i=1}^{M} R^2{}_{zi}}.$$

The weighted estimates follow

(6)

$$\hat{\beta}_z = \sum_{j=1}^{M} w_{zj}\beta_{zj}$$

and

$$\hat{\sigma}^2{}_z = \sum_{j=1}^{M} w_{zj}\sigma^2{}_{zj} \tag{7}$$

The decision rule in this paper is that z is robust if both the weighted normal and non-normal CDFs are greater than or equal to 0.95.[4]

III. Data and Research Design

This section outlines the data and research design for the EBA and includes details with respect to the composition of χ, the particular sample of the cross-section of expected stock returns, the underlying (Fama-MacBeth) regressions that produce the estimates of β_{zj} and σ_{zj}, and the factor space of the EBA.

A. The Doubtful Variables

This study examines the robustness of 23 possible correlates of total monthly stock returns. While these factors are clearly distinct, each can crudely be subsumed under factor groups related to size, accounting-based measures of the price level of the firm, price history or technical patterns, proxies for firm growth potential, and systemic risk. (Additional details are in

[4] Sala-i-Martin outlines different calculations of the CDF based on alternative assumptions regarding whether the estimates of β_z are normally distributed. In contrast to Durham (2000, 2001), this application of the CDF tests for the normality of the distribution using the Shapiro-Wilk tests with respect to skewness and kurtosis. These tests largely suggest that the hypothesis that the β_z estimates are normally distributed can be rejected. Following Sala-i-Martin (1997a, 1997b) for non-normal distributions, the aggregate CDF follows

$$\Phi z = \sum_{j=1}^{M} w_j \Phi_j \left(0 / \beta_{zj}\sigma_{zj}\right),$$

which is the weighted sum of the individual (normal) CDFs for each estimate of β_{zj} and σ_{zj} from the M regressions.

Appendix I.) Also, following the literature, measurement of each variable is consistent with a realizable investment strategy.[5]

The size effect is perhaps the most researched empirical anomaly vis-à-vis SLB. In the seminal study, Banz (1981) finds that market equity (ME), a firm's stock price times shares outstanding) explains considerable cross-sectional variation in stock returns. Average returns on stocks with low ME are too high, controlling for market β, and average returns on stocks with high ME are too low. Brown et al. (1983), French and Fama (1992, 1993), Haugen and Baker (1996) and many others subsequently document this correlation. In this study, following Fama and French (1992), ME in June of year t is matched with returns from July of year t through June of year $t - 1$, and the expected coefficient is negative.

The accounting based measures include six variables in χ. A vast empirical literature tests the ratio of a firm's book value of common equity to its market value (BE/ME) (Stattman (1980), Rosenberg, Reid, and Lanstein (1985), Fama and French (1992), Pontiff and Schall (1998)) and the ratio of earnings to market value (E/P) (Basu (1983)). Also, the doubtful set includes the dividend yield (D/P) and the ratios of cash flow (Lakonishok et al. (1994)), sales, and assets to market equity (CF/ME, S/ME, and A/ME, respectively). The expected coefficients on all six variables are positive.

The accounting based ratios essentially represent alternative ways to scale stock prices (Keim (1983)). Following Fama and French (1992), to ensure that market participants know the accounting variables before the returns are realized, the COMPUSTAT accounting data for all fiscal yearends in calendar year $t - 1$ (1962-2000) are matched with the CRSP returns for July of year t to June of year $t + 1$. As Fama and French (1992) suggest, the 6-month minimum gap is

[5] χ does not purport to comprise an exhaustive list of all published findings. Rather, as this section further suggests, data constraints become somewhat restrictive.

conservative. The firm's ME at the end of December of year $t - 1$ is the denominator of the accounting ratios.[6]

Technical analyses are based on the assumption that past stock returns contain information about future returns, and such chartist strategies based on price history are numerous (Malkiel (1996)). χ includes proxies for contrarian strategies in the short and long run as well as momentum (relative strength) strategies in the medium run. De Bondt and Thaler (1985) posit a negative correlation between past and future returns and argue that stock markets tend to overreact with excessive pessimism (optimism) following series of poor (exceptional) returns. The long run proxy in this study is the average monthly return from the 25- through the 60-month lagged return, and the expected sign is negative. With respect to the short run, Jegadeesh (1990) suggests that large orders create price pressure that causes returns to reverse direction. The proxy is the one-month lagged return, and the expected sign is negative. Relative strength strategies exploit medium run inertia in stock returns, and Jegadeesh and Titman (1993) find evidence of lagged reactions to earnings reports and therefore a positive correlation. The medium run proxy is the average monthly return from the 7- through the 12-month lagged return, and the expected sign is positive.

Factors that purport to capture firm profitability include profit margin, capital turnover, the return on assets (ROA), and the return on equity (ROE) (Haugen and Baker (1996)). Similar to the numerator of the accounting-based factors, data for these variables are measured for fiscal year $t - 1$ from COMPUSTAT and matched with returns from July of year t through June of year $t + 1$. The expected coefficient for these four variables is positive. Sales growth (Lakonishok et al. (1994)), measure as the percentage rank among all firms in the COMPUSTAT database

[6] The use of December ME in year $t - 1$ is objectionable for firms that do not have December fiscal yearends. But, ME at fiscal yearends is also problematic because "part of the cross-sectional variation of a ratio for a given year is

during fiscal year $t - 1$,[7] and a "glamour" proxy (Lakonishok (1994)), the interaction between the sales rank and the (percentage) rank of CF/ME, are also included in χ with expected positive and negative signs, respectively.

Finally, χ also includes seven alternative measures of risk. First and foremost, these include the post-ranking market β to test the CAPM, and the post-ranking procedure closely follows Fama and French (1992). That is, all NYSE stocks in CRSP are sorted on ME for each year using the June value. NYSE, AMEX, and NASDAQ stocks that have the required CRSP and COMPUSTAT data for the remaining doubtful variables are then allocated to five size portfolios based on the NYSE breakpoints for each year. Each size quintile is then divided into five portfolios on the basis of pre-ranking βs for individual stocks, estimated from 60 monthly returns in the five years before July of year t.[8] The size-β portfolios are rebalanced in June, and the equally weighted returns on each of the 25 portfolios is calculated for the next 12 months. The post-ranking β for each of the 25 portfolios[9] is the sum of the slopes in the regression of the size-β portfolio return on the current and prior month market return, measured by the CRSP value-weighted portfolio of NYSE, AMEX, and (after 1972) NASDAQ stocks, over the entire sample period (450 months). Finally, the full-period post ranking β of a size-β portfolio is assigned to each stock in the sample.[10]

Variables associated with arbitrage pricing theory (APT) are also included in χ. These factors comprise βs with respect to industrial production, the total return spread between 3-

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due to market-wide variation in the ratio during the year (Fama and French (1992, p. 430))."

[7] Given data limitations, this proxy differs from the 5-year (weighted) sales growth rankings in the literature (Lakonishok (1994)).

[8] Following Fama and French (1992), the β breakpoints for each size quartile are set with respect to NYSE stocks.

[9] Fama and French (1992) form 100 portfolios. Given the limited number of firms for which data on all doubtful variables are available, this study uses two quintile divisions on size and pre-ranking β to produce 25 size-β portfolios.

month Treasury bills and long-term government bonds, the total return spread between long-term corporate and government bonds (Chen et al. (1986)), and inflation (Haugen and Baker (1996)). The calculation of the βs follows Fama and French (1992), as the pre-ranking βs are formed with respect to economic state variables instead of the market proxy. Similar to the market β, the expected sign is positive.

Additional variables under the broad rubric of risk include firm leverage, total firm assets to the book value of total equity (A/BE) (Fama and French (1992)), and the interest coverage ratio (times interest earned), net operating income divided by interest expense (Haugen and Baker (1996)). The expected signs are positive and negative, respectively.

B. The Sample

The EBA covers all firms for which there are data in the intersection of the NYSE, AMEX and NASDAQ return files from CRSP and the merged COMPUSTAT annual industrial files of income-statement and balance-sheet data.[11] Following Fama and French (1992), the analysis uses COMPUSTAT data beginning in fiscal year 1962, and the data for all variables extend through December 2000.[12]

Given the requirement that firms in the sample have data on all 23 doubtful variables, the underlying *M* models typically include fewer cases than studies with more restricted

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[10] A stock's β is not necessarily constant – "a stock can move across portfolios with year-to-year changes in the stock's size (ME) and in the estimates of its β for the preceding 5 years (Fama and French (1992, p. 432))."

[11] CRSP data cover almost 90 percent of all firm-years for which COMPUSTAT data are available for all variables in the analysis. A dataset of firm-years for which there are no CRSP data is available on request.

[12] As Fama and French (1992, p. 429) explain, some series, including the book value of common equity, are not generally available prior to 1962. Also, COMPSTAT data before 1962 have considerable selection bias.

specification assumptions. The average number of firms in the monthly cross-sectional regressions for the 450-month sample is 646.[13]

C. Data Design: Fama-MacBeth Regressions

The purpose of this study is not to propose alternative estimation procedures for the underlying regressions that produce β_z and σ_z but to expand the specification assumptions and assess the sensitivity of previous findings to alternative conditioning information sets. Therefore, the estimation methods follow common convention in the literature, and the organization of the underlying regressions is similar to Fama and French (1992). The *M* models follow the familiar Fama-MacBeth (FM) procedure – β_{zj} and σ_{zj} are FM coefficients and standard errors, respectively, based on time-series averages of the monthly cross-sectional regression estimates.

Also similar to Fama and French (1992, given data constraints and, more importantly, that each variable in χ (besides of course the post-ranking market β and the APT βs) are measured precisely for individual stocks, there is no reason to waste information in these variables by forming portfolios. Therefore, the unit of analysis in the monthly regressions is the individual (firm) monthly stock return from CRSP.

[13] The average number of stocks in the monthly regressions in Fama and French (1992, p. 439) is 2267. In this study, the number of observations in the cross-section increases for more recent sample periods. For example, there are on average 124 firms in the regressions from July 1963 to December 1970, 310 from January 1971 to June 1978, 588 from July 1978 to December 1985, 871 from January 1986 to June 1993, and 1338 from July 1993 to December 2000.

D. EBA Design

Description of the details on this particular application of EBA is necessary. For example, the EBA does not follow (1) precisely because the underlying FM regressions include no **f** set. That is, the models resemble

(8)

$$Y = \alpha_j + \beta_{zj} z + \beta_{xj} \mathbf{x}_j + \varepsilon$$

where *Y* is the one-month stock return, and *z* and **x** are from χ. Therefore, (8) circumvents the arguably problematic distinction between "free" and "doubtful" variables in other applications of EBA (McAleer et al. (1985)), to be discussed in greater detail in Section IV. Also, this study follows common assumptions regarding model space and considers all possible 3-, 4-, and 5-factor models of stock returns. The total number of possible specifications or estimates of β_z and σ_z given the 23 factors is

(9)

$$\sum_{n=3}^{5} \frac{23!}{(23-n)! \times n!} = 9086 .$$

IV. EBA Results

The section outlines four sets of results based on the 9086 estimates of β_z and σ_z. The first is the application of EBA to the cross-section of expected stock returns with no restrictions on the underlying regressions. The remaining results address improvements to EBA, including a restricted EBA based on an indicator of multicollinearity, sample divisions that examine the stability of the estimates over time, and a relaxation of the assumption of an empty **f** set. In

addition, this section considers 6-factor models for those variables that are robust to the traditional EBA decision rule using 3-, 4-, and 5-factor models.

A. Total (450-month) Sample of *M* Regressions: Traditional, R^2, and CDF Criteria

As Table IA indicates, ME is robust to every decision rule, including the traditional criterion, as the lower and upper bounds (columns 3 and 4) among the 9086 regressions (column 1) are both negative and consistent with the hypothesis that returns decrease with ME. The lower and upper bounds (columns 7 and 8) for the subset of 123 regressions (column 10) that produce comparatively high R^2 values are necessarily also both negative, and ME also passes the CDF decision rule, as both the weighted (column 11) and non-weighted (column 12) CDF values are greater than 0.95.

Only one of the six accounting-based variables of the price level of the firm are robust to at most one EBA decision rule. For example, BE/ME is significant in approximately 67 percent (column 5) of the 9086 regressions, and the weighted coefficient (column 1)[14] is positive as hypothesized, but the upper and lower bounds have the opposite sign. As column 9 indicates, about 75 percent of the 32 regressions that have a comparatively high R^2 values produce statistically significant estimates, and therefore BE/ME also fails the R^2 decision rule. Similarly, the non-normal CDF is 0.947, and the factor thus narrowly fails the CDF criterion. The robustness of BE/ME seems particularly sensitive to whether **x** includes A/ME or S/ME. For example, column 6 (7) in Table IB, which examines the sensitivity of the estimates to the inclusion of each remaining variable in χ, indicates that only approximately 1.5 (15.1) percent of the regressions that include A/ME (S/ME) produce statistically significant estimates.[15] To the

[14] The weighted coefficient follows (6).
[15] The issue of potential multicollinearity between these variables is addressed shortly.

other extreme, BE/ME is significant in about 82.3 percent of the regressions that include ROE (Table IB, column 14).

E/P is clearly fragile and passes no EBA criterion. In fact, the weighted coefficient is perversely negative, and the estimate is significant with 10 percent confidence in only approximately 1.6 percent (column 6) of the 9086 regressions. D/P has a perversely negative weighted coefficient and is not robust to any decision rule, as about 19.3 percent of the *M* regressions produce significant estimates. The estimates for CF/ME produce a positive weighted coefficient as expected, but the parameters are only significant in about 37.2 percent of the *M* regressions, and the CF/ME is not robust to any EBA criteria. Also, A/ME has the expected positive weighted coefficient, but is only significant in about 65.2 percent of the 9086 regressions, and the CDF only passes the threshold under the normality assumption.

S/ME is robust to the CDF decision rule with a non-normal CDF of 0.990 and is therefore the only accounting based variable to pass an EBA decision rule. The factor does not pass the traditional criterion, as 87.3 percent of the *M* regressions are significant, or the R^2 decision rule, as 85.7 percent of the 28 regressions with comparatively greater R^2 values are significant. Table IB (column 2) indicates that S/ME is somewhat more sensitive to inclusion of BE/ME, as only 51.1 percent of the specifications that include BE/ME produce significant results.

The price history variables are largely robust to EBA. For example, one-month lagged return is significant with the expected negative sign in all 9086 regressions, and the variable passes every EBA decision rule. The weighted coefficient suggests that a one percentage point increase in returns in the previous month produces about a 6.1 basis point decrease in returns in

the current month, and the bounds range from –7.7 to –4.2 basis points.[16] The EBA also supports the hypothesis of medium run inertia in stock returns. Medium run lags returns are robust to the three EBA decision rules, and the weighted coefficient suggests that a one percentage point increase in average 7- to 12-month lagged return leads to an approximate 5.5 basis point increase in contemporaneous returns. The extreme bounds range from 1.8 to 9.9 basis points. Finally, some data support the long run contrarian hypothesis. For example, long run lagged return is robust to the CDF and R^2 decision rules, but the factor is not robust in all 9086 regressions, as about 82.9 percent produce significant estimates. As Table IB indicates, the factor is comparatively more sensitive to specifications that include either BE/ME or S/ME. Long run lagged return is only significant in 59.8 percent of these regressions.

The six factors that broadly relate to firm profitability are not robust. The results for profit margin, capital turnover, ROA, ROE, sales rank, and the glamour proxy do not pass any EBA decision rule. The glamour proxy produces the most significant results – about 25.3 percent of the regressions are significant, but the positive weighted coefficient contradicts the hypothesis. Profit margin and ROA also have perverse weighted coefficients.

The seven risk factors are largely fragile, and none are robust to the traditional or the R^2 decision rule. The post ranking β of the SLB model has a weighted coefficient that is positive as hypothesized, but only 13.7 percent of the 9086 regressions produce significant results with 10 percent confidence, and the factor is not robust to any EBA criterion. Turning to the APT related risk factors, the post ranking industrial production β is positive, consistent with the hypothesis, and significant in about 81.0 percent of the *M* regressions. The factor narrowly misses the R^2 decision rule, but both CDFs are greater than 0.95. The remaining post-ranking βs with respect

[16] Interpretation of the coefficients is instructive, given that some argue that EBA is preoccupied with statistical significance and does not satisfactorily consider the economic significance of doubtful variables (Temple (2000),

to the yield curve, the spread between corporate and Treasury bonds, and inflation have the expected positive weighted coefficients. The yield curve β, the corporate spread β, and the inflation β are significant in about 63.1 percent, 78.1 percent, and 53.0 percent of the *M* models, respectively. Also, each variable is significant in every regression that has a comparatively high R^2 value, but the lower and upper bounds do not have the same sign, and therefore these factors do not pass any decision rule.

The remaining risk proxies are clearly not robust to EBA. A/BE is only significant in about 2.2 percent of the M regressions with 10 percent confidence, and the interest coverage ratio is only significant, again with 10 percent confidence, in about 2.7 percent of the 9086 regressions.

B. Multicollinearity and the VIF Restriction

EBA understandably elicits some concern with multicollinaerity,[17] and previous applications with respect to index-level stock returns (Durham (2000, 2001)) as well as other research questions do not satisfactorily addresses the problem. Again, EBA entails all possible linear combinations of *n*-variables from χ, and some specifications are likely to be more problematic in this regard than others. Consider the extreme example of the 5-factor model that includes the accounting based variables BE/ME, E/P, D/P, CF/ME, and A/ME on the right-hand-side (as either *z* or in **x**). All of these factors scale price and are positively correlated with one another. Nonetheless, this model is one of the 9086 regressions that inform the traditional decision rule. The R^2 and CDF decision rules might exclude this specification on the basis of

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McCloskey and Ziliak (1996)).

[17] Leamer (1985, 312) argues that the complaint that EBA "does not deal with serial correlation, nonnormality, etcetera, is quite irrelevant…it is hardly reasonable to complain that brain surgery can't cure a hangnail." That said,

overall fit. But as discussed in Section II, these two EBA criteria do not exclude models with comparatively high overall fit but possibly severe multicollinearity. Therefore, failure to consider multicollinearity, which inflates σ_z and therefore widens the extreme bounds, increases the risk that the EBA will erroneously reject a variable as fragile.[18]

To address this issue, this section examines a modification of EBA that excludes regressions that exhibit a degree of multicollinearity based on the variance inflation factor (VIF) of the corresponding j^{th} specification.[19] The objective is to isolate instances in which multicollinear specifications, rather than specification bias, disqualifies an otherwise robust correlate. Indicators of multicollinearity are somewhat arbitrary, but most rule of thumb measures suggest that a VIF equal to 10 indicates a problematic degree of multicollinearity (Belsley et al. (1980)). The VIF restriction for the *M* models is more aggressive – a specification with a VIF greater than 5 does not inform the estimates. The EBA decision rules only apply to the subset of regressions that produce VIFs below the threshold.

Table IIA indicates that multicollinaerity is not problematic for most doubtful variables, even under this aggressive VIF restriction. None of the 9086 regressions produce VIFs > 5 for 14 of the 23 factors (column 1), including short run lagged return, medium run lagged return, long run lagged return, profit margin, capital turnover, ROA, ROE, sales rank, glamour, market

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EBA certainly does not preclude and is easily amenable to simple regression diagnostics, such as the use of VIFs in this section.

[18] Following Goldberger (1991), multicollinearity ultimately reflects the fact that there are insufficient data to produce statistically significant relations among a set of imperfectly collinear variables. The problem is secondary to satisfactory specification – multicollinearity is not a sufficient excuse for ignoring competing factors.

[19] The VIF is equal to

$$\frac{1}{1-R^2}$$

where R^2 is based on

$$z = \alpha_j + \beta_{xj}\mathbf{x}_j + \varepsilon.$$

β, the industrial production β, the yield curve β, the inflation β, and the interest coverage ratio. Of course, the EBA results for those variables are identical to those in Table IA.

Considering the variables for which multicollinearity is potentially problematic, 83 of the regressions summarized in Table IA for ME produce VIFs that exceed the threshold. But again, ME is nonetheless robust to all 9086 possible 5-factor models. Perhaps as expected, the VIF restriction indicates that the specifications for accounting-based variables produce the most severe multicollinearity. For example, the proportion of *M* regressions in Table IA that exceed the VIF threshold ranges from approximately 17 percent (BE/ME) to about 32 percent (E/P, D/P, and CF/ME).[20] But, even with the VIF restriction, E/P, D/P, and CF/ME do not pass any EBA decision rule, and S/ME similarly fails the extreme and R^2 decision rules. However, BE/ME and A/ME, which are fragile according to the results in Table IA, are robust to the CDF decision rule according to Table IB, as the weighted non-normal CDF values (column 12) are greater than 0.95. However, neither BE/ME nor A/ME pass the traditional or R^2 decision rules, as only 80.9 and 81.0 percent of the 7501 and 7316 regressions produce statistically significant estimates, respectively.

Also, about 3 percent of the *M* regressions for the post ranking corporate yield spread β exceed the VIF threshold, but the factor still fails all decision rules among the subset of 8837 regressions. Approximately 2 percent of the regressions for leverage (A/BE) exhibit multicollinearity, but the factor fails every EBA decision rule given the remaining 8875 regressions.

In sum, models that produce VIFs > 5 for *z* inform 21 of the EBA tests that indicate fragility in Table IA (across the eight variables). The VIF restriction indicates that only two of

[20] As Table IIB indicates, the VIF restriction eliminates all models for BE/ME that include A/ME in **x**. Also, the VIF restriction eliminates all β_z and σ_z estimates for E/P, D/P, and CF/ME that include the remaining two variables in **x**.

these results – the (non-normal) CDF decision rules for BE/ME and A/ME – are sensitive to multicollinearity. And again, the EBA for 14 of the 23 variables is not based on any regression that produces a VIF greater than the threshold. Therefore, while the issue is potentially problematic, the results in Table IA do not seem particularly beset by multicollinearity. More generally, multicollinearity need not preclude EBA of doubtful variables, and the VIF restriction can accommodate any threshold of concern.

C. Division of the Sample

Another shortcoming of previous applications of EBA regards satisfactory consideration of the stability of the decision rules over different sample periods, which is particularly germane to the study of expected stock returns.[21] Again, the EBA in Tables 1A and 2A refer to the averaged monthly cross-sections from the 37½-year period from July 1963 to December 2000 (450 months). Division of the sample address two questions. First, are the robust factors – particularly ME, short run lagged return, medium run lagged return – in the complete sample also sturdy given sub-periods of the data? Second, are some anomalies (or risk proxies) robust in such sub-samples but arbitraged away over the remaining months of the total sample, producing fragile results in Tables 1A and 2A?

To address this issue, Tables 3-7 outline the EBA results from five equal duration 90-month sub-samples of the July 1963 to December 2000 period.[22] This application includes the VIF restriction to consider multicollinearity. One limitation of sample divisions in general is that the t-statistics are averaged over fewer observations (90 versus 450 months), and therefore standard errors are based on fewer observations compared to the complete sample estimations.

[21] Applications of EBA to empirical determinants of economic growth, for example, are germane to pure cross-sectional underlying regressions (Levine and Renelt (1992), Sala-i-Martin (1997a, 1997b)).

Therefore, insignificant results might partially reflect the decrease in degrees of freedom rather than sample bias.

C.1. July 1963-December 1970

Table III indicates that only three variables – ME, short run lagged return, and the glamour proxy – pass at least one decision rule, and the remaining 20 doubtful variables, including medium run lagged return, are fragile for the sub-sample covering July 1963-December 1970. ME is significant in 85.2 percent of the 9086 regressions and in 93.6 percent of the 109 regressions that produce comparatively high R^2 values. But, consistent with Table IA, the factor passes the CDF decision rule for the period, and the weighted coefficient is negative as expected. The data indicate that one month lagged return passes the extreme and the R^2 decision rules. The weighted coefficient, –6.5 basis points per percentage increase in returns, is consistent with the hypothesis. Also, the glamour proxy passes the CDF decision rule, but only 57.2 percent of the *M* regressions are significant, and only about 6.5 percent of the 46 regressions with comparatively greater R^2 values produce significant estimates of β_z. Moreover, the weighted coefficient is positive, which contradicts the hypothesis.

C.2. January 1971-June 1978

As Table IV indicates, seven of the 23 factors pass at least one decision rule, but only two variables pass the traditional criterion using the sub-period from January 1971 through June 1978. Similar to the previous period, the weighted coefficient for ME is negative, as expected, and the estimate passes the CDF decision rule, but only about 30.2 percent of the regressions produce statistically significant estimates. Some data suggest that three accounting variables –

[22] Of course, anomalies can be arbitraged away within the 90-month sub-periods.

BE/ME, CF/ME, and A/ME – are robust, at least according to the CDF decision rule. Also, this sub-period is consistent with the results in the complete sample regarding price history patterns. One-month lagged return as well as medium run lagged return pass all decision rules with negative and positive weighted coefficients, respectively. Long run lagged return is robust to the CDF decision rule and has a negative weighted coefficient. None of the profitability or risk factors passes any decision rule.

C.3. July 1978-December 1985

According to Table V, four of the 23 variables pass at least one decision rule using data from July 1978 through December 1985. ME has the expected negative sign and is significant in 99.7 percent of the regressions and very narrowly fails the extreme criterion. However, ME is robust to the R^2 and CDF decision rules for the period. Also, consistent with the overall results, S/ME produces a positive coefficient as hypothesized and the result is robust to the CDF decision rule. The data from July 1978 through December 1985 also confirm the robustness of one-month lagged return, as the weighted coefficient is negative and statistically significant in all *M* regressions and therefore passes each decision rule. Medium run lagged return has the hypothesized positive coefficient and passes the R^2 and CDF decision rules. None of the profitability or risk factors pass any decision rule.

C.4. January 1986-June 1993

Table VI indicates that four of the 23 variables pass at least one EBA decision rule using data from January 1986 through June 1993. Again, S/ME has a positive weighted coefficient, is significant in about 60.0 percent of the *M* regressions, and passes the CDF decision rule. One-

month lagged return has a negative weighted coefficient and is robust to each decision rule, and medium run lagged return has a positive weighted coefficient and is also robust to each criteria. Long run lagged return is significant in 77.5 percent of the regressions and is robust, at least according to the CDF decision rule. None of the profitability or risk factors pass any decision rule.

C.5. July 1993-December 2000

Finally, Table VII indicates that five of the 23 factors are robust to at least one EBA decision rule using data for the most recent period. For example, D/P is significant in 48.3 percent of the *M* regressions and passes the CDF decision rule. But, the weighted coefficient is perversely negative. Turning to price history variables, one-month lagged return is again robust to each decision rule. The weighted coefficient is still negative, but the estimate of about –3.1 basis points is the smallest among the sub-sample estimates. Average medium run lagged return has the expected positive weighted coefficient, but the factor passes only the CDF decision rule. Two of the profitability variables pass the CDF decision rule. ROA is significant in 38.3 percent of the regressions, but the weighted coefficient is negative and contradicts the hypothesis. Also, the glamour proxy is significant in about 44.8 percent of the *M* regressions, and the weighted coefficient is negative as hypothesized. None of the risk factors is robust to any EBA decision rule.

C.6. Summary of Sample Divisions

In general, these results suggest that the results for the complete sample are somewhat sensitive to sample divisions. For example, eight of the 23 variables in Table IIA pass at least

one EBA decision rule with the VIF restriction, but only seven of these variables are robust to at least one EBA criterion in at least one 90-month sub-sample. Also, among the three variables that pass the traditional criterion in Tables 1A and 1B, only one-month lagged return is robust to all decision rules with the hypothesized negative sign in the five sub-periods. Average medium run lagged return is not robust to any decision rule in the July 1963 through December 1970 period, and some evidence suggests that the size effect has vitiated over time – ME is not robust to any decision rule using the two sub-periods after January 1986.

Also, few data indicate that anomalies are arbitraged away in the complete sample. Among the 15 variables that do not pass any EBA decision rule in Table IIB, none passes either the traditional or R^2 decision rules using any sub-period of the total sample. Only CF/ME passes the CDF decision rule with the expected weighted coefficient using data from January 1971 through June 1978. ROA and D/P pass the CDF rule using the most recent sample, but the weighted coefficients contradict the hypotheses, and while the glamour proxy is robust to the CDF rule in the first and most recent sub-samples, the weighted coefficients are alternatively positive and negative, respectively.

D. The McAleer et al. (1985) Critique

Some argue that the a priori decision to place a variable in **f** as opposed to χ and vice versa is problematic for EBA (McAleer et al. (1985)). Again, the preceding application of EBA does not make the potentially problematic distinction between "free" and "doubtful" variables.[23] But, to consider this critique more fully, this section examines the related argument that if some

[23] McAleer et al. (1985, p. 298) write "(U)nless extreme bounds are presented for all possible classifications of variables as doubtful and free, an observer cannot be certain that the selection does not constitute a 'con job.' Selectivity in regression reporting therefore has an exact analog in EBA, the different classifications of variables as doubtful and free."

variables in χ are indeed robust, perhaps all *M* specifications that exclude such variables are therefore mis-specified, and such specifications should not inform the extreme bounds.

Again, Tables 1A and 2A indicate that three factors pass the traditional criterion – ME, short run lagged return, and medium run lagged return. To address the question of whether (8) is mis-specified, Table VIII presents EBA that includes these three factors in **f**. The results refer to 5-factor models that include *z*, **f**, and one of the remaining variables in χ (which therefore exclusively includes variables that are not robust to the traditional criteria). All regressions that inform the bounds satisfy $VIF_{zj} \leq 5$, and therefore there are no more than 19 estimates of β_{zj} and σ_{zj} per doubtful variable.

The results are somewhat mixed. For example, as Table VIII indicates, long run lagged return is significant with the expected negative sign in all 19 possible specifications. The factor therefore passes the traditional, R^2, and CDF decision rules. The post-ranking corporate spread β is also significant in all possible models, but the upper and lower bounds are curiously negative, in contrast to the hypothesis and the weighted coefficients in Tables 1A and 2A. Similarly, the remaining APT variables with respect to industrial production, the yield curve, and inflation pass the R^2 and CDF decision rules. However, the weighted coefficients and (restricted) extreme bounds are negative and perversely suggest a negative relation between risk and return.

Table VIII also suggests that some accounting variables are robust, at least according to the most lenient CDF decision rule. BE/ME, CFME, A/ME, and S/ME pass the criterion and have the expected positive weighted coefficients. The remaining 12 variables are not robust to any EBA decision rule using **f**.

D. EBA and Model Space: *N*-factor Models

Similar to the McAleer et al. (1985) critique, some suggest that EBA problematically fails to provide guidance on underlying model space (Temple (2000)). The researcher must stipulate whether (1) or (8) is an *n*-factor model, and in the absence of formal guidelines, the preceding EBA follows convention in the literature and includes estimates of β_z and σ_z from 3-, 4-, and 5-factor equations. Of course, while perhaps not generally representative of the literature, factor models of greater space are possible given the number of variables in χ.[24]

Consideration of additional models can only widen the extreme bounds. Therefore, the question is whether the robust variables in Tables 1A and 2A – ME, short run lagged return, and long run lagged return – pass the EBA decision rule under broader assumptions about the model space. To address this issue, Table IX presents the EBA results for these variables using 6-factor models. In short, the data suggest that each factor is robust according to the traditional decision rule. The upper and lower bounds for ME, short run lagged return, and long run lagged return have the same sign, considering up to 26,334 6-factor models for each variable. Also, the weighted coefficients are of very similar magnitude to those listed in Tables IA and IIA.

V. Conclusions

The vast empirical literature on stock returns produces several contradictions of the SLB model but no consensus on specification. EBA, which has been extensively applied to other econometric issues, can usefully address such model uncertainty and specification bias. There is no reason why empirical studies of the cross-section of expected stock returns should be less rigorous than empirics of economic growth or the demand for money.

[24] Concern with multicollinearity grows with an increase in the model space. However, the VIF restriction can be applied to any *n*-factor model and address the issue.

That said, in contrast to previous applications, EBA should not be applied mechanically without transparent presentation of the underlying regressions. Toward that end, Section IV explores several possible improvements to EBA. These include consideration of specifications that produce wide bounds (Tables 1B and 2B), explicit incorporation of VIFs to address multicollinearity, divisions of the sample, alternative compositions of **f** and χ, and broad assumptions with respect to model space.

Given these addenda, perhaps particularly including the exclusion of models that exhibit multicollinearity, the results generally suggest that few factors are robust to alternative specification assumptions using the cross-section of expected stock returns. All 23 variables are significant in at least one 5-factor model with 10 percent confidence, but only three variables pass the traditional EBA decision rule, and four additional factors are robust to more lenient criteria. Moreover, the sample divisions suggest that only one variable, short run lagged return, is robust in each 90-month sub-period, and little evidence suggest that anomalies are arbitraged away over the complete sample.

Additional sensitivity analyses would be instructive. For example, the list of 23 doubtful variables is not exhaustive. While data availability is a formidable practical issue, EBA of other factors, including for example liquidity measures such as bid-ask spreads,[25] would be instructive. Regarding a related issue, some variables in χ have alternative measures, including most prominently the technical factors given numerous chartist strategies. Also, EBA could address other measures of the dependent variable and consider stock returns over a longer period, in addition to monthly returns. Finally, perhaps additional "global sensitivity analyses" (Leamer

[25] Bid-ask spreads were not included in c given that the CRSP series does not extend to July 1963.

(1985)) would be useful and address issues such as sample selection[26] in addition to specification bias.

[26] Issues related to sample selection might include exclusive EBA of firms with certain characteristics with respect to the variables in χ, such as size or value. For example, a researcher might explore whether there are robust correlates of small cap stocks (using some threshold of ME).

Table IA
EBA, Cross-Section of Expected Stock Returns (No VIF Restriction)
July 1963 – December 2000
(23 Doubtful Variables, Average monthly observations in Fama-MacBeth Regresions = 646)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Traditional Rule (Levine and Renelt (1992))				R^2 Decision Rule (Granger and Uhlig (1990))				CDF Decision Rule (Sala-i-Martin (1997a))	
Variable	Number of Regressions	Weighted Coefficient	Lower Bound	Upper Bound	Fraction Significant	Fraction Significant (10 percent)	Granger Lower Bound	Granger Upper Bound	Granger Fraction Significant	Granger Number of Regressions	Weighted Normal CDF	Weighted Non normal CDF
Market Equity	9086	-0.002	-0.005	-0.001	1.000	1.000	-0.004	-0.001	1.000	123	1.000	1.000
Book Equity to Market Equity	9086	0.002	-0.003	0.006	0.670	0.742	-0.002	0.004	0.750	32	0.992	0.947
Earnings to Market Equity	9086	-1.017	-38.792	36.857	0.000	0.016	-30.474	22.379	0.000	30	0.571	0.737
Dividend Yield	9086	-20.843	-121.514	36.476	0.193	0.404	-66.644	20.897	0.000	33	0.925	0.867
Cash Flow to Market Equity	9086	4.520	-17.360	23.349	0.372	0.475	-3.503	18.224	0.750	28	0.924	0.888
Total Assets to Market Equity	9086	0.002	-0.005	0.006	0.652	0.698	-0.002	0.003	0.806	31	0.986	0.933
Sales to Market Equity	9086	0.002	-0.001	0.006	0.873	0.952	0.000	0.003	0.857	28	0.999	0.990
Short run Lagged return (1 month)	9086	-0.061	-0.077	-0.042	1.000	1.000	-0.077	-0.051	1.000	127	1.000	1.000
Medium run Lagged return (7-12 months)	9086	0.055	0.018	0.099	1.000	1.000	0.023	0.086	1.000	44	1.000	1.000
Long run Lagged return (25-60 months)	9086	-0.072	-0.166	0.021	0.829	0.949	-0.152	-0.005	1.000	27	0.995	0.989
Profit Margin	9086	-0.005	-0.039	0.017	0.150	0.301	-0.014	0.015	0.000	27	0.861	0.825
Capital Turnover	9086	0.000	-0.003	0.002	0.097	0.296	-0.001	0.001	0.000	26	0.748	0.860
Return on Assets	9086	-0.005	-0.038	0.034	0.083	0.214	-0.023	0.017	0.000	30	0.778	0.786
Return on Equity	9086	0.003	-0.025	0.037	0.011	0.062	-0.009	0.021	0.000	25	0.747	0.763
Sales Rank	9086	-0.002	-0.013	0.004	0.145	0.239	-0.010	0.002	0.103	29	0.896	0.819
Glamour Proxy	9086	0.003	-0.006	0.020	0.253	0.369	-0.004	0.015	0.138	29	0.919	0.836
Beta (Post-ranking)	9086	0.002	-0.007	0.012	0.005	0.137	-0.007	0.007	0.000	113	0.799	0.777
Post-ranking Industrial Production Beta	9086	0.006	-0.015	0.022	0.810	0.943	-0.015	0.019	0.968	63	0.960	0.983
Post-ranking Yield Curve Beta	9086	0.004	-0.020	0.021	0.631	0.738	-0.020	0.018	1.000	47	0.878	0.964
Post-ranking Corporate Spread Beta	9086	0.005	-0.029	0.026	0.781	0.889	-0.027	0.023	1.000	79	0.884	0.983
Post-ranking Inflation Beta	9086	0.005	-0.018	0.022	0.530	0.707	-0.018	0.019	1.000	45	0.898	0.962
Leverage (Assets to Book Equity)	9086	0.000	-0.006	0.006	0.001	0.022	-0.003	0.004	0.000	31	0.627	0.741
Interest Coverage Ratio	9086	1.69E-06	-1.4E-05	1.50E-05	0.003	0.027	-7.01E-06	1.15E-05	0.000	25	0.695	0.740

Table IB
Probability of Significant Findings: Subsets of M Regressions by Doubtful Variable
(Table 1A: No VIF Restriction, July 1963 – December 2000)

Doubtful Variable	(1) Market Equity	(2) Book Equity to Market Equity	(3) Earnings to Market Equity	(4) Dividend Yield	(5) Cash Flow to Market Equity	(6) Total Assets to Market Equity	(7) Sales to Market Equity	(8) Short run Lagged return (1 month)	(9) Medium run Lagged return (7-12 months)	(10) Long run Lagged return (25-60 months)	(11) Profit Margin	(12) Capital Turnover
Market Equity		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Book Equity to Market Equity	0.532		0.721	0.778	0.658	0.015	0.151	0.759	0.742	0.668	0.731	0.716
Earnings to Market Equity	0.000	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dividend Yield	0.001	0.494	0.231		0.578	0.222	0.152	0.236	0.099	0.288	0.138	0.126
Cash Flow to Market Equity	0.296	0.002	0.014	0.429		0.008	0.017	0.541	0.396	0.471	0.434	0.423
Total Assets to Market Equity	0.541	0.045	0.714	0.730	0.657		0.009	0.733	0.720	0.671	0.709	0.716
Sales to Market Equity	0.711	0.511	0.936	0.932	0.914	0.731		0.941	0.933	0.896	0.832	0.877
Short run Lagged return (1 month)	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000
Medium run Lagged return (7-12 months)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000
Long run Lagged return (25-60 months)	0.982	0.598	0.812	0.865	0.776	0.623	0.598	0.832	0.762		0.824	0.817
Profit Margin	0.001	0.053	0.258	0.206	0.176	0.069	0.001	0.238	0.156	0.153		0.256
Capital Turnover	0.001	0.156	0.150	0.133	0.120	0.139	0.055	0.152	0.100	0.111	0.010	
Return on Assets	0.000	0.000	0.123	0.136	0.049	0.000	0.000	0.192	0.118	0.043	0.001	0.205
Return on Equity	0.029	0.041	0.007	0.015	0.001	0.012	0.001	0.005	0.004	0.051	0.026	0.015
Sales Rank	0.080	0.000	0.161	0.181	0.122	0.001	0.000	0.157	0.115	0.086	0.134	0.178
Glamour Proxy	0.104	0.000	0.295	0.275	0.188	0.001	0.000	0.374	0.328	0.293	0.283	0.280
Beta (Post-ranking)	0.000	0.000	0.004	0.004	0.003	0.000	0.000	0.028	0.008	0.027	0.003	0.007
Post-ranking Industrial Production Beta	0.620	0.828	0.888	0.884	0.892	0.787	0.700	0.894	0.896	0.880	0.864	0.830
Post-ranking Yield Curve Beta	0.865	0.603	0.696	0.644	0.693	0.627	0.577	0.755	0.725	0.710	0.716	0.693
Post-ranking Yield Spread Beta	1.000	0.660	0.836	0.821	0.804	0.678	0.665	0.892	0.857	0.851	0.833	0.858
Post-ranking Inflation Beta	0.719	0.493	0.589	0.532	0.572	0.555	0.389	0.660	0.618	0.645	0.645	0.589
Leverage (Assets to Book Equity	0.000	0.001	0.000	0.004	0.000	0.005	0.000	0.002	0.001	0.003	0.001	0.001
Interest Coverage Ratio	0.006	0.004	0.001	0.001	0.001	0.015	0.003	0.001	0.001	0.001	0.016	0.004

Table IB (Continued)
Probability of Significant Findings: Subsets of *M* Regressions by Doubtful Variable
(Table 1A: No VIF Restriction, July 1963 – December 2000)

Doubtful Variable	(13) Return on Assets	(14) Return on Equity	(15) Sales Rank	(16) Glamour Proxy	(17) Beta (Post-ranking)	(18) Post-ranking Industrial Production Beta	(19) Post-ranking Yield Curve Beta	(20) Post-ranking Yield Spread Beta	(21) Post-ranking Inflation Beta	(22) Leverage (Assets to Book Equity	(23) Interest Coverage Ratio
Market Equity	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Book Equity to Market Equity	0.741	0.823	0.739	0.716	0.755	0.724	0.727	0.719	0.746	0.735	0.738
Earnings to Market Equity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dividend Yield	0.201	0.220	0.199	0.043	0.133	0.111	0.133	0.105	0.197	0.225	0.151
Cash Flow to Market Equity	0.464	0.505	0.407	0.306	0.491	0.449	0.466	0.450	0.486	0.522	0.454
Total Assets to Market Equity	0.748	0.755	0.709	0.670	0.730	0.714	0.716	0.703	0.724	0.769	0.735
Sales to Market Equity	0.948	0.898	0.939	0.899	0.938	0.894	0.879	0.847	0.876	0.860	0.937
Short run Lagged return (1 month)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Medium run Lagged return (7-12 months)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Long run Lagged return (25-60 months)	0.798	0.826	0.806	0.822	0.991	0.982	0.972	0.951	0.984	0.809	0.822
Profit Margin	0.329	0.246	0.153	0.196	0.160	0.050	0.025	0.013	0.035	0.158	0.229
Capital Turnover	0.283	0.091	0.146	0.114	0.106	0.005	0.005	0.001	0.013	0.071	0.126
Return on Assets		0.133	0.051	0.111	0.131	0.055	0.029	0.022	0.092	0.092	0.104
Return on Equity	0.010		0.004	0.000	0.001	0.004	0.010	0.005	0.003	0.001	0.006
Sales Rank	0.098	0.127		0.612	0.288	0.128	0.133	0.117	0.165	0.157	0.154
Glamour Proxy	0.512	0.370	0.619		0.178	0.216	0.190	0.184	0.204	0.263	0.307
Beta (Post-ranking)	0.000	0.006	0.003	0.005		0.000	0.000	0.000	0.000	0.002	0.006
Post-ranking Industrial Production Beta	0.857	0.901	0.873	0.832	0.947		0.673	0.381	0.611	0.821	0.862
Post-ranking Yield Curve Beta	0.630	0.717	0.670	0.707	0.722	0.177		0.000	0.400	0.713	0.715
Post-ranking Yield Spread Beta	0.835	0.842	0.841	0.846	0.840	0.444	0.424		0.519	0.845	0.865
Post-ranking Inflation Beta	0.557	0.586	0.604	0.604	0.690	0.184	0.037	0.000		0.646	0.600
Leverage (Assets to Book Equity	0.001	0.005	0.001	0.001	0.004	0.000	0.000	0.000	0.001		0.001
Interest Coverage Ratio	0.000	0.000	0.001	0.001	0.012	0.003	0.001	0.001	0.003	0.004	

Table IIA
EBA, Cross-Section of Expected Stock Returns, VIF Restriction (> 5)
July 1963 – December 2000
(23 Doubtful Variables, Average monthly observations in Fama-MacBeth Regresions = 646)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Traditional Rule (Levine and Renelt (1992))				R^2 Decision Rule (Granger and Uhlig (1990))				CDF Decision Rule (Sala-i-Martin (1997a))	
Variable	Number of Regressions	Weighted Coefficient	Lower Bound	Upper Bound	Fraction Significant	Fraction Significant (10 percent)	Granger Lower Bound	Granger Upper Bound	Granger Fraction Significant	Granger Number of Regressions	Weighted Normal CDF	Weighted Non normal CDF
Market Equity	9003	-0.002	-0.005	-0.001	1.000	1.000	-0.004	-0.001	1.000	123	1.000	1.000
Book Equity to Market Equity	7501	0.002	-0.002	0.006	0.809	0.888	-0.001	0.004	0.828	29	0.999	0.981
Earnings to Market Equity	6175	-1.453	-23.646	14.851	0.000	0.011	-12.602	10.015	0.000	26	0.638	0.726
Dividend Yield	6175	-13.528	-67.662	23.401	0.106	0.289	-35.574	20.897	0.000	28	0.876	0.828
Cash Flow to Market Equity	6175	3.638	-8.011	12.416	0.437	0.510	-3.503	10.529	0.760	25	0.940	0.894
Total Assets to Market Equity	7316	0.002	-0.002	0.006	0.800	0.841	-0.001	0.003	0.893	28	0.998	0.965
Sales to Market Equity	8664	0.002	-0.001	0.005	0.891	0.962	0.000	0.003	0.857	28	0.999	0.991
Short run Lagged return (1 month)	9086	-0.061	-0.077	-0.042	1.000	1.000	-0.077	-0.051	1.000	127	1.000	1.000
Medium run Lagged return (7-12 months)	9086	0.055	0.018	0.099	1.000	1.000	0.023	0.086	1.000	44	1.000	1.000
Long run Lagged return (25-60 months)	9086	-0.072	-0.166	0.021	0.829	0.949	-0.152	-0.005	1.000	27	0.995	0.989
Profit Margin	9086	-0.005	-0.039	0.017	0.150	0.301	-0.014	0.015	0.000	27	0.861	0.825
Capital Turnover	9086	0.000	-0.003	0.002	0.097	0.296	-0.001	0.001	0.000	26	0.748	0.860
Return on Assets	9086	-0.005	-0.038	0.034	0.083	0.214	-0.023	0.017	0.000	30	0.778	0.786
Return on Equity	9086	0.003	-0.025	0.037	0.011	0.062	-0.009	0.021	0.000	25	0.747	0.763
Sales Rank	9086	-0.002	-0.013	0.004	0.145	0.239	-0.010	0.002	0.103	29	0.896	0.819
Glamour Proxy	9086	0.003	-0.006	0.020	0.253	0.369	-0.004	0.015	0.138	29	0.919	0.836
Beta (Post-ranking)	9086	0.002	-0.007	0.012	0.005	0.137	-0.007	0.007	0.000	113	0.799	0.777
Post-ranking Industrial Production Beta	9086	0.006	-0.015	0.022	0.810	0.943	-0.015	0.019	0.968	63	0.960	0.983
Post-ranking Yield Curve Beta	9086	0.004	-0.020	0.021	0.631	0.738	-0.020	0.018	1.000	47	0.878	0.964
Post-ranking Corporate Spread Beta	8837	0.006	-0.029	0.026	0.777	0.888	-0.027	0.023	1.000	78	0.906	0.983
Post-ranking Inflation Beta	9086	0.005	-0.018	0.022	0.530	0.707	-0.018	0.019	1.000	45	0.898	0.962
Leverage (Assets to Book Equity)	8875	0.000	-0.006	0.006	0.001	0.023	-0.003	0.004	0.000	31	0.629	0.743
Interest Coverage Ratio	9086	1.69E-06	-1.4E-05	1.50E-05	0.003	0.027	-7.01E-06	1.15E-05	0.000	25	0.695	0.740

Table IIB
Probability of Significant Findings: Subsets of *M* Regressions by Doubtful Variable
(Table IIA: VIF Restriction [> 5], July 1963 – December 2000)

Doubtful Variable	(1) Market Equity	(2) Book Equity to Market Equity	(3) Earnings to Market Equity	(4) Dividend Yield	(5) Cash Flow to Market Equity	(6) Total Assets to Market Equity	(7) Sales to Market Equity	(8) Short run Lagged return (1 month)	(9) Medium run Lagged return (7-12 months)	(10) Long run Lagged return (25-60 months)	(11) Profit Margin	(12) Capital Turnover
Market Equity		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Book Equity to Market Equity	0.616		0.834	0.898	0.762		0.167	0.877	0.857	0.773	0.845	0.839
Earnings to Market Equity	0.000	0.000				0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dividend Yield	0.000	0.442				0.184	0.099	0.138	0.020	0.137	0.071	0.072
Cash Flow to Market Equity	0.366	0.000				0.000	0.008	0.590	0.440	0.520	0.493	0.478
Total Assets to Market Equity	0.635		0.832	0.847	0.767		0.012	0.856	0.840	0.780	0.840	0.962
Sales to Market Equity	0.718	0.567	0.946	0.941	0.924	0.718		0.949	0.942	0.907	0.850	0.997
Short run Lagged return (1 month)	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000
Medium run Lagged return (7-12 months)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000
Long run Lagged return (25-60 months)	0.982	0.598	0.812	0.865	0.776	0.623	0.598	0.832	0.762		0.824	0.817
Profit Margin	0.001	0.053	0.258	0.206	0.176	0.069	0.001	0.238	0.156	0.153		0.256
Capital Turnover	0.001	0.156	0.150	0.133	0.120	0.139	0.055	0.152	0.100	0.111	0.010	
Return on Assets	0.000	0.000	0.123	0.136	0.049	0.000	0.000	0.192	0.118	0.043	0.001	0.205
Return on Equity	0.029	0.041	0.007	0.015	0.001	0.012	0.001	0.005	0.004	0.051	0.026	0.015
Sales Rank	0.080	0.000	0.161	0.181	0.122	0.001	0.000	0.157	0.115	0.086	0.134	0.178
Glamour Proxy	0.104	0.000	0.295	0.275	0.188	0.001	0.000	0.374	0.328	0.293	0.283	0.280
Beta (Post-ranking)	0.000	0.000	0.004	0.004	0.003	0.000	0.000	0.028	0.008	0.027	0.003	0.007
Post-ranking Industrial Production Beta	0.620	0.828	0.888	0.884	0.892	0.787	0.700	0.894	0.896	0.880	0.864	0.830
Post-ranking Yield Curve Beta	0.865	0.603	0.696	0.644	0.693	0.627	0.577	0.755	0.725	0.710	0.716	0.693
Post-ranking Yield Spread Beta	1.000	0.656	0.834	0.819	0.802	0.674	0.661	0.891	0.856	0.849	0.831	0.857
Post-ranking Inflation Beta	0.719	0.493	0.589	0.532	0.572	0.555	0.389	0.660	0.618	0.645	0.645	0.589
Leverage (Assets to Book Equity	0.000	0.001	0.000	0.004	0.000	0.006	0.000	0.002	0.001	0.003	0.001	0.001
Interest Coverage Ratio	0.006	0.004	0.001	0.001	0.001	0.015	0.003	0.001	0.001	0.001	0.016	0.004

Table IIB (Continued)
Probability of Significant Findings: Subsets of *M* Regressions by Doubtful Variable
(Table IIA: VIF Restriction [> 5], July 1963 – December 2000)

Doubtful Variable	(13) Return on Assets	(14) Return on Equity	(15) Sales Rank	(16) Glamour Proxy	(17) Beta (Post-ranking)	(18) Post-ranking Industrial Production Beta	(19) Post-ranking Yield Curve Beta	(20) Post-ranking Yield Spread Beta	(21) Post-ranking Inflation Beta	(22) Leverage (Assets to Book Equity	(23) Interest Coverage Ratio
Market Equity	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Book Equity to Market Equity	0.857	0.948	0.853	0.827	0.869	0.837	0.841	0.832	0.862	0.851	0.854
Earnings to Market Equity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dividend Yield	0.148	0.169	0.112	0.047	0.082	0.031	0.048	0.049	0.112	0.142	0.068
Cash Flow to Market Equity	0.523	0.581	0.448	0.398	0.563	0.505	0.528	0.506	0.538	0.595	0.510
Total Assets to Market Equity	0.874	0.876	0.829	0.783	0.848	0.837	0.840	0.824	0.846	0.851	0.849
Sales to Market Equity	0.965	0.909	0.949	0.909	0.951	0.905	0.890	0.857	0.887	0.874	0.945
Short run Lagged return (1 month)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Medium run Lagged return (7-12 months)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Long run Lagged return (25-60 months)	0.798	0.826	0.806	0.822	0.991	0.982	0.972	0.951	0.984	0.809	0.822
Profit Margin	0.329	0.246	0.153	0.196	0.160	0.050	0.025	0.013	0.035	0.158	0.229
Capital Turnover	0.283	0.091	0.146	0.114	0.106	0.005	0.005	0.001	0.013	0.071	0.126
Return on Assets		0.133	0.051	0.111	0.131	0.055	0.029	0.022	0.092	0.092	0.104
Return on Equity	0.010		0.004	0.000	0.001	0.004	0.010	0.005	0.003	0.001	0.006
Sales Rank	0.098	0.127		0.612	0.288	0.128	0.133	0.117	0.165	0.157	0.154
Glamour Proxy	0.512	0.370	0.619		0.178	0.216	0.190	0.184	0.204	0.263	0.307
Beta (Post-ranking)	0.000	0.006	0.003	0.005		0.000	0.000	0.000	0.000	0.002	0.006
Post-ranking Industrial Production Beta	0.857	0.901	0.873	0.832	0.947		0.673	0.381	0.611	0.821	0.862
Post-ranking Yield Curve Beta	0.630	0.717	0.670	0.707	0.722	0.177		0.000	0.400	0.713	0.715
Post-ranking Yield Spread Beta	0.834	0.840	0.840	0.845	0.838	0.435	0.339		0.513	0.843	0.864
Post-ranking Inflation Beta	0.557	0.586	0.604	0.604	0.690	0.184	0.037	0.000		0.646	0.600
Leverage (Assets to Book Equity	0.001	0.005	0.001	0.001	0.004	0.000	0.000	0.000	0.001		0.001
Interest Coverage Ratio	0.000	0.000	0.001	0.001	0.012	0.003	0.001	0.001	0.003	0.004	

Table III
EBA, Cross-Section of Expected Stock Returns, VIF Restriction (> 5)
July 1963 – December 1970
(23 Doubtful Variables, Average monthly observations in Fama-MacBeth Regresions = 124)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Traditional Rule (Levine and Renelt (1992))				R^2 Decision Rule (Granger and Uhlig (1990))				CDF Decision Rule (Sala-i-Martin (1997a))	
Variable	Number of Regressions	Weighted Coefficient	Lower Bound	Upper Bound	Fraction Significant	Fraction Significant (10 percent)	Granger Lower Bound	Granger Upper Bound	Granger Fraction Significant	Granger Number of Regressions	Weighted Normal CDF	Weighted Non normal CDF
Market Equity	8521	-0.003	-0.008	0.001	0.852	0.994	-0.008	0.000	0.936	109	0.991	0.987
Book Equity to Market Equity	7256	0.002	-0.008	0.015	0.129	0.211	-0.007	0.006	0.000	39	0.811	0.781
Earnings to Market Equity	6175	9.257	-87.531	70.096	0.008	0.035	-62.544	57.976	0.000	34	0.726	0.746
Dividend Yield	6175	17.045	-139.983	110.808	0.000	0.010	-70.117	87.465	0.000	43	0.713	0.741
Cash Flow to Market Equity	6175	11.129	-37.276	46.000	0.021	0.116	-18.469	46.000	0.306	36	0.866	0.854
Total Assets to Market Equity	7099	0.001	-0.009	0.013	0.139	0.231	-0.007	0.006	0.000	32	0.803	0.800
Sales to Market Equity	8612	0.002	-0.004	0.011	0.214	0.406	-0.004	0.004	0.000	27	0.926	0.893
Short run Lagged return (1 month)	9086	-0.065	-0.107	-0.018	1.000	1.000	-0.103	-0.034	1.000	94	1.000	1.000
Medium run Lagged return (7-12 months)	9086	-0.004	-0.117	0.119	0.000	0.000	-0.110	0.076	0.000	49	0.542	0.588
Long run Lagged return (25-60 months)	9086	-0.094	-0.357	0.137	0.000	0.040	-0.329	0.109	0.000	23	0.877	0.868
Profit Margin	9064	-0.012	-0.157	0.070	0.018	0.073	-0.044	0.055	0.000	42	0.750	0.754
Capital Turnover	8985	0.001	-0.007	0.005	0.011	0.054	-0.005	0.004	0.000	38	0.711	0.783
Return on Assets	8897	0.010	-0.118	0.138	0.037	0.121	-0.086	0.070	0.020	50	0.711	0.783
Return on Equity	9060	0.033	-0.084	0.189	0.224	0.420	-0.015	0.122	0.583	36	0.936	0.897
Sales Rank	9086	0.002	-0.020	0.015	0.010	0.043	-0.016	0.010	0.000	32	0.678	0.778
Glamour Proxy	9086	0.011	-0.011	0.040	0.572	0.871	-0.006	0.030	0.065	46	0.979	0.972
Beta (Post-ranking)	9086	0.008	-0.007	0.025	0.035	0.329	-0.007	0.021	0.014	72	0.935	0.925
Post-ranking Industrial Production Beta	9086	0.005	-0.034	0.038	0.034	0.167	-0.032	0.036	0.168	101	0.728	0.859
Post-ranking Yield Curve Beta	9086	0.002	-0.043	0.037	0.007	0.111	-0.040	0.028	0.000	33	0.603	0.805
Post-ranking Corporate Spread Beta	8842	0.008	-0.044	0.047	0.007	0.094	-0.041	0.044	0.013	77	0.765	0.868
Post-ranking Inflation Beta	9086	0.010	-0.024	0.041	0.023	0.152	-0.023	0.036	0.015	65	0.879	0.856
Leverage (Assets to Book Equity)	8875	0.003	-0.019	0.027	0.001	0.010	-0.012	0.019	0.000	79	0.697	0.702
Interest Coverage Ratio	9086	1.09E-06	-6.9E-05	6.35E-05	0.006	0.027	-4.1E-05	5.52E-05	0.000	33	0.532	0.709

Table IV
EBA, Cross-Section of Expected Stock Returns, VIF Restriction (> 5)
January 1971 – June 1978
(23 Doubtful Variables, Average monthly observations in Fama-MacBeth Regresions = 310)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Traditional Rule (Levine and Renelt (1992))				R^2 Decision Rule (Granger and Uhlig (1990))				CDF Decision Rule (Sala-i-Martin (1997a))	
Variable	Number of Regressions	Weighted Coefficient	Lower Bound	Upper Bound	Fraction Significant	Fraction Significant (10 percent)	Granger Lower Bound	Granger Upper Bound	Granger Fraction Significant	Granger Number of Regressions	Weighted Normal CDF	Weighted Non normal CDF
Market Equity	7948	-0.002	-0.006	0.001	0.302	0.618	-0.006	0.001	0.555	200	0.964	0.952
Book Equity to Market Equity	7330	0.004	-0.003	0.011	0.682	0.881	-0.001	0.009	0.925	53	0.990	0.979
Earnings to Market Equity	6175	5.229	-12.012	18.017	0.405	0.483	-11.495	15.678	0.410	39	0.908	0.853
Dividend Yield	6175	25.718	-25.909	65.434	0.519	0.608	-25.536	61.665	0.622	45	0.981	0.932
Cash Flow to Market Equity	6175	6.023	-5.238	14.847	0.628	0.705	-4.874	13.233	0.735	34	0.988	0.953
Total Assets to Market Equity	7213	0.003	-0.004	0.010	0.536	0.706	-0.001	0.008	0.900	40	0.979	0.956
Sales to Market Equity	8466	0.002	-0.005	0.009	0.462	0.619	-0.003	0.006	0.737	38	0.960	0.918
Short run Lagged return (1 month)	9086	-0.088	-0.125	-0.047	1.000	1.000	-0.125	-0.061	1.000	211	1.000	1.000
Medium run Lagged return (7-12 months)	9086	0.087	0.008	0.180	1.000	1.000	0.016	0.167	1.000	104	0.997	0.996
Long run Lagged return (25-60 months)	9086	-0.154	-0.418	0.060	0.546	0.887	-0.371	0.028	0.902	41	0.982	0.976
Profit Margin	9086	-0.017	-0.096	0.036	0.063	0.300	-0.053	0.025	0.052	58	0.909	0.880
Capital Turnover	9086	-0.001	-0.006	0.002	0.064	0.117	-0.004	0.002	0.074	54	0.748	0.701
Return on Assets	9086	-0.003	-0.077	0.099	0.005	0.044	-0.051	0.035	0.000	46	0.577	0.728
Return on Equity	9086	-0.014	-0.063	0.034	0.014	0.127	-0.045	0.014	0.019	52	0.873	0.851
Sales Rank	9086	-0.006	-0.034	0.008	0.127	0.205	-0.027	0.005	0.170	53	0.909	0.857
Glamour Proxy	9086	0.006	-0.014	0.048	0.151	0.254	-0.011	0.036	0.151	53	0.874	0.791
Beta (Post-ranking)	9086	0.002	-0.016	0.026	0.000	0.000	-0.016	0.019	0.000	127	0.614	0.646
Post-ranking Industrial Production Beta	9086	0.008	-0.021	0.046	0.002	0.072	-0.020	0.039	0.058	103	0.825	0.820
Post-ranking Yield Curve Beta	9086	0.008	-0.026	0.045	0.007	0.072	-0.024	0.042	0.057	158	0.786	0.821
Post-ranking Corporate Spread Beta	8512	0.014	-0.028	0.054	0.142	0.368	-0.025	0.051	0.351	174	0.910	0.912
Post-ranking Inflation Beta	9086	0.002	-0.034	0.045	0.000	0.006	-0.034	0.039	0.000	152	0.588	0.744
Leverage (Assets to Book Equity)	8875	-0.002	-0.013	0.012	0.033	0.108	-0.013	0.005	0.054	74	0.776	0.742
Interest Coverage Ratio	9086	2.16E-06	-2.2E-05	2.80E-05	0.000	0.000	-1.96E-05	2.15E-05	0.000	47	0.618	0.675

Table V
EBA, Cross-Section of Expected Stock Returns, VIF Restriction (> 5)
July 1978 – December 1985
(23 Doubtful Variables, Average monthly observations in Fama-MacBeth Regresions = 588)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Traditional Rule (Levine and Renelt (1992))				R^2 Decision Rule (Granger and Uhlig (1990))				CDF Decision Rule (Sala-i-Martin (1997a))	
Variable	Number of Regressions	Weighted Coefficient	Lower Bound	Upper Bound	Fraction Significant	Fraction Significant (10 percent)	Granger Lower Bound	Granger Upper Bound	Granger Fraction Significant	Granger Number of Regressions	Weighted Normal CDF	Weighted Non normal CDF
Market Equity	9086	-0.003	-0.006	0.000	0.997	1.000	-0.006	0.000	1.000	105	0.997	0.994
Book Equity to Market Equity	8673	0.002	-0.005	0.008	0.511	0.624	-0.003	0.005	0.087	23	0.950	0.888
Earnings to Market Equity	7525	0.279	-21.055	23.205	0.000	0.005	-12.903	16.671	0.000	17	0.525	0.686
Dividend Yield	9086	-21.891	-134.099	85.938	0.054	0.129	-83.381	24.601	0.150	20	0.834	0.816
Cash Flow to Market Equity	7525	-3.017	-20.097	9.931	0.172	0.398	-9.334	5.747	0.059	17	0.875	0.814
Total Assets to Market Equity	8201	0.003	-0.004	0.008	0.634	0.750	-0.003	0.004	0.087	23	0.976	0.936
Sales to Market Equity	8664	0.003	-0.002	0.008	0.723	0.856	-0.001	0.005	0.435	23	0.992	0.978
Short run Lagged return (1 month)	9086	-0.072	-0.100	-0.041	1.000	1.000	-0.099	-0.053	1.000	106	1.000	1.000
Medium run Lagged return (7-12 months)	9086	0.067	-0.008	0.144	0.756	1.000	0.019	0.134	1.000	21	0.985	0.983
Long run Lagged return (25-60 months)	9086	0.015	-0.158	0.217	0.000	0.035	-0.114	0.125	0.000	19	0.614	0.699
Profit Margin	9086	0.003	-0.027	0.031	0.002	0.013	-0.015	0.025	0.000	19	0.632	0.674
Capital Turnover	9086	0.001	-0.003	0.004	0.166	0.408	-0.002	0.003	0.000	18	0.902	0.886
Return on Assets	9086	-0.004	-0.052	0.041	0.000	0.003	-0.027	0.031	0.000	20	0.615	0.656
Return on Equity	9086	-0.001	-0.019	0.016	0.000	0.000	-0.012	0.013	0.000	19	0.584	0.629
Sales Rank	9086	0.002	-0.017	0.013	0.000	0.010	-0.007	0.010	0.000	19	0.684	0.759
Glamour Proxy	9086	0.008	-0.015	0.030	0.520	0.605	-0.004	0.018	0.722	18	0.965	0.928
Beta (Post-ranking)	9086	-0.005	-0.023	0.016	0.000	0.013	-0.023	0.005	0.000	106	0.786	0.766
Post-ranking Industrial Production Beta	9086	0.008	-0.021	0.036	0.179	0.442	-0.012	0.034	0.471	34	0.906	0.908
Post-ranking Yield Curve Beta	9086	0.009	-0.024	0.037	0.243	0.553	-0.018	0.035	0.414	29	0.912	0.930
Post-ranking Corporate Spread Beta	8916	0.009	-0.039	0.044	0.303	0.563	-0.031	0.042	0.696	56	0.851	0.930
Post-ranking Inflation Beta	9086	0.013	-0.022	0.042	0.415	0.678	-0.012	0.041	0.346	26	0.955	0.912
Leverage (Assets to Book Equity)	8875	0.001	-0.006	0.008	0.019	0.137	-0.003	0.005	0.000	18	0.807	0.815
Interest Coverage Ratio	9086	8.39E-06	-5.77E-06	2.62E-05	0.055	0.426	-4.05E-06	1.97E-05	0.000	18	0.943	0.935

Table VI
EBA, Cross-Section of Expected Stock Returns, VIF Restriction (> 5)
January 1986 – June 1993
(23 Doubtful Variables, Average monthly observations in Fama-MacBeth Regresions = 871)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Traditional Rule (Levine and Renelt (1992))				R^2 Decision Rule (Granger and Uhlig (1990))				CDF Decision Rule (Sala-i-Martin (1997a))	
Variable	Number of Regressions	Weighted Coefficient	Lower Bound	Upper Bound	Fraction Significant	Fraction Significant (10 percent)	Granger Lower Bound	Granger Upper Bound	Granger Fraction Significant	Granger Number of Regressions	Weighted Normal CDF	Weighted Non normal CDF
Market Equity	9086	-0.001	-0.005	0.001	0.046	0.414	-0.004	0.001	0.045	110	0.934	0.913
Book Equity to Market Equity	8856	0.001	-0.004	0.006	0.013	0.325	-0.003	0.004	0.000	54	0.862	0.836
Earnings to Market Equity	7525	-2.521	-16.440	17.985	0.000	0.000	-14.343	9.332	0.000	46	0.717	0.719
Dividend Yield	9086	-9.237	-66.589	40.441	0.000	0.000	-36.624	19.473	0.000	51	0.748	0.733
Cash Flow to Market Equity	7525	0.672	-5.242	10.858	0.003	0.033	-4.606	9.279	0.000	47	0.649	0.770
Total Assets to Market Equity	8661	0.001	-0.004	0.006	0.041	0.386	-0.003	0.004	0.018	55	0.886	0.870
Sales to Market Equity	8856	0.002	-0.002	0.006	0.600	0.902	-0.001	0.005	0.577	52	0.981	0.976
Short run Lagged return (1 month)	9086	-0.048	-0.072	-0.028	1.000	1.000	-0.067	-0.032	1.000	56	1.000	1.000
Medium run Lagged return (7-12 months)	9086	0.081	0.017	0.150	1.000	1.000	0.021	0.128	1.000	52	1.000	1.000
Long run Lagged return (25-60 months)	9086	-0.124	-0.297	0.026	0.775	0.998	-0.258	0.019	0.698	53	0.984	0.982
Profit Margin	9086	0.001	-0.006	0.008	0.000	0.000	-0.004	0.007	0.000	48	0.672	0.669
Capital Turnover	9086	0.001	-0.003	0.004	0.044	0.440	-0.002	0.003	0.000	48	0.906	0.879
Return on Assets	9086	-0.005	-0.046	0.028	0.000	0.000	-0.031	0.025	0.000	49	0.664	0.662
Return on Equity	9086	-0.001	-0.005	0.003	0.000	0.000	-0.004	0.003	0.000	55	0.778	0.766
Sales Rank	9086	-0.003	-0.019	0.009	0.001	0.052	-0.013	0.005	0.000	51	0.830	0.800
Glamour Proxy	9086	0.002	-0.012	0.019	0.004	0.050	-0.008	0.015	0.000	54	0.684	0.721
Beta (Post-ranking)	9086	0.000	-0.015	0.016	0.000	0.000	-0.015	0.014	0.000	111	0.521	0.564
Post-ranking Industrial Production Beta	9086	0.000	-0.026	0.020	0.000	0.025	-0.021	0.016	0.000	62	0.518	0.699
Post-ranking Yield Curve Beta	9086	-0.001	-0.026	0.020	0.018	0.128	-0.023	0.017	0.312	77	0.562	0.715
Post-ranking Corporate Spread Beta	8875	0.003	-0.034	0.027	0.002	0.081	-0.030	0.023	0.070	115	0.660	0.815
Post-ranking Inflation Beta	9086	-0.001	-0.031	0.022	0.020	0.034	-0.027	0.017	0.758	62	0.578	0.682
Leverage (Assets to Book Equity)	8875	0.001	-0.005	0.005	0.000	0.000	-0.003	0.004	0.000	54	0.693	0.746
Interest Coverage Ratio	9086	-1.25E-06	-6.66E-06	3.38E-06	0.000	0.000	-5.66E-06	3.10E-06	0.000	47	0.744	0.740

Table VII
EBA, Cross-Section of Expected Stock Returns, VIF Restriction (> 5)
July 1993 – December 2000
(23 Doubtful Variables, Average monthly observations in Fama-MacBeth Regresions = 1338)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Traditional Rule (Levine and Renelt (1992))				R^2 Decision Rule (Granger and Uhlig (1990))				CDF Decision Rule (Sala-i-Martin (1997a))	
Variable	Number of Regressions	Weighted Coefficient	Lower Bound	Upper Bound	Fraction Significant	Fraction Significant (10 percent)	Granger Lower Bound	Granger Upper Bound	Granger Fraction Significant	Granger Number of Regressions	Weighted Normal CDF	Weighted Non normal CDF
Market Equity	9083	-0.002	-0.007	0.001	0.417	0.502	-0.006	0.001	0.082	85	0.974	0.947
Book Equity to Market Equity	8873	0.001	-0.005	0.008	0.015	0.075	-0.004	0.004	0.000	30	0.770	0.764
Earnings to Market Equity	7525	-16.885	-51.295	28.004	0.179	0.327	-46.510	11.861	0.250	28	0.929	0.905
Dividend Yield	9086	-87.502	-281.858	27.231	0.483	0.944	-154.460	22.183	0.179	39	0.980	0.975
Cash Flow to Market Equity	7525	5.212	-10.015	28.777	0.188	0.272	-8.679	16.889	0.032	31	0.873	0.817
Total Assets to Market Equity	8665	0.001	-0.008	0.007	0.003	0.021	-0.004	0.004	0.000	31	0.632	0.688
Sales to Market Equity	8856	0.000	-0.005	0.005	0.000	0.001	-0.005	0.003	0.000	33	0.525	0.651
Short run Lagged return (1 month)	9086	-0.031	-0.053	-0.006	1.000	1.000	-0.052	-0.014	1.000	62	1.000	1.000
Medium run Lagged return (7-12 months)	9086	0.044	-0.011	0.105	0.202	0.972	-0.006	0.101	0.481	52	0.971	0.969
Long run Lagged return (25-60 months)	9086	-0.003	-0.118	0.141	0.000	0.000	-0.102	0.123	0.000	40	0.533	0.621
Profit Margin	9086	0.000	-0.002	0.002	0.000	0.000	-0.002	0.002	0.000	32	0.599	0.668
Capital Turnover	9086	-0.001	-0.004	0.004	0.000	0.007	-0.004	0.002	0.000	32	0.769	0.761
Return on Assets	9086	-0.025	-0.070	0.009	0.383	0.925	-0.053	0.004	0.625	48	0.974	0.972
Return on Equity	9086	0.000	-0.003	0.004	0.044	0.148	-0.002	0.004	0.000	28	0.631	0.648
Sales Rank	9086	-0.005	-0.016	0.016	0.330	0.620	-0.014	0.012	0.375	40	0.916	0.901
Glamour Proxy	9086	-0.011	-0.039	0.014	0.448	0.728	-0.031	0.011	0.419	31	0.962	0.951
Beta (Post-ranking)	9086	0.006	-0.011	0.026	0.000	0.000	-0.010	0.020	0.000	84	0.822	0.817
Post-ranking Industrial Production Beta	9086	0.009	-0.021	0.039	0.099	0.161	-0.019	0.035	0.012	85	0.850	0.835
Post-ranking Yield Curve Beta	7525	0.001	-0.029	0.034	0.174	0.179	-0.027	0.030	0.408	76	0.572	0.772
Post-ranking Corporate Spread Beta	7506	-0.004	-0.059	0.040	0.177	0.177	-0.056	0.036	0.368	87	0.643	0.738
Post-ranking Inflation Beta	9086	0.000	-0.037	0.033	0.103	0.142	-0.037	0.023	0.597	67	0.507	0.728
Leverage (Assets to Book Equity)	8875	-0.001	-0.010	0.005	0.000	0.001	-0.005	0.004	0.000	42	0.641	0.657
Interest Coverage Ratio	9086	-1.60E-06	-4.40E-06	1.16E-06	0.000	0.023	-4.23E-06	8.03E-07	0.000	29	0.923	0.920

Table VIII
"Second Pass" EBA, Cross-Section of Expected Stock Returns, VIF Restriction (> 5)
July 1963 – December 2000
(20 Doubtful Variables, Average monthly observations in Fama-MacBeth Regresions = 646)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Traditional Rule (Levine and Renelt (1992))				R^2 Decision Rule (Granger and Uhlig (1990))				CDF Decision Rule (Sala-i-Martin (1997a))	
Variable	Number of Regressions	Weighted Coefficient	Lower Bound	Upper Bound	Fraction Significant	Fraction Significant (10 percent)	Granger Lower Bound	Granger Upper Bound	Granger Fraction Significant	Granger Number of Regressions	Weighted Normal CDF	Weighted Non normal CDF
Book Equity to Market Equity	18	0.001	-0.001	0.003	0.833	0.944	-0.001	0.003	0.625	8	0.991	0.983
Earnings to Market Equity	17	-0.881	-11.532	10.015	0.000	0.000	-11.532	10.015	0.000	7	0.588	0.636
Dividend Yield	17	-4.497	-33.934	20.897	0.000	0.000	-33.934	20.897	0.000	8	0.655	0.650
Cash Flow to Market Equity	17	4.334	-2.381	10.209	0.706	0.824	-2.381	10.209	0.714	7	0.976	0.969
Total Assets to Market Equity	18	0.001	-0.001	0.003	0.889	0.944	-0.001	0.003	0.833	6	0.990	0.973
Sales to Market Equity	19	0.001	0.000	0.003	0.895	0.947	0.000	0.002	0.714	7	0.995	0.990
Long run Lagged return (25-60 months)	19	-0.072	-0.142	-0.005	1.000	1.000	-0.142	-0.005	1.000	8	0.996	0.995
Profit Margin	19	0.000	-0.011	0.015	0.000	0.000	-0.010	0.015	0.000	7	0.528	0.598
Capital Turnover	19	0.000	-0.001	0.001	0.000	0.000	-0.001	0.001	0.000	7	0.645	0.697
Return on Assets	19	-0.002	-0.022	0.017	0.000	0.000	-0.022	0.017	0.000	7	0.666	0.711
Return on Equity	19	0.005	-0.006	0.023	0.000	0.053	-0.006	0.017	0.000	6	0.875	0.863
Sales Rank	19	-0.001	-0.010	0.002	0.053	0.053	-0.010	0.002	0.111	9	0.843	0.809
Glamour Proxy	19	0.003	-0.003	0.015	0.105	0.579	-0.003	0.015	0.250	8	0.948	0.926
Beta (Post-ranking)	19	-0.001	-0.007	0.006	0.000	0.000	-0.007	0.006	0.000	19	0.619	0.629
Post-ranking Industrial Production Beta	19	-0.007	-0.015	0.002	0.842	0.947	-0.015	-0.001	1.000	8	0.992	0.986
Post-ranking Yield Curve Beta	19	-0.012	-0.020	0.001	0.947	1.000	-0.020	-0.005	1.000	8	1.000	0.998
Post-ranking Corporate Spread Beta	18	-0.018	-0.027	-0.008	1.000	1.000	-0.027	-0.009	1.000	8	1.000	1.000
Post-ranking Inflation Beta	19	-0.010	-0.018	0.002	0.895	0.947	-0.018	-0.002	1.000	12	0.996	0.992
Leverage (Assets to Book Equity)	19	0.001	-0.003	0.004	0.000	0.000	-0.003	0.004	0.000	7	0.750	0.761
Interest Coverage Ratio	19	1.87E-06	-7.01E-06	1.08E-05	0.000	0.000	-7.01E-06	1.08E-05	0.000	7	0.717	0.709

Table IX
EBA, Cross-Section of Expected Stock Returns, VIF Restriction (> 5)
6-Factor Models
July 1963 – December 2000
(3 Doubtful Variables, Average monthly observations in Fama-MacBeth Regresions = 646)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Traditional Rule (Levine and Renelt (1992))				R^2 Decision Rule (Granger and Uhlig (1990))				CDF Decision Rule (Sala-i-Martin (1997a))	
Variable	Number of Regressions	Weighted Coefficient	Lower Bound	Upper Bound	Fraction Significant	Fraction Significant (10 percent)	Granger Lower Bound	Granger Upper Bound	Granger Fraction Significant	Granger Number of Regressions	Weighted Normal CDF	Weighted Non normal CDF
Market Equity	25144	-0.002	-0.005	-0.001	1.000	1.000	-0.004	-0.001	1.000	470	1.000	1.000
Short run Lagged return (1 month)	26334	-0.062	-0.078	-0.044	1.000	1.000	-0.078	-0.052	1.000	499	1.000	1.000
Medium run Lagged return (7-12 months)	26334	0.054	0.017	0.099	1.000	1.000	0.021	0.088	1.000	225	1.000	1.000

Appendix 1: Data Sources

Variable	Primary Data Source	Description
Market Equity (ME)	CRSP	ME is market price (CRSP code, MPRC) times shares outstanding (MSHR) (or MCAP).
Book Equity to Market Equity (BE/ME)	COMPUSTAT	BE/ME is the book value of common equity (COMPUTSTAT code, 60) plus balance sheet deferred taxes (74) (year *t* -1), divided by ME (June, year *t*).
Earnings to Market Equity (E/P)	COMPUSTAT	Earnings to market equity is earnings is (net) income before extraordinary items (18), plus income statement deferred taxes (50), minus preferred dividends (19) (year *t* - 1), divided by ME (June, year *t*).
Dividend Yield (D/P)	COMPUSTAT	The dividend yield is common dividends (21) (year *t* - 1), divided by ME (June, year *t*).
Cash Flow to Market Equity (CF/ME)	COMPUSTAT	CF/ME is net income before extraordinary items (18) plus depreciation (14) (year *t* - 1), divided by ME (June, year *t*).
Total Assets to Market Equity (A/ME)	COMPUSTAT	A/ME is total assets (6) (year *t* - 1), divided by ME (June, year *t*).
Sales to Market Equity (S/ME)	COMPUSTAT	S/ME is sales (12) (year *t* - 1), divided by ME (June, year *t*).
Short run Lagged return (1 month)	CRSP	The short run proxy is the lagged value of returns (MRET).
Medium run Lagged return (7-12 months)	CRSP	The medium run proxy is the average monthly return from the seven through the 12-month lagged return (MRET).
Long run Lagged return (25-60 months)	CRSP	The long run proxy is the average monthly return from the 25- through the 60-month lagged return (MRET).
Profit Margin	COMPUSTAT	Profit margin is net operating income (EBIT - nonoperating income) (178) divided by sales (12) (year *t* - 1).
Capital Turnover	COMPUSTAT	Capital turnover is total Sales (12) divided by Total Assets (6) (year *t* - 1).
Return on Assets (ROA)	COMPUSTAT	ROA is net operating income (EBIT - nonoperating income) (178) divided by total assets (6) (year *t* - 1).
Return on Equity (ROE)	COMPUSTAT	ROE is net income before extraordinary items (18), plus income statement deferred taxes (50), minus preferred dividends (19), divided by the book value of common equity (60) plus balance sheet deferred taxes (74) (year *t* – 1).
Sales Rank	COMPUSTAT	Sales rank is the percentage annual rank of sales growth (12).
Glamour Proxy	COMPUSTAT	The glamour prosy is the percentage annual rank of sales growth (12) times the percentage annual rank of CF/ME.
Post-ranking β	CRSP	Post-ranking β estimates follow Fama and French (1992) (using quintiles instead of deciles).
Post-ranking Industrial Production β	CRSP, Federal Reserve Board	Post-ranking estimates follow Chen et al. (1986) and Fama and French (1992).
Post-ranking Yield Curve β	CRSP, Ibbotson (2002)	Post-ranking estimates follow Chen et al. (1986) and Fama and French (1992).
Post-ranking Yield Spread β	CRSP, Ibbotson (2002)	Post-ranking estimates follow Chen et al. (1986) and Fama and French (1992).
Post-ranking Inflation β	CRSP, BLS	Post-ranking estimates follow Haugen and Baker (1996) and Fama and French (1992).
Leverage (Assets to Book Equity) (A/BE)	COMPUSTAT	Leverage is total ssets (6) to the book value of total equity (60 + 74) (year, *t* - 1)
Interest Coverage Ratio	COMPUSTAT	Interest coverage ratio (times interest earned) is net operating income (EBIT - nonoperating income) (178) divided by interest expense (15) (year *t* - 1).

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