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Economic Forces and the Stock Market*

This paper tests whether innovations in macroeconomic variables are risks that are rewarded in the stock market. Financial theory suggests that the following macroeconomic variables should systematically affect stock market returns: the spread between long and short interest rates, expected and unexpected inflation, industrial production, and the spread between high- and low-grade bonds. We find that these sources of risk are significantly priced. Furthermore, neither the market portfolio nor aggregate consumption are priced separately. We also find that oil price risk is not separately rewarded in the stock market.

I. Introduction

Asset prices are commonly believed to react sensitively to economic news. Daily experience seems to support the view that individual asset prices are influenced by a wide variety of unanticipated events and that some events have a more pervasive effect on asset prices than do others. Consistent with the ability of investors to diversify, modern financial theory has focused on pervasive, or "systematic," influences as the likely source of investment risk.[1] The general conclusion of theory is that an additional component of long-run return is required and obtained whenever a particular asset is influenced by systematic economic news and that no extra reward can be earned by (needlessly) bearing diversifiable risk.

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1. For example, the APT (Ross 1976) and the models of Merton (1973) and Cox, Ingersoll, and Ross (1985) are consistent with this view.

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The theory has been silent, however, about which events are likely to influence all assets. A rather embarrassing gap exists between the theoretically exclusive importance of systematic "state variables" and our complete ignorance of their identity. The comovements of asset prices suggest the presence of underlying exogenous influences, but we have not yet determined which economic variables, if any, are responsible.

Our paper is an exploration of this identification terrain. In Section II, we employ a simple theoretical guide to help choose likely candidates for pervasive state variables. In Section III we introduce the data and explain the techniques used to measure unanticipated movements in the proposed state variables. Section IV investigates whether exposure to systematic state variables explains expected returns. As specific alternatives to the pricing influence of the state variables identified by our simple theoretical model, Section IV considers the value- and the equally weighted market indices, an index of real consumption, and an index of oil prices. Each of these is found to be unimportant for pricing when compared with the identified economic state variables. Section V briefly summarizes our findings and suggests some directions for future research.

II. Theory

No satisfactory theory would argue that the relation between financial markets and the macroeconomy is entirely in one direction. However, stock prices are usually considered as responding to external forces (even though they may have a feedback on the other variables). It is apparent that all economic variables are endogenous in some ultimate sense. Only natural forces, such as supernovas, earthquakes, and the like, are truly exogenous to the world economy, but to base an asset-pricing model on these systematic physical factors is well beyond our current abilities. Our present goal is merely to model equity returns as functions of macro variables and nonequity asset returns. Hence this paper will take the stock market as endogenous, relative to other markets.

By the diversification argument that is implicit in capital market theory, only general economic state variables will influence the pricing of large stock market aggregates. Any systematic variables that affect the economy's pricing operator or that influence dividends would also influence stock market returns. Additionally, any variables that are necessary to complete the description of the state of nature will also be part of the description of the systematic risk factors. An example of such a variable would be one that has no direct influence on current cash flows but that does describe the changing investment opportunity set.

Stock prices can be written as expected discounted dividends:

$$p = \frac{E(c)}{k}, \tag{1}$$

where c is the dividend stream and k is the discount rate. This implies that actual returns in any period are given by

$$\frac{dp}{p} + \frac{c}{p} = \frac{d[E(c)]}{E(c)} - \frac{dk}{k} + \frac{c}{p}. \tag{2}$$

It follows (trivially) that the systematic forces that influence returns are those that change discount factors, k, and expected cash flows, $E(c)$.[2]

The discount rate is an average of rates over time, and it changes with both the level of rates and the term-structure spreads across different maturities. Unanticipated changes in the riskless interest rate will therefore influence pricing, and, through their influence on the time value of future cash flows, they will influence returns. The discount rate also depends on the risk premium; hence, unanticipated changes in the premium will influence returns. On the demand side, changes in the indirect marginal utility of real wealth, perhaps as measured by real consumption changes, will influence pricing, and such effects should also show up as unanticipated changes in risk premia.

Expected cash flows change because of both real and nominal forces. Changes in the expected rate of inflation would influence nominal expected cash flows as well as the nominal rate of interest. To the extent that pricing is done in real terms, unanticipated price-level changes will have a systematic effect, and to the extent that relative prices change along with general inflation, there can also be a change in asset valuation associated with changes in the average inflation rate. Finally, changes in the expected level of real production would affect the current real value of cash flows. Insofar as the risk-premium measure does not capture industrial production uncertainty, innovations in the rate of productive activity should have an influence on stock returns through their impact on cash flows.

III. Constructing the Economic Factors

Having proposed a set of relevant variables, we must now specify their measurement and obtain time series of unanticipated movements. We could proceed by identifying and estimating a vector autoregressive model in an attempt to use its residuals as the unanticipated innova-

2. Since we are only concerned with intuition, we are ignoring the second-order terms from the stochastic calculus in deriving eq. (2). Also notice that the expectation is taken with respect to the martingale pricing measure (see Cox et al. 1985) and not with respect to the ordinary probability distribution.

tions in the economic factors. It is, however, more interesting and (perhaps) robust out of sample to employ theory to find single equations that can be estimated directly. In particular, since monthly rates of return are nearly serially uncorrelated, they can be employed as innovations without alteration. The general impact of a failure adequately to filter out the expected movement in an independent variable is to introduce an errors-in-variables problem. This has to be traded off against the error introduced by misspecification of the estimated equation for determining the expected movement.

A somewhat subtler version of the same problem arises with procedures such as vector autoregression. Any such statistically based time-series approach will find lagged stock market returns having a significant predictive content for macroeconomic variables. In the analysis of pricing, then, we will indirectly be using lagged stock market variables to explain the expected returns on portfolios of stocks. Whatever econometric advantages such an approach might offer, it is antithetical to the spirit of this investigation, which is to explore the pricing influence of exogenous macroeconomic variables. For this reason, as much as for any other, we have chosen to follow the simpler route in constructing the time series we use.[3]

Throughout this paper we adopt the convention that time subscripts apply to the end of the time period. The standard period is 1 month. Thus, $E(\ \ |t-1)$ denotes the expectation operator at the end of month $t-1$ conditional on the information set available at the end of month $t-1$, and $X(t)$ denotes the value of variable X in month t, or the growth that prevailed from the end of $t-1$ to the end of t.

A. *Industrial Production*

The basic series is the growth rate in U.S. industrial production. It was obtained from the *Survey of Current Business*. If IP(t) denotes the rate of industrial production in month t, then the monthly growth rate is

$$\mathrm{MP}(t) = \log_e \mathrm{IP}(t) - \log_e \mathrm{IP}(t-1), \tag{3}$$

and the yearly growth rate is

$$\mathrm{YP}(t) = \log_e \mathrm{IP}(t) - \log_e \mathrm{IP}(t-12) \tag{4}$$

(see table 1 for a summary of variables).

Because IP(t) actually is the flow of industrial production during month t, MP(t) measures the change in industrial production lagged by at least a partial month. To make this variable contemporaneous with other series, subsequent statistical work will lead it by 1 month. Except for an annual seasonal, it is noisy enough to be treated as an innovation.

3. In addition, the pricing tests reported below used portfolios that have induced autocorrelations in their returns arising from the nontrading effect.

TABLE 1 Glossary and Definitions of Variables

Symbol	Variable	Definition or Source
	Basic Series	
I	Inflation	Log relative of U.S. Consumer Price Index
TB	Treasury-bill rate	End-of-period return on 1-month bills
LGB	Long-term government bonds	Return on long-term government bonds (1958–78: Ibbotson and Sinquefield [1982]; 1979–83: CRSP)
IP	Industrial production	Industrial production during month (*Survey of Current Business*)
Baa	Low-grade bonds	Return on bonds rated Baa and under (1953–77: Ibbotson [1979], constructed for 1978–83)
EWNY	Equally weighted equities	Return on equally weighted portfolio of NYSE-listed stocks (CRSP)
VWNY	Value-weighted equities	Return on a value-weighted portfolio of NYSE-listed stocks (CRSP)
CG	Consumption	Growth rate in real per capita consumption (Hansen and Singleton [1982]; *Survey of Current Business*)
OG	Oil prices	Log relative of Producer Price Index/Crude Petroleum series (Bureau of Labor Statistics)
	Derived Series	
MP(t)	Monthly growth, industrial production	$\log_e[\mathrm{IP}(t)/\mathrm{IP}(t-1)]$
YP(t)	Annual growth, industrial production	$\log_e[\mathrm{IP}(t)/\mathrm{IP}(t-12)]$
E[I(t)]	Expected inflation	Fama and Gibbons (1984)
UI(t)	Unexpected inflation	$\mathrm{I}(t) - \mathrm{E}[\mathrm{I}(t)\mid t-1]$
RHO(t)	Real interest (ex post)	$\mathrm{TB}(t-1) - \mathrm{I}(t)$
DEI(t)	Change in expected inflation	$\mathrm{E}[\mathrm{I}(t+1)\mid t] - \mathrm{E}[\mathrm{I}(t)\mid t-1]$
URP(t)	Risk premium	$\mathrm{Baa}(t) - \mathrm{LGB}(t)$
UTS(t)	Term structure	$\mathrm{LGB}(t) - \mathrm{TB}(t-1)$

The monthly series of yearly growth rates, YP(t), was examined because the equity market is related to changes in industrial activity in the long run. Since stock market prices involve the valuation of cash flows over long periods in the future, monthly stock returns may not be highly related to contemporaneous monthly changes in rates of industrial production, although such changes might capture the information pertinent for pricing. This month's change in stock prices probably reflects changes in industrial production anticipated many months into the future. Therefore, subsequent statistical work will lead this variable by 1 year, similar to the variable used in Fama (1981).

Because of the overlap in the series, YP(t) is highly autocorrelated. A procedure was developed for forecasting expected YP(t) and a series of unanticipated changes in YP(t), and changes in the expectation itself were examined for their influence on pricing. The resulting series offered no discernible advantage over the raw production series, and, as a consequence, they have been dropped from the analysis.[4]

B. *Inflation*

Unanticipated inflation is defined as

$$\mathrm{UI}(t) = \mathrm{I}(t) - E[\mathrm{I}(t)|t - 1], \tag{5}$$

where I(t) is the realized monthly first difference in the logarithm of the Consumer Price Index for period t. The series of expected inflation, $E[\mathrm{I}(t)|t - 1]$ for the period 1953–78, is obtained from Fama and Gibbons (1984). If RHO(t) denotes the ex post real rate of interest applicable in period t and TB($t - 1$) denotes the Treasury-bill rate known at the end of period $t - 1$ and applying to period t, then Fisher's equation asserts that

$$\mathrm{TB}(t - 1) = E[\mathrm{RHO}(t)|t - 1] + E[\mathrm{I}(t)|t - 1]. \tag{6}$$

Hence, $\mathrm{TB}(t - 1) - \mathrm{I}(t)$ measures the ex post real return on Treasury bills in the period. From a time-series analysis of this variable, Fama and Gibbons (1984) constructed a time series for $E[\mathrm{RHO}(t)|t - 1]$. Our expected inflation variable is defined by subtracting their time series for the expected real rate from the TB($t - 1$) series.

Another inflation variable that is unanticipated and that might have an influence separable from UI is

$$\mathrm{DEI}(t) = E[\mathrm{I}(t + 1)|t] - E[\mathrm{I}(t)|t - 1], \tag{7}$$

the change in expected inflation. We subscript this variable with t since it is (in principle) unknown at the end of month $t - 1$. While, strictly speaking, DEI(t) need not have mean zero, under the additional assumption that expected inflation follows a martingale this variable may be treated as an innovation, and it may contain information not present in the UI variable. This would occur whenever inflation forecasts are influenced by economic factors other than past forecasting errors. (Notice that the UI series and the DEI series will contain the information in a series of innovations in the nominal interest rate, TB.)[5]

4. Results that include these series are available in an earlier draft of the paper, which is available from the authors on request.

5. As an aside, the resulting unanticipated inflation variable, UI(t), is perfectly negatively correlated with the unanticipated change in the real rate. This follows from the observation that the Fisher equation (6) holds for realized rates as well as for expectations. The UI(t) series also has a simple correlation of .98 with the unanticipated inflation series in Fama (1981).

C. *Risk Premia*

To capture the effect on returns of unanticipated changes in risk premia, we will employ another variable drawn from the money markets. The variable, UPR, is defined as

$$\text{UPR}(t) = \text{``Baa and under'' bond portfolio return } (t) - \text{LGB}(t), \tag{8}$$

where LGB(t) is the return on a portfolio of long-term government bonds obtained from Ibbotson and Sinquefield (1982) for the period 1953–78. From 1979 through 1983, LGB(t) was obtained from the Center for Research in Securities Prices (CRSP) data file. Again, UPR is not formally an innovation, but, as the differences in two return series, it is sufficiently uncorrelated that we can treat it as unanticipated, and we will use it as a member of the set of economic factors.

The low-grade bond return series is for nonconvertible corporate bonds, and it was obtained from R. G. Ibbotson and Company for the period prior to 1977. A detailed description of the sample is contained in Ibbotson (1979). The low-grade series was extended through 1983 by choosing 10 bonds whose ratings on January 1966 were below Baa. By 1978 these bonds still were rated below Baa, but their maturity was shorter than that of the long-term government bond series. These 10 bonds were then combined with three that were left over from the Ibbotson series at the end of 1978 to create a low-grade bond portfolio of 13 bonds in all. The returns on this portfolio were then used to extend the UPR series beyond 1977 and through 1983. Two further difficulties with the series are that the ratings have experienced considerable inflation since the mid-1950s and that the low-grade series contains bonds that are unrated.

The UPR variable would have mean zero in a risk-neutral world, and it is natural to think of it as a direct measure of the degree of risk aversion implicit in pricing (at least insofar as the rating agencies maintain constant standards for their classifications). We hoped that UPR would reflect much of the unanticipated movement in the degree of risk aversion and in the level of risk implicit in the market's pricing of stocks.[6]

D. *The Term Structure*

To capture the influence of the shape of the term structure, we employ another interest rate variable,

$$\text{UTS}(t) = \text{LGB}(t) - \text{TB}(t - 1). \tag{9}$$

6. It could be argued that UPR captures a leverage effect, with highly levered firms being associated with lower ratings. Furthermore, UPR is also similar to a measure of equity returns since a substantial portion of the value of low-grade bonds comes from the same sort of call option (behind secured debt) as for ordinary stock.

Again, under the appropriate form of risk neutrality,

$$E[\text{UTS}(t)|t - 1] = 0, \tag{10}$$

and this variable can be thought of as measuring the unanticipated return on long bonds. The assumption of risk neutrality is used only to isolate the pure term-structure effects; the variable UPR is used to capture the effect of changes in risk aversion.

E. *Market Indices*

The major thrust of our effort is to examine the relation between non-equity economic variables and stock returns. However, because of the smoothing and averaging characteristics of most macroeconomic time series, in short holding periods, such as a single month, these series cannot be expected to capture all the information available to the market in the same period. Stock prices, on the other hand, respond very quickly to public information. The effect of this is to guarantee that market returns will be, at best, weakly related and very noisy relative to innovations in macroeconomic factors.

This should bias our results in favor of finding a stronger linkage between the time-series returns on market indices and other portfolios of stock returns than between these portfolio returns and innovations in the macro variables. To examine the relative pricing influence of the traditional market indices we used the following variables:

$$\begin{aligned} \text{EWNY}(t) &= \text{return on the equally weighted NYSE index;} \\ \text{VWNY}(t) &= \text{return on the value-weighted NYSE index.} \end{aligned} \tag{11}$$

These variables should reflect both the real information in the industrial production series and the nominal influence of the inflation variables.

F. *Consumption*

In addition to the macro variables discussed above, we also examined a time series of percentage changes in real consumption, CG. The series is in real per capita terms and includes service flows. It was constructed by dividing the CITIBASE series of seasonally adjusted real consumption (excluding durables) by the Bureau of Census's monthly population estimates. The CG series extends from January 1959 to December 1983, and it is an extension of a series obtained from Lars Hansen for the period through 1979. A detailed description of its construction can be found in Hansen and Singleton (1983).

G. *Oil Prices*

It is often argued that oil prices must be included in any list of the systematic factors that influence stock market returns and pricing. To test this proposition and to examine another alternative to the macro variables discussed above, we formed the OG series of realized monthly first differences in the logarithm of the Producer Price Index/ Crude Petroleum series (obtained from the Bureau of Labor Statistics, U.S. Department of Labor, DRI series no. 3884). The glossary in table 1 summarizes the variables.

H. Statistical Characteristics of the Macro Variables

Table 2 displays the correlation matrix for the state variables. The correlation matrices of table 2 are computed for several different pe-

TABLE 2 **Correlation Matrices for Economic Variables**

Symbol	EWNY	VWNY	MP	DEI	UI	UPR	UTS
			A. January 1953–November 1983				
VWNY	.916						
MP	.103	.020					
DEI	−.163	−.119	.063				
UI	−.163	−.112	−.067	.378			
UPR	.105	.042	.216	.266	.018		
UTS	.227	.248	−.159	−.394	−.103	−.752	
YP	.270	.270	.139	−.003	−.005	.113	.099
			B. January 1953–December 1972				
VWNY	.930						
MP	.147	.081					
DEI	−.130	−.122	.020				
UI	−.081	−.021	−.203	.388			
UPR	.265	.214	.213	.068	−.072		
UTS	.110	.108	−.059	−.210	−.041	−.688	
YP	.260	.238	.128	−.013	−.032	.128	.063
			C. January 1973–December 1977				
VWNY	.883						
MP	.022	−.118					
DEI	−.314	−.263	.004				
UI	−.377	−.352	−.004	.505			
UPR	.341	.231	.227	.032	−.289		
UTS	.217	.313	−.350	−.280	.026	−.554	
YP	.335	.361	.107	−.124	−.334	.221	.174
			D. January 1978–November 1983				
VWNY	.937						
MP	.092	−.010					
DEI	−.143	−.073	.169				
UI	−.055	−.024	.168	.375			
UPR	−.275	−.319	.248	.458	.259		
UTS	.424	.431	−.277	−.512	−.239	−.890	
YP	.269	.261	.193	.053	.247	.018	.115

NOTE.—VWNY = return on the value-weighted NYSE index; EWNY = return on the equally weighted NYSE index; MP = monthly growth rate in industrial production; DEI = change in expected inflation; UI = unanticipated inflation; UPR = unanticipated change in the risk premium (Baa and under return − long-term government bond return); UTS = unanticipated change in the term structure (long-term government bond return − Treasury-bill rate); and YP = yearly growth rate in industrial production.

TABLE 3 **Autocorrelations of the Economic Variables, January 1953–November 1983**

Symbol	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}	ρ_{11}	ρ_{12}	Adjusted Box/Pierce (24)
YP	.9615	.8896	.7937	.6838	.5658	.4477	.3290	.2088	.0919	−.0196	−.1233	−.2109	1,639
MP	−.0990	−.1711	−.1204	.0413	.0778	.0241	.0765	.0240	−.1558	−.2122	−.1914	.8030	632.9
DEI	−.0432	−.0864	−.0094	−.0719	.0284	.0130	−.0874	.1662	.1101	−.0290	.0297	.0007	43.33
UI	.1804	.1314	.0567	.0483	.0490	−.0454	−.0398	.0535	.1391	.1536	.1361	.1875	85.50
UPR	−.1053	.0491	−.1340	.0882	−.0196	.0422	−.1297	.0117	−.0494	−.0733	.0834	.0264	52.81
UTS	.0267	−.0052	−.1637	.0383	.0739	.0750	−.0929	−.0278	.0023	−.0105	.1693	−.0029	57.15
CG	−.2458	−.0269	.1190	.0192	−.0460	.0082	.0497	−.0496	.0121	.0470	.1364	−.1324	53.06
OG	.4088	.2194	.1523	.1613	.0954	.1447	.1594	.0674	.0969	.0976	.0609	−.0038	159.0
EWNY	.1447	−.0133	.0141	.0554	.0518	−.0213	−.0959	−.0861	.0072	−.0140	.0043	.0997	40.43
VWNY	.0677	−.0223	.0456	.0936	.0909	−.0755	−.0779	−.0258	.0147	−.0515	−.0320	.0655	37.24

NOTE.—YP = yearly growth rate in industrial production; MP = monthly growth rate in industrial production; DEI = change in expected inflation; UI = unanticipated inflation; UPR = unanticipated change in the risk premium (Baa and under return − long-term government bond return); UTS = unanticipated change in the term structure (long-term government bond return − Treasury-bill rate); CG = growth rate in real per capita consumption; OG = growth rate in oil prices; EWNY = return on the equally weighted NYSE index; and VWNY = return on the value-weighted NYSE index.

riods; part A covers the entire 371-month sample period from January 1953 through November 1983, and the remaining parts cover three subperiods, with breaks at December 1977 and January 1973. We have broken the sample at this time because it is often argued that the oil price jump in 1973 presaged a structural shift in the macro variables. (The work of Litterman and Weiss [1983] supports this view, but, although we have performed no formal tests, the correlation matrix does not appear to differ markedly across the subperiods.)

With the exception of the market indices, the strongest correlation is between UPR and UTS. This is to be expected since they both use the long-term bond series, LGB(t). The resulting collinearity tends to weaken the individual impact of these variables. Substituting an Aaa corporate bond series for treasuries in the definition of UPR did, in fact, improve the significance of both UPR and UTS, but the improvement was not sufficiently important to make a qualitative difference in our findings.

The production series, YP and MP, are correlated with each other and with each of the other variables except DEI and UI, which are also strongly correlated. These latter two series are correlated because they both contain the EI(t) series, and the negative correlation between DEI and UTS occurs for a similar reason. A number of other correlations are not negligible, but the variables are far from perfectly correlated, and no one variable can be substituted for any other.

Table 3 displays the autocorrelations for the state variables computed over the entire sample period, January 1953–November 1983. There are no surprises here; as expected, YP is highly autocorrelated. The variables generally display mild autocorrelations, and many of them have seasonals at the 12-month lag. The MP series, in particular, has a peak in its lag at 12 months (repeated at 24 months), warning that this variable is highly seasonal. As noted above, the autocorrelation in the state variables implies the existence of an errors-in-variables problem that will bias estimates of the loadings of the stock returns on these variables and will bias downward estimates of statistical significance.

IV. The Economic State Variables and Asset Pricing

A. *Basic Results*

Using the state variables[7] defined above implies that individual stock returns follow a factor model of the form

7. We did the following experiment to find out if asset prices do, in fact, react to news associated with our proposed economic state variables. We first extracted the most important stock factors (common covariations) during the period 1953–72, using the Chen (1983) algorithm. Five factors were chosen on the basis of previous empirical studies (see Roll and Ross 1980; Brown and Weinstein 1983). The factors can be thought of as portfolios constructed to capture the common movements in stock market returns.

$$R = a + b_{MP}MP + b_{DEI}DEI + b_{UI}UI + b_{UPR}UPR + b_{UTS}UTS + e, \tag{12}$$

where the betas are the loadings on the state variables, a is the constant term, and e is an idiosyncratic error term. To ascertain whether the identified economic state variables are related to the underlying factors that explain pricing in the stock market, a version of the Fama-MacBeth (1973) technique was employed. The procedure was as follows. (*a*) A sample of assets was chosen. (*b*) The assets' exposure to the economic state variables was estimated by regressing their returns on the unanticipated changes in the economic variables over some estimation period (we used the previous 5 years). (*c*) The resulting estimates of exposure (betas) were used as the independent variables in 12 cross-sectional regressions, one regression for each of the next 12 months, with asset returns for the month being the dependent variable. Each coefficient from a cross-sectional regression provides an estimate of the sum of the risk premium, if any, associated with the state variable and the unanticipated movement in the state variable for that month. (*d*) Steps *b* and *c* were then repeated for each year in the sample, yielding for each macro variable a time series of estimates of its associated risk premium. The time-series means of these estimates were then tested by a *t*-test for significant difference from zero.

To control the errors-in-variables problem that arises from the use at step *c* of the beta estimates obtained in step *b* and to reduce the noise in individual asset returns, the securities were grouped into portfolios. An effort was made to construct the portfolios so as to spread their expected returns over a wide range in an effort to improve the discriminatory power of the cross-sectional regression tests. To accomplish this spreading we formed portfolios on the basis of firm size. Firm size is known to be strongly related to average return (see Banz 1981), and we hoped that it would provide the desired dispersion without biasing the tests of the economic variables. (It has been facetiously noted that size may be the best theory we now have of expected returns. Unfortunately, this is less of a theory than an empirical observation.)[8]

The time series of those five factors were then each regressed on the state variables. An economic variable is significantly related to stock movements if and only if it is significantly related to at least one of the five common stock factors. The null hypothesis for each variable is the restriction across the equations that the five regression coefficients for that variable (one to each of the factor regressions) are jointly zero. The null hypothesis was rejected for the production growth, the term structure, and the risk premium variables. The support for the inflation variables, however, was weak. When a market index was included in the list of state variables, the significance of the other variables remained unchanged, except for the production variable, which became insignificantly related to the time series of the factors.

8. A number of alternative experiments were run in which securities were grouped into portfolios according to (*a*) their betas on a market index, (*b*) the standard deviation of their returns in a market-model regression (i.e., their residual variability), and (*c*) the

Table 4 reports the results of these tests on 20 equally weighted portfolios, grouped according to the total market values of their constituent securities at the beginning of each test period. Each part of table 4 is broken into four subperiods beginning with January 1958, the first month preceded by the requisite 60 months of data used to estimate exposures. Part A of table 4 examines the state variables, YP, MP, DEI, UI, UPR, and UTS. Over the entire sample period MP, UI, and UPR are significant, while UTS is marginally so. The inflation-related variables, DEI and UI, were highly significant in the 1968–77 period and insignificant both earlier and later. The yearly production series, YP, was not significant in any subperiod, and, as can be seen from part B, deleting it had no substantive effect on the remaining state variables. Although the coefficients have the same signs as in the overall period, they are generally smaller in absolute magnitude and less significant in the last subperiod, 1978–84.[9]

While we have not developed a theoretical foundation for the signs of the state variables, it is worth noting that their signs are, at least, plausible. The positive sign on MP reflects the value of insuring against real systematic production risks. Similarly, UPR has a positive risk premium since individuals would want to hedge against unanticipated increases in the aggregate risk premium occasioned by an increase in uncertainty. Since changes in inflation have the general effect of shifting wealth among investors, there is no strong a priori presumption that would sign the risk premia for UI or DEI, but the negative signs on the premia for these variables probably mean that stock market assets are generally perceived to be hedges against the adverse influence on other assets that are, presumably, relatively more fixed in nominal terms.

As for UTS, the negative risk premium indicates that stocks whose returns are inversely related to increases in long rates over short rates are, ceteris paribus, more valuable. One interpretation of this result is that UTS measures a change in the long-term real rate of interest (remember that inflation effects are included in the other variables). After long-term real rates decrease, there is subsequently a lower real return on any form of capital. Investors who want protection against this possibility will place a relatively higher value on assets whose price increases when long-term real rates decline, and such assets will carry a negative risk premium. Thus, stocks whose returns are cor-

level of the stock price. These efforts were not successful. The first two of these grouping techniques failed completely to spread portfolio returns out of sample and had to be discarded. Grouping by the level of the stock price did spread returns, although not as well as did size, but the state variables were then individually only marginally significant, and the market indices were of no significance. The sensitivity of the results to different grouping techniques is an important area for research.

9. This subperiod had only about two-thirds as many observations as did the first two subperiods.

TABLE 4 **Economic Variables and Pricing (Percent per Month × 10), Multivariate Approach**

A

Years	YP	MP	DEI	UI	UPR	UTS	Constant
1958–84	4.341	13.984	−.111	−.672	7.941	−5.87	4.112
	(.538)	(3.727)	(−1.499)	(−2.052)	(2.807)	(−1.844)	(1.334)
1958–67	.417	15.760	.014	−.133	5.584	.535	4.868
	(.032)	(2.270)	(.191)	(−.259)	(1.923)	(.240)	(1.156)
1968–77	1.819	15.645	−.264	−1.420	14.352	−14.329	−2.544
	(.145)	(2.504)	(−3.397)	(−3.470)	(3.161)	(−2.672)	(−.464)
1978–84	13.549	8.937	−.070	−.373	2.150	−2.941	12.541
	(.774)	(1.602)	(−.289)	(−.442)	(.279)	(−.327)	(1.911)

B

	MP	DEI	UI	UPR	UTS	Constant
1958–84	13.589	−.125	−.629	7.205	−5.211	4.124
	(3.561)	(−1.640)	(−1.979)	(2.590)	(−1.690)	(1.361)
1958–67	13.155	.006	−.191	5.560	−.008	4.989
	(1.897)	(.092)	(−.382)	(1.935)	(−.004)	(1.271)
1968–77	16.966	−.245	−1.353	12.717	−13.142	−1.889
	(2.638)	(−3.215)	(−3.320)	(2.852)	(−2.554)	(−.334)
1978–84	9.383	−.140	−.221	1.679	−1.312	11.477
	(1.588)	(−.552)	(−.274)	(.221)	(−.149)	(1.747)

C

	EWNY	MP	DEI	UI	UPR	UTS	Constant
1958–84	5.021	14.009	−.128	−.848	8.130	−5.017	6.409
	(1.218)	(3.774)	(−1.666)	(−2.541)	(2.855)	(−1.576)	(1.848)
1958–67	6.575	14.936	−.005	−.279	5.747	−.146	7.349
	(1.199)	(2.336)	(−.060)	(−.558)	(2.070)	(−.067)	(1.591)
1968–77	2.334	17.593	−.248	−1.501	12.512	−9.904	3.542
	(.283)	(2.715)	(−3.039)	(−3.366)	(2.758)	(−2.015)	(.558)
1978–84	6.638	7.563	−.132	−.729	5.273	−4.993	9.164
	(.906)	(1.253)	(−.529)	(−.847)	(.663)	(−.520)	(1.245)

D

	VWNY	MP	DEI	UI	UPR	UTS	Constant
1958–84	−2.403	11.756	−.123	−.795	8.274	−5.905	10.713
	(−.633)	(3.054)	(−1.600)	(−2.376)	(2.972)	(−1.879)	(2.755)
1958–67	1.359	12.394	.005	−.209	5.204	−.086	9.527
	(.277)	(1.789)	(.064)	(−.415)	(1.815)	(−.040)	(1.984)
1968–77	−5.269	13.466	−.255	−1.421	12.897	−11.708	8.582
	(−.717)	(2.038)	(−3.237)	(−3.106)	(2.955)	(−2.299)	(1.167)
1978–84	−3.683	8.402	−.116	−.739	6.056	−5.928	15.452
	(−.491)	(1.432)	(−.458)	(−.869)	(.782)	(−.644)	(1.867)

NOTE.—VWNY = return on the value-weighted NYSE index; EWNY = return on the equally weighted NYSE index; MP = monthly growth rate in industrial production; DEI = change in expected inflation; UI = unanticipated inflation; UPR = unanticipated change in the risk premium (Baa and under return − long-term government bond return); UTS = unanticipated change in the term structure (long-term government bond return − Treasury-bill rate); and YP = yearly growth rate in industrial production. t-statistics are in parentheses.

related with long-term bond returns, abstracting from unanticipated changes in inflation or in expected inflation and holding all other characteristics equal, will be more valuable than stocks that are uncorrelated or negatively correlated with long-term bond returns.

To test the pricing influence on the market indices, EWNY and VWNY were added to the set of state variables (actually, they were substituted for YP). It would not be inconsistent with asset-pricing theory to discover, for example, that the betas on the market portfolio were sufficient to capture the pricing impact of the macroeconomic state variables, and it would certainly rationalize past efforts that have focused on examining the efficiency of a market index. In some sense, then, an important test of the independent explanatory influence of the macroeconomic variables on pricing is to see how they fare in direct competition with a market index.

Parts C and D of table 4 report the results of such tests. Using the EWNY as a substitute for YP and including MP, DEI, UI, UPR, and UTS, we find in part C that the market index fails to have a statistically significant effect on pricing in any subperiod. On the other hand, the original macroeconomic variables have about the same significance as they did in part B. Nor are these results affected by the choice of market index; part D of table 4 reports similar results when using the VWNY.

By contrast with the tests reported in table 4, table 5 reports on tests that purposely have been designed to enhance the impact of the market indices. The tests discussed above were "fair" in the sense that the time-series regressions that measured the betas and the subsequent cross-sectional regressions that estimated their pricing influence gave each variable an a priori equal opportunity to be significant; that is, the design treated the variables in a symmetric fashion. The tests reported in table 5 are asymmetric in that they are weighted a priori to favor the market indices.

The tests in table 4 can be interpreted from the perspective of the arbitrage pricing theory. They are tests of whether the set of economic variables can be usefully augmented by the inclusion of a market index. In this sense they are tests of whether the market contains missing priced factors or, alternatively, whether the factors fail to have pricing significance as against the market. The tests in table 5 are best interpreted as tests whose null hypothesis is the CAPM, or, rather more simply, the efficiency of the index. If the index is efficient, then the factors should not improve on its pricing ability. Of course, all these interpretations are subject to the caveat that the factors may only help to improve the estimate of the "true" market portfolio either by accounting for missing assets or through their correlations with measurement errors in the market beta estimates.

TABLE 5 **Economic Variables and Pricing**

Years	VWNY	MP	DEI	UI	UPR	UTS	Constant
				A			
1958–84	14.527	...	...	...	...	...	−5.831
	(2.356)						(−.961)
1958–67	5.005	...	...	...	...	...	6.853
	(.673)						(.928)
1968–77	17.987	...	...	...	...	...	−15.034
	(1.460)						(−1.254)
1978–84	23.187	...	...	...	...	...	−10.802
	(1.935)						(−.907)
				B			
1958–84	−9.989	12.185	−.145	−.912	9.812	−5.448	10.714
	(−2.014)	(3.153)	(−1.817)	(−2.590)	(3.355)	(−1.609)	(2.755)
1958–67	−5.714	13.024	.004	−.193	6.104	−.593	9.527
	(−1.008)	(1.852)	(.057)	(−.369)	(1.994)	(−.260)	(1.983)
1968–77	−17.396	14.467	−.291	−1.614	14.367	−9.227	8.584
	(−1.824)	(2.214)	(−3.388)	(−3.297)	(3.128)	(−1.775)	(1.167)
1978–84	−5.515	7.725	−.150	−.935	8.602	−6.986	15.454
	(−.513)	(1.303)	(−.574)	(−1.051)	(1.064)	(−.681)	(1.867)
				C			
1958–84	11.507	10.487	−.190	−.738	8.126	−7.073	−3.781
	(1.189)	(2.761)	(−2.459)	(−2.215)	(2.869)	(−2.194)	(−.402)
1958–67	22.311	9.597	.001	−.163	3.186	.697	−11.734
	(1.950)	(1.494)	(.012)	(−.341)	(1.474)	(.337)	(−1.015)
1968–77	11.689	13.381	−.293	−1.422	13.007	−12.981	−9.488
	(.622)	(1.947)	(−3.590)	(−2.814)	(2.697)	(−2.214)	(−.526)
1978–84	−4.188	7.624	−.316	−.584	8.211	−9.735	15.732
	(−.207)	(1.286)	(−1.246)	(−.716)	(1.039)	(−1.123)	(.803)

NOTE.—VWNY = return on the value-weighted NYSE index; EWNY = return on the equally weighted NYSE index; MP = monthly growth rate in industrial production; DEI = change in expected inflation; UI = unanticipated inflation; UPR = unanticipated change in the risk premium (Baa and under return − long-term government bond return); and UTS = unanticipated change in the term structure (long-term government bond return − Treasury-bill rate). *t*-statistics are in parentheses.

Part A of table 5 reports the results of a simple test of the pricing influence of the ordinary CAPM betas computed from the VWNY index in the absence of the state variables. The VWNY-index betas are significant and positively related to average returns over the entire period, although they are significant only in the last subperiod. Part B of table 5 reports a more demanding test of the pricing influence of the index. These results differ from part D of table 4 because the cross sections were run with the simple betas for the VWNY index (instead of betas from a multivariate time-series regression). The betas for the state variables came from multivariate time-series regressions with only those variables included (they are the same as those used in part B of table 4). The VWNY betas are significant over the entire period but appear with a negative sign, and a comparison with part B of table 4 reveals that neither the coefficients nor the significance of the factor betas is altered substantially by the inclusion of the market index. (The results for the EWNY were essentially the same.)

Part C of table 5 reports on a final test in which, instead of estimating the index betas for the VWNY in the same fashion as for the other variables, the estimates were obtained from a single multiple regression that was run over the testing period from 1958 to 1983. The resulting market-index beta estimates were then used in each of the cross-sectional tests along with the betas for the other variables. The betas for the other variables were estimated as before, from time-series multiple regressions. (The betas for variables other than the market index came from part D of table 4.) It was thought that using the index-beta estimates from the testing period would lessen the ability of the other variables to show up as significant in pricing merely through their correlation with measurement errors in the index betas. Once again, the market index was insignificant overall, and the other variables were unaltered by its inclusion. The results for the EWNY were similar and are not reported.

The insignificance for pricing of the stock market indices contrasts sharply with their significance in time series. In the time-series regressions, EWNY and VWNY were by far the most statistically significant variables. For example, the average *t*-statistics for EWNY ranged between 11.7 and 29.9 over the 20 portfolios. The largest *t*-statistic for any other variable was only 3.4 when the indices were not included (for UPR and the smallest portfolio), and this fell to 2.5 when the VWNY was included, and most were considerably smaller. Although stock market indices "explain" much of the intertemporal movements in other stock portfolios, their estimated exposures (their betas) do not explain cross-sectional differences in average returns after the betas of the economic state variables have been included. This suggests that the "explanatory power" of the market indices may have less to do with economics and more to do with the statistical observation that large, positively weighted portfolios of random variables are correlated.

B. Consumption and Asset Pricing

Because of the current interest in consumption-based asset pricing models, we also examined the influence of the real consumption series. In a one-good intertemporal asset-pricing model, assets will be priced according to their covariances with aggregate (marginal utility of) consumption (see Lucas 1978; Breeden 1980; or Cox et al. 1985). There is nothing in this analysis that requires that consumption represents any particular state variable, and, in fact, the model is consistent with multistate descriptions of the economy. As a consequence, consumption-based theories predict that, when factors that represent state variables are included along with consumption, they will be rejected as having an influence on pricing.

Put formally, the consumption beta theories argue that

$$E - r = b_c^* k, \tag{13}$$

where $E - r$ is the vector of excess returns, k is a risk-premium measure, and b_c is the vector of consumption betas. The intuition of the theory is that individuals will adjust their intertemporal consumption streams so as to hedge against changes in the opportunity set. In equilibrium, assets that move with consumption, that is, assets for which $b_c > 0$, will be less valuable than will those that can insure against adverse movements in consumption, that is, those for which $b_c < 0$. It follows from risk aversion that the risk-premium measure, k, should be positive.

The alternative hypothesis that we will examine states that

$$E - r = b_c^* k + b_q^*, \tag{14}$$

where b is a vector of betas on the economic state variables used above, and q is the vector of associated risk premia. The null hypothesis of the consumption beta models would be that k is positive and that q is zero. Of course, it can always be argued that the other variables pick up changes in the relative pricing of different consumption goods or correct errors in the measurement of real consumption. Alternatively, although our updating procedure is an attempt to deal with intertemporal changes in the beta coefficients, it could also be argued that the factors could be correlated with such changes (see Cornell [1981] for a discussion of this possibility).

Table 6 reports the results of these tests using the CG series of real per capita consumption growth described in Section III. Because of data collection timing, the CG series, like the monthly production series, MP, may actually measure consumption changes with a lag. To deal with this problem, we led the CG series forward by 1 month. The results with the contemporaneous CG series are uniformly less favorable for its pricing influence and are not reported.

TABLE 6 **Pricing with Consumption**

Years	CG	MP	DEI	UI	UPR	UTS	Constant
1964–84	.68	14.964	−.166	−.846	8.813	−6.921	2.289
	(.108)	(3.800)	(−1.741)	(−2.250)	(2.584)	(−1.790)	(.628)
1964–77	−.485	18.150	.166	−.946	11.442	−9.191	−1.910
	(−.659)	(3.535)	(−2.419)	(−2.494)	(3.288)	(−2.412)	(−.442)
1978–84	1.173	8.592	−.166	−.645	3.556	−2.382	10.687
	(.998)	(1.476)	(−.659)	(−.770)	(.474)	(−.272)	(1.609)

NOTE.—t-statistics are in parentheses.

TABLE 7 Pricing with Oil Price Changes

Years	OG	MP	DEI	UI	UPR	UTS	Constant
1958–84	2.930	12.728	−.095	−.391	11.844	−8.726	4.300
	(.996)	(1.406)	(−1.193)	(−1.123)	(4.294)	(−2.770)	(1.340)
1958–67	4.955	14.409	.078	.119	8.002	−1.022	2.663
	(1.978)	(.921)	(1.102)	(.204)	(2.604)	(−.421)	(.556)
1968–77	1.038	4.056	−.223	−1.269	16.170	−16.055	−1.344
	(.251)	(.296)	(−2.737)	(−2.975)	(3.839)	(−3.154)	(−.243)
1978–84	2.738	22.718	−.159	.134	11.152	−9.264	14.702
	(.303)	(1.228)	(−.598)	(.156)	(1.465)	(−1.024)	(2.240)

NOTE.—CG = growth rate in real per capita consumption; OG = growth rate in oil prices; VWNY = return on the value-weighted NYSE index; EWNY = return on the equally weighted NYSE index; MP = monthly growth rate in industrial production; DEI = change in expected inflation; UI = unanticipated inflation; UPR = unanticipated change in the risk premium (Baa and under return − long-term government bond return); and UTS = unanticipated change in the term structure (long-term government bond return − Treasury-bill rate). *t*-statistics are in parentheses.

Since the CG series begins in 1959, the tests were conducted only for the period beginning in 1964, 5 years later. In these tests the consumption betas and the factor betas are estimated simultaneously and then the risk premia are measured from the cross-sectional tests. Over the entire period and in no subperiod are the consumption betas significant for pricing. Furthermore, their signs are negative, and a comparison with the results of part B of table 4 shows that the coefficients and the significance of the state variables are unaltered by the presence of the CG betas.

To summarize the results of this subsection, the rate of change in consumption does not seem to be significantly related to asset pricing. The estimated risk premium is insignificant and has the wrong sign.

C. *Oil and Asset Pricing*

Oil prices are often mentioned as being an important economic factor even though there is no a priori reason to believe that innovations in oil prices should have the same degree of influence as, for example, interest rate variables or industrial production. To examine the independent influence of oil prices on asset pricing, we used the methods described above to test the impact of the OG series of petroleum price changes.

Table 7 reports on these tests. As with the consumption tests, the OG series was led by 1 month to enhance its influence. The oil betas were insignificant for pricing in the overall period and in two of the subperiods. As a comparison with part B of table 4 shows, inclusion of oil growth did reduce the significance of industrial production, but it increased the significance of the risk-premium variable (UPR) and the term-structure variable (UTS). The risk associated with oil price changes was not priced in the stock market during the critical 1968–77 subperiod, when the OPEC cartel became important (or in the later subperiods).

V. Conclusion

This paper has explored a set of economic state variables as systematic influences on stock market returns and has examined their influence on asset pricing. From the perspective of efficient-market theory and rational expectations intertemporal asset-pricing theory (see Cox et al. 1985), asset prices should depend on their exposures to the state variables that describe the economy. (This conclusion is consistent with the asset-pricing theories of Merton [1973], Cox et al. [1985], or the APT [Ross 1976].)

In Part II of this paper we used simple arguments to choose a set of economic state variables that, a priori, were candidates as sources of systematic asset risk. Several of these economic variables were found to be significant in explaining expected stock returns, most notably, industrial production, changes in the risk premium, twists in the yield curve, and, somewhat more weakly, measures of unanticipated inflation and changes in expected inflation during periods when these variables were highly volatile. We do not claim, of course, that we have exhaustively characterized the set of influential macro variables, but the set that was chosen performed well against several other potential pricing variables. Perhaps the most striking result is that even though a stock market index, such as the value-weighted New York Stock Exchange index, explains a significant portion of the time-series variability of stock returns, it has an insignificant influence on pricing (i.e., on expected returns) when compared against the economic state variables. We also examined the influence on pricing of exposure to innovations in real per capita consumption. These results are quite disappointing to consumption-based asset-pricing theories; the consumption variable was never significant. Finally, we examined the impact of an index of oil price changes on asset pricing and found no overall effect.

Our conclusion is that stock returns are exposed to systematic economic news, that they are priced in accordance with their exposures, and that the news can be measured as innovations in state variables whose identification can be accomplished through simple and intuitive financial theory.

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