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EXPLANATION OF INDUSTRY RETURNS USING THE VARIABLE BETA MODEL AND LAGGED VARIABLE BETA MODEL

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Abstract

Beta is found to be a function of several leading economic indicators and government policy variables within the context of the Variable Beta Model which incorporates economic characteristics in the single index model in a multiplicative manner. When contemporaneous macroeconomic descriptors are replaced with reporting-period-lagged macroeconomic descriptors, in the Lagged Variable Beta Model, model explanatory power increases. Findings suggest that the lagged beta model is more likely to satisfy the ordinary least squares assumptions of serially independent error terms.

INTRODUCTION

Beta as a measure of priced risk is again under attack. Fama and French's [10,11] finding that the single index market model (SIMM) does not describe the last 50 years of average stock returns has been widely reported. Such a finding has widespread implications for corporate finance and investment management. Capital budgeting has frequently been based upon the belief that a higher return was required from projects with more volatile cash flows under the assumption that the volatile cash flows are at least partially dependent upon systematic factors. Firms which have based a portion of their appeal on the basis of their high beta and assumed higher rates of return may see an exodus of shareholders. Utility rate structures designed to give investors a return consistent with that required according to the capital asset pricing model will come into question.

In a recent *Journal of Financial and Strategic Decisions* article, Burnie and Gunay [6] report their finding that there is a significant relationship between the returns of shares listed on the Toronto Stock Exchange and several macroeconomic series. Interest rates, inflation, and money/credit characteristics appear to be the most highly related to Canadian stock returns. Inclusion of a stock market index did displace macroeconomic variables.

In another characterization of systematic risk, Abell and Krueger [1] identified a characterization of systematic, known as the Variable Beta Model (VBM) and found beta to be sensitive to a number of macroeconomic variables. The prediction of future betas using a variable beta model, which incorporates significant economic variables, was found to be more accurate than utilizing historical betas. Using changes in the federal budget deficit, producer price indexes, and a main cofactor, based on fifteen additional variables, Krueger and Rahbar [15] were able to forecast beta and equity returns to a greater extent than that afforded by the single index market model. In light of the current interest in beta, this article reexamines the benefit of using the VBM to characterize stock returns.

A literature review is presented below, followed by the derivation of the VBM and LBM as extensions of the SIMM. Data are presented next. Results are given, followed by a conclusion.

LITERATURE REVIEW

Fama and French have recently reported that the single index market model (SIMM) does not describe the last 50 years of average stock returns using cross-sectional data [10] or time-series regressions [11]. Their analysis

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indicates firm characteristics that result in firms being more likely to earn a higher rate of return, but does not indicate why size or book-to-market values are important. Firm size, in and of itself, does not influence returns. However, size may accentuate the impact of those macroeconomic and microeconomic conditions that influence firm profitability. Recognizing this void, Fama, French, Booth, and Sinquefield [12] devote considerable attention to the issue of why book-to-market equity ratios may be surrogating for firm risk. The persistent absence of a significant relationship between market and security returns, or beta, does not support the single-index model.

A conflicting result was obtained by Value Line, which publishes betas for 1600 firms weekly, conducted its own study of beta's relationship to price changes. [4] Analysts grouped the Value Line Universe into ten bracket according to each firm betas as of year-end 1992. Mean returns were then calculated for each decile. On average, during 1992, firms with a beta less than 0.71 earned a return that was twenty percent lower than that of firms with betas exceeding 1.40. The explanatory power of beta was a high 0.86, indicating that the positive relationship between beta and return was far from random. Value Line also observed a positive beta-return relationship among stocks with a market capitalization exceeding one billion dollar and stocks with market capitalizations of less than one billion dollars.

By comparison, the present study attempts to explain portfolio returns using macroeconomic variables in the VBM framework. Sharpe's [16] single index market model (SIMM) offers the most general of advice to investors, as seen from the following representations. It is assumed that the return of a security or portfolio, Rt, and the market return, Rmt, in the same period, t, have the following relationship,

Equation 1

$$R_t = a + BR_{mt} + e_t \qquad t=1,2,...n$$

where a and B are the intercept and the slope, respectively, and e_t is the random error term, which is assumed to have a normal distribution with $E(e_t) = 0$, $V(e_t) = \sigma^2$.

In Sharpe's model, the return of a security or portfolio is a linear function of the market return, where the market is typically represented by one of the broad equity indexes. The closer the individual security follows the market, the closer to a value of 1.0 is its beta. If investors can develop an estimate for the general direction of market movement from a study such as Hardouvelis' [14] finding that the stock market responds to monetary information and conclude that individual securities warrant further investigation, then one may make selection on the basis of beta values and one's own willingness to accept risk.

While beta is simply a measure of relative risk, risk itself is determined by some combination of firm fundamentals, market conditions, and the sensitivity of the firm's stock to market conditions. It is the purpose of this study to examine closely the measure of systematic risk found in the single index market model, in order to improve explanatory power. It may be possible to identify macroeconomic variables that influence beta, improve beta estimation, and return explanation.

Techniques designed to improve the prediction of beta estimates based upon fundamental firm characteristics can be traced at least as far back as the study of Beaver, Kettler, and Scholes [3] who identified fundamental relationships between a firm's beta and firm-specific information. Several subsequent fundamental analysis studies are reviewed in Elton and Gruber [8, pp. 119-123]. Some of the variables that were consistently examined and were found to be significant include leverage, dividends, earnings variance, firm size, and industrial classification. Chan and Chen [7] recently found that firm distress, as measured by a cut in dividends of fifty percent or more, and leverage are significant determinants of return at virtually all size levels.

Numerous studies deal with the general topic of stock prices and economic activity. Inflationary impacts are the focus of the conflicting results of Fama [9], Geske and Roll [13], and Stulz [17]. Bulmash and Trivoli [5] recently developed a three-stage model to describe the time lags that transpire between economic conditions and effect on stock prices. For portfolio managers faced with the decision of which securities to buy under a given set of economic circumstances, more specified information is needed concerning which macroeconomic variables are priced. Visscher, Moore, and Kok [19] found continued price adjustment up to 60 days following utility rate decisions. Continued post settlement information flows or inefficient incorporation of settlement information as cited as two potentials for the value of the public information several days following its original dissemination.

Abell and Krueger [2] found that at least one macroeconomic descriptor could be used to explain equity returns in eleven of fifteen industries over the 1980-1986 period. Using significant macroeconomic variables and the 1986 values of these variables, Abell and Krueger were able to improve forecasts of subsequent betas in eight of the eleven industries. Among the extensions of the research of Abell and Krueger and Krueger and Rahbar [15] are a more comprehensive investigation of the predictive power of the variable beta model, inclusion of lagged independent variable values to reflect the speed with which several macroeconomic variables are reported to the public, greater attention is paid to the assumptions of the models, and an updating of the sample period.

VARIABLE BETA MODELS

Contemporaneous Variable Beta Model (VBM)

Following Rosenberg and Marathe [15], when beta is not constant but rather varies over time as a linear function of the concurrent macroeconomic variables, x_i, i=1,2,...,j, then:

Equation 2

$$B_t = b_0 + b_1 x_{1t} + \ldots + b_j x_{jt} + v_t$$

Substituting for B_t in the SIMM results in the following variable beta model (VBM):

Equation 3

$$R_t = a + b_0 R_{mt} + b_1(R_{mt} \times x_{1t}) + \ldots + b_j(R_{mt} \times x_{jt}) + U_t$$

where $U_t = v_t \times R_{mt} + e_t$

We assume that the necessary assumptions of ordinary least squares are satisfied, i.e., U_t's have normal distributions with zero means and equal variances.

When beta is influenced by at least one macroeconomic variable, the term b_0 no longer represents the “pure” beta of the SIMM, nor should one anticipate it taking on the same value as in the SIMM. The b_0 term may be negligible which forces the return of the market to leave the model.

Lagged Variable Beta Model (LBM)

Since the announcement of economic indicators generally is not published simultaneously with the economic condition, the contemporaneous VBM was modified with respect to timing of the report of economic variables. Assuming the jth economic descriptor is not available until the kjth month,

Equation 5

$$B'_t = b_0 + b_1 x_{1,t-k1} + b_2 x_{2,t-k2} + \ldots + b_j x_{j,t-kj} + v'_t$$

The SIMM can be written in the following form:

Equation 6

$$R_t = a + b_0 R_{mt} + b_1(R_{mt} \times x_{1,t-k1}) + \ldots + b_j(R_{mt} \times x_{j,t-kj}) + U'_t$$

where $U'_t = v'_t \times R_{mt} + e_t$

We assume that the necessary assumptions of ordinary least squares are satisfied, i.e., U'_t's have normal distributions with zero means and equal variances. Inclusion of the lagged term implies that official information on the macroeconomic activity from a previous time period is priced by investors. A different set of variables may be significant across industries and across the VBM and LBM.

DATA

SIMMs and VBMs are estimated for the same 17 industry portfolios analyzed by Abell and Krueger. Monthly data was obtained for the January 1985 through December 1991 period. The estimation of portfolio betas helps to minimize the influence of nonsystematic influences, random errors, and spurious correlations.[1] Since Standard and Poor's industry stock indexes are used for the portfolios, one can then make general inferences as to the response of a specific security's beta from observing macroeconomic influences on an industry portfolio's beta. Monthly percentage changes in Standard and Poor's industry stock indexes served as the dependent return variable. Monthly changes on the industry indexes and the Standard and Poor's 500 (SP), which served as a proxy for the total market, were turned into rates of return and expressed as fractions. Selected industries and the notation used to represent them in the empirical results are given in Table 1. These portfolios were chosen because they represent a broad spectrum of the market, including Standard and Poor's high grade and low price portfolios.

TABLE 1
Industry Portfolios

Automobiles (Auto)	Financial (Finance)	Textile
Bank, New York	Machinery	Transportation
Bank, Regional	Paper	Utilities
Bituminous Coal (Coal)	Real Estate Investment Trust (REIT)	High Grade Common (High Grade)
Computer Equipment (Computer)	Retail	Low Price
Pharmaceutical (Drug)	Steel	

Selected macroeconomic variables and the notations employed to represent each in the empirical results are listed in Table 2. These seventeen characteristics are among the most important macroeconomic variables. They tend to be closely followed by both government and market participants.[2] The variables are very similar to those used by Burnie and Gunay [6] to explain Canadian stock returns.

TABLE 2
Macroeconomic Variables

Variable	Notation	Reporting[a] Lag
Budget Deficit, federal government	DEF	3
Building Permits, private housing	BUILD	2
Business Formation, Net	FORM	2
Commercial Paper, 6-month rate	CPR	0
Consumer Price Index	CPI	2
Corporate Bond Yield, AAA Rated	BOND	0
Crude Oil Price Index	OPI	2
Exchange Rate, Weighted Average	EXCH	0
Federal Funds Rate	FF	0
Inventories, Deliveries	INV	2
Merchandise Trade Balance	MTB	3
M2 Money Supply	M2	2
New Orders Consumer Goods	ORDER	3
Plant & Equipment Contracts	PE	2
Producer Price Index	PPI	2
Unemployment Rate, Initial Claims	UN	2
Work Week, Production Workers	WORK	2

a. Average of reporting lag obtained for seven randomly selected months during the 1985 to 1991 period, rounded to the next highest integer. Sources included *Barron's*, *Business Conditions Digest*, and *Federal Reserve Bulletin*. Bond yields, commercial paper rate, federal funds rate, and foreign exchange rates are calculated and published daily.

The right column indicates the number of months transpiring between specified economic conditions and the announcement of such conditions. Announcement lag information was obtained from the *Survey of Current Business*, *Federal Reserve Bulletin*, *Barron's*, and *Wall Street Journal*. Four economic conditions are continuously updated and, hence, exclude a lag. Many of the macroeconomic variables have a reporting lag of two months because they are reported during the following month and would be unknown and unusable in investment deliberations until the beginning of the second month. For instance, inflation rates are reported with a three-week lag. The lag used here is two months because inflation rate information is unavailable until the beginning of the second month. This procedure creates conservative results, since the market has had time to adjust to the inflation announcements during the latter portion of the first month.

FINDINGS

Multiple regression with backward elimination, on the basis of p-values of less than 0.10, is used to regress the return of each industry on the independent variables R_{mt}, $R_{mt} \times x_{1t-k1}$, ..., $R_{mt} \times x_{jt-kj}$. This selection procedure enters all independent variables in the model and eliminates the independent variables one-by-one on the basis of which has the highest p-value of the t-statistic. Elimination of independent variables stopped whenever the p-values of the remaining independent variables were less than 0.10.

The results are presented in Table 3.[3] Results obtained using the single index model, contemporaneous VBM, and LBM for each industry are exhibited in row one, row two, and row three, respectively. Macroeconomic

TABLE 3
Explanation Of Industry Returns

Industry		Independent Variables										A	B	C
Auto	1.	SP										.609	.001	.045
	2.	SP*	(FF+	FORM+	CPR-	WORK-	ORDER+	EXCH-	PE-	UN+	PPI+)	.707	.001	.041
			.005	.009	.013	.023	.044	.059	.060	.077	.072			
	3.	SP*	(FFL	CPRL	MTBL	ORDERL	WORKL	FORML	BONDL)			.700	.001	.042
			.004	.005	.017	.017	.043	.045	.077					
Bank-NY	1.	SP										.306	.001	.066
	2.	SP*	(BUILD	M2	OPI	INV	CPR)					.537	.001	.056
			.001	.001	.001	.001	.002							
	3.	SP*	(FFL	BOND	CPR	1)						.387	.001	.065
			.019	.025	.026	.036								
Bank-	1.	SP										.007	.453	.074
Regional	2.	SP*	(FF	CPI	UN	EXCH	PPI)					.480	.001	.055
			.001	.001	.001	.001	.004							
	3.	SP*	(BONDL	CPRL	EXCHL	UNL	WORKL	INVL	FORML	MTBL	ORDERL)	.402	.001	.061
			.001	.001	.001	.008	.013	.014	.026	.032	.039			
Coal	1.	SP										.473	.001	.042
	2.	SP*	(BOND	EXCH	WORK	FORM)						.561	.001	.039
			.024	.038	.051	.070								
	3.	SP*	(BONDL	EXCHL	DEFL	PPIL)						.602	.001	.037
			.001	.008	.024	.073								
Computer	1.	SP										.417	.001	.052
	2.	SP*	(CPI	PE	WORK	MTB	FORM	DEF)				.575	.001	.046
			.001	.001	.001	.011	.017							
	3.	SP*	(FFL	MTBL	ORDERL	UNL	1	FORML)				.506	.001	.050
			.001	.021	.024	.069	.078	.083						
Drug	1.	SP										.641	.001	.037
	2.	SP*	(FF)									.648	.001	.036
			.001											
	3.	SP*	(FFL	FORML	WORKL	BUILDL	DEFL	INVL	PEL	UNL	MTBL)	.730	.001	.034
			.001	.011	.013	.013	.016	.024	.051	.061	.091			
Finance	1.	SP										.565	.001	.045
	2.	SP*	(OPIL	WORKL	PEL	DEFL	FORML)					.676	.001	.039
			.001	.001	.002	.014	.015							
	3.	SP*	(FF)											
			.001									.594	.001	.044

TABLE 3
Explanation Of Industry Returns
(CONT'D)

Industry		Independent Variables									A	B	C
Machine	1.	SP									.401	.001	.073
	2.	SP*	(WORK	1	PE	OPI)					.469	.001	.070
			.006	.006	.039	.086							
	3.	SP*	(BONDL	OPIL	BUILDL	PEL)					.455	.001	.071
			.001	.041	.056	.062							
Paper	1.	SP									.688	.001	.043
	2.	SP*	(WORK	MTB	CPI	ORDER	INV)				.788	.001	.036
			.001	.001	.002	.006	.030						
	3.	SP*	(DEFL	INVL	PPIL	UNL	EXCHL	FFL	BONDL	CPRL)	.760	.001	.040
			.013	.015	.016	.016	.030	.033	.040	.074			
REIT	1.	SP									.117	.002	.051
	2.	SP*	(FORM	1)							.159	.001	.050
			.051	.061									
	3.	SP*	(DEFL	UNL	BONDL	INVL	1	M2L	ORDERL	BUILDL)	.419	.001	.044
			.001	.001	.008	.017	.017	.057	.061	.062			
Retail	1.	SP									.457	.001	.059
	2.	SP*	(FORM	UN	1	PPI	WORK)				.556	.001	.055
			.001	.003	.005	.007	.026						
	3.	SP*	(FFL	CPRL	EXCHL	BONDL)					.532	.001	.057
			.008	.015	.015	.028							
Steel	1.	SP									.345	.001	.081
	2.	SP*	(FORM	EXCH	CPI)						.452	.001	.075
			.001	.001	.005								
	3.	SP*	(BONDL	M2L	EXCHL	INVL	CPIL	BUILDL	DEFL)		.515	.001	.074
			.001	.006	.007	.008	.010	.011	.018				
Textile	1.	SP									.048	.047	.308
	2.	SP*	(WORK)								.048	.046	.308
			.046										
	3.	SP*	(INVL	BUILDL	M2L	PPIL	WORKL	1)			.235	.003	.291
			.005	.016	.017	.018	.043	.051					
Transport	1.	SP									.572	.001	.047
	2.	SP*	(FF	1	M2	PE)					.631	.001	.045
			.001	.051	.060	.094							
	3.	SP*	(FFL	OPIL	WORKL	PEL)					.642	.001	.044
			.001	.006	.012	.023							
Utility	1.	SP									.057	.029	.106
	2.	SP*	(1)								.057	.029	.106
			.029										
	3.	SP*	(PEL	OPIL	UNL	FFL	PPIL	INVL)			.374	.001	.091
			.001	.001	.001	.029	.042	.077					
High Grade	1	SP									.747	.001	.027
	2.	SP*	(PE	EXCH	FORM	FF	M2)				.828	.001	.022
			.001	.001	.006	.069	.078						
	3.	SP*	(DEFL	FFL	MTBL	CPRL	EXCHL	BONDL)			.821	.001	.023
			.001	.002	.007	.009	.030	.037					
Low Price	1	SP									.564	.001	.051
	2.	SP*	(EXCH	1	BUILD	UN	FF	MTB	ORDER	BOND)	.686	.001	.045
			.001	.001	.003	.003	.005	.011	.016	.058			
	3.	SP*	(FFL	FORML	INVL	OPI	UNL	CPIL	PPIL)		.702	.001	.044
			.001	.001	.001	.001	.001	.001	.012				
AVERAGES		SIMM									.413	.032	.071
		Contemporaneous VBM									.521	.006	.066
		Reporting Lagged VBM									.552	.001	.063

1. Single Index Model
2. Contemporaneous VBM: Macroeconomic Variables are a multiple of macroeconomic variable and S&P 500
3. Reporting Lagged VBM: Macroeconomic Variables are a Multiple of Reporting Lagged Macroeconomic Variable and S&P 500

A. R^2
B. P-Value
C. RMSE

Values beneath the macroeconomic variables are the independent variable's p-value.

variables with p-values less than 0.10 are reported in decreasing order of significance. P-values for each independent variable are exhibited beneath the significant variable. Overall model p-values are exhibited in the middle column of those listed on the right side. Note that macroeconomic variables enter the model as an interaction with the market return. In the contemporaneous VBM, it is assumed that there is complete information regarding the current level of each macroeconomic variable. A reporting lag based upon the time between occurrence and reporting of the macroeconomic variable is used to identify the macroeconomic variable observation in the LBM. Lagged macroeconomic variables are reported with an L attached to the symbols presented in Table 2. A value of 1 in the VBM or LBM rows indicates the presence of the market return in the model.

Single Index Market Model (SIMM)

The coefficient of determination, p-value for the model, and root mean square error of the single index model for each industry is exhibited on the first row of each industry grouping in Table 3. The ability of the single index market model to explain industry returns exhibited a wide range over the 1985-1991 period. The coefficient of determination, R^2, in the auto, drug, and paper industries exceeded 0.60. At the other extreme, the coefficient of determination was under 0.20 in the regional bank, real estate investment trust, textile, and utility industries. The root mean square error was under four percent in only the drug industry and high grade portfolio.

What is perhaps the most surprising finding is the general significance of the single index model. Its p-value was significant at the one percent level in fourteen of seventeen instances. A lack of goodness of fit in the regional bank industry results in a p-value of 0.453. Nonetheless, the average SIMM p-value across all seventeen industries is 0.03.

Contemporaneous Variable Beta Model (VBM)

The VBM is exhibited in the second row within each industry set in Table 3. At least one significant macroeconomic variable was identified using the backward selection procedure in all but the utility industry. The number of significant macroeconomic variables in the VBM ranged from one in the textile and drug industries to nine in the auto industry.

The explanatory power of the VBM was better in every instance except that utility industry. For instance, in the regional bank industry, adding information on the federal funds rate, consumer price index, unemployment rate, exchange rate and producer price index increased the coefficient of determination from 0.007 to 0.480. The R^2 increased by approximately seventy-five percent in the New York bank industry over that of the SIMM. Interestingly, the New York bank portfolio and regional bank portfolio were sensitive to a separate set of variables, with the money supply found in the New York bank regression model, but not in the regional model.

A R^2 increase of over 0.10 may be observed in the computer, paper, steel, finance, and low price portfolios. The average coefficient of determination increase was twenty-five percent. Meanwhile the root mean square error decreased by approximately seven percent, while fifteen of seventeen models had an overall p-value of 0.001.

An interesting finding is the absence of a separate SP term in eleven of the VBMs. This absence does not mean that the S&P 500 return is useless in prediction of industry returns. It indicates that the *S&P 500 ∗ macroeconomic variable* terms will be capturing the important aspects of the market's performance.

Lagged Variable Beta Model (LBM)

Although the usage of historical data might suggest a diminishment in the explanatory power of the VBM, the coefficient of determination increased in several instances. P-values were significant at the 0.01 level in all industries. Meanwhile, the average root mean square error of the LBM was the lowest of the three models.

The number of significant macroeconomic variables ranged from one to nine. Only the federal funds rate influenced the performance of firms in the finance portfolio. A small increase in the coefficient of determination may be noted above that of the single index market model. At the other extreme, nine macroeconomic variables had p-values under 0.10 in the regional bank and drug industries. The p-values of each reported term in the regional bank industry was less than 0.04.

Several interesting characteristics of the macroeconomic variables may be observed. First, the number of variables in the LBM tended to exceed that of the VBM. On average, 5.9 variables were included in the LBM, while 3.8 variables were in the VBM. Investors appear to use additional economic information when attempting to ascertain market conditions without the benefit of the current value for all macroeconomic variables.

Another interesting facet is the inconsistency of explanatory variables as one compares the contemporaneous VBM and the reporting LBM. In fact, the variable with the lowest p-value in the VBM also had the lowest p-value in the LBM in only three instances. Corporate bond yields were consistently most significant in the coal industry, while the federal funds rate was consistently most significant in the drug and transportation industries. The change in macroeconomic variable importance suggests that when certain contemporaneous information is unavailable the marketplace attempts to use alternative variables to capture the underlying influence of the factor priced by investors.

A belief that investors were able to accurately decipher current economic conditions prior to reports would lead to an anticipation that the LBM would have a lesser explanatory power than the VBM. The findings presented here support the usage of the latest economic reports in security selection. In fact, information concerning recent economic conditions is frequently as important as current conditions themselves.

Frequency Of Descriptor Inclusion

As noted above, there was a general increase in the number of significant macroeconomic variables as one moves from the VBM to the LBM. The frequency of each variable's inclusion was measured in order to test the relative importance of the macroeconomic variables within each model and differences across the VBM and LBM. Inclusion frequency data are presented in Table 4.

TABLE 4
Frequency Of Inclusion

Variable	Contemporaneous VBM	Reporting Lagged VBM
Budget Deficit ∗ SP	1	6
Building Permits ∗ SP	2	5
Business Formation ∗ SP	7	5
Commercial Paper Rate ∗ SP	2	6
Consumer Price Index ∗ SP	4	2
Corporate Bond Yield ∗ SP	2	10
Crude Oil Price Index ∗ SP	2	4
Exchange Rate, Weighted ∗ SP	6	6
Federal Funds Rate ∗ SP	6	11
Inventories ∗ SP	2	8
Merchandise Trade Balance ∗ SP	3	3
M2 Money Supply ∗ SP	3	5
Orders of Consumer Goods ∗ SP	3	4
Plant & Equipment Contracts ∗ SP	5	4
Producer Price Index ∗ SP	3	5
Unemployment Rate ∗ SP	4	7
Workweek ∗ SP	7	5
S&P 500	6	4

The federal budget deficit has relatively little impact on a contemporaneous basis. However, when the budget deficit information is lagged there is a six-fold increase in the number of industries where budget deficit information is important in describing returns. Despite the relatively long reporting lag, investors appear to prefer using the reported numbers instead of investor perceptions.

Twelve of the seventeen independent variables were more common in the LBM than the VBM. Among those variables less common in the LBM is the return on the market, as measured by the change in the S&P 500 Index. Since other macroeconomic conditions are not precisely known investors may be relying upon the general trend in the market in security selection. When the other data is properly lagged to represent the real information structure, as in the LBM, the importance of the market return as a separate variable declines.

While none of the macroeconomic descriptors were found in a majority of VBMs, the corporate bond yield and federal funds rate were included in a majority of the LBMs. Their significance is likely due to the rapid reporting of these economic measures. As such, they may be indicators of underlying economic conditions, some of which may not be reported for several months. Supporting this view is the low level of the corporate bond yield's explanatory power in the VBM. The frequency with which the federal funds rate appears in the VBM is one half that of its appearance in the LBM and is less common than work week and business formation in the VBM.

Checking Some Of The Assumptions Of Ordinary Least Squares

One of the assumptions of ordinary least squares is the independence of the error terms across time. Abell and Krueger's [2] examination of the error structure of the SIMM found the assumption of serially uncorrelated errors is inappropriate to a much greater extent than other assumptions, such as homoscedasticity or zero covariance between portfolios. Following Abell and Krueger, the Durbin-Watson D statistic was used to test for the existence of serial correlation in the time series data used here. The values of the D statistic, exhibited in Table 5, are close to 2 for the VBM and LBM. Such a finding does not support the existence of autocorrelation.

TABLE 5
Durbin-Watson D Statistics And First Order Autocorrelation Across Industries

	Contemporaneous VBM		Reporting Lagged VBM	
Industry	Durbin-Watson D	1st Order Autocorrelation	Durbin-Watson D	1st Order Autocorrelation
Auto	1.519	0.227	1.968*	0.014*
Bank - New York	1.739*	0.080*	1.593	0.131
Bank - Regional	2.078*	-0.040*	2.244	-0.125
Coal	2.252	-0.129*	2.039*	-0.021*
Computer	1.893	0.052	1.921*	0.036*
Drug	1.762*	0.037*	1.635	0.089
Finance	1.848	0.011	1.877*	0.009*
Machine	2.085*	-0.046*	2.490	-0.253
Paper	2.040*	-0.039*	2.154	-0.092
REIT	2.391	-0.197	2.163*	-0.082*
Retail	2.151*	-0.112*	2.359	-0.198
Steel	2.024	-0.024	2.004*	-0.008*
Textile	2.551	-0.276	1.880*	0.060*
Transportation	1.963*	-0.076*	2.153	-0.134
Utility	2.145*	-0.074*	2.421	-0.218
High Grade	1.897	-0.044*	2.097*	-0.095
Low Price	1.450	0.274	1.710*	0.141*

*Indicates Durbin-Watson D Statistics Closest To 2.0 And Lowest Level Of First Order Autocorrelation

Within industries, Durbin-Watson D statistics closer to 2.0 and first order autocorrelations closer to 0.0 are highlighted with an asterisk in Table 5. Slightly more asterisks can be observed in the LBM columns. Furthermore, the balance between negative and positive first order autocorrelation values is more even for the LBM. These findings suggests that the LBM is slightly more likely to satisfy the ordinary least squares assumptions of serially independent error terms than the VBM.

CONCLUSION

Fama and French's recent study argues that beta, as measured using the single index model, is unable to explain portfolio returns. Nonetheless, there is the widespread perception that return should be a positive function of risk. Burnie and Gunay, in an article recently published in the *Journal of Financial and Strategic Decisions*, observed that there are several factors beyond the market which account for return variation in a portfolio of firms listed on the Toronto Stock Exchange in an APT framework.

This report examines one method of measuring risk which does not dismiss beta or the rich literature related to beta. Usage of seventeen macroeconomic variables in conjunction with the return on the market in the VBM improved explanation of all monthly returns in sixteen of seventeen industries. The coefficient of determination for the overall model in several industries exceeded seventy percent, and averaged over fifty-two percent. The root mean square error of the VBM was better in every instance except the utility industry.

Despite its historical nature, the average R^2 of the LBM, exceeded that of the VBM in eight industries. The LBM was able to explain more than twice the return variation in several industries where both the SIMM and VBM had little value (i.e., real estate investment trust, textile, and utility). On average, the LBM had both a higher R^2 and lower root mean square error than the other models. These findings suggest that reported economic conditions are as useful as current economic conditions in explaining industry returns.

On a contemporaneous basis, business formations and workweek were most frequently found to be related to returns. The explanatory power of the corporate bond yields and the federal funds rate had the most persistence when values were lagged for their reporting period. The market index had relatively infrequent value beyond that already captured through the multiplication of macroeconomic and market returns. Findings suggests that error terms in the VBM and LBM do not tend to be autocorrelated. Specifying economic variables enhances one's ability to explain returns without abandoning the beta framework.

ENDNOTES

1. Elton and Gruber (1991, p. 112) have noted that individual security betas tend to be more volatile than portfolio betas. Given that changes of individual betas within a portfolio tend to be offsetting, one can be more confident of the response of a portfolio beta to a macroeconomic change than in the case of a single security beta. For this reason, our analysis is limited to the examination of portfolio betas.

2. As with their study, this does not appear to be an unwieldy set of data to input into the VBM. The biggest cost in terms of time and effort would be actual data collection. However, most of these values are widely reported. The actual estimation of beta response to each of the macroeconomic variables is easily completed on most personal computers.

3. Industry betas are not reported due to their volatile nature, as implied by the VBM and LBM. Model components and coefficient p-values are presented to indicate the level of the variable’s significance. Complete regression data, VBM betas, and LBM betas are available upon request.

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