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Stock Returns and Real Activity: A Century of Evidence

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ABSTRACT

This paper analyzes the relation between real stock returns and real activity from 1889–1988. It replicates Fama's (1990) results for the 1953–1987 period using an additional 65 years of data. It also compares two measures of industrial production in the tests: (1) the series produced by Babson for 1889–1918, spliced with the Federal Reserve Board index of industrial production for 1919–1988, and (2) the new Miron and Romer (1989) index spliced with the Federal Reserve Board index in 1941. Fama's findings are robust for a much longer period—future production growth rates explain a large fraction of the variation in stock returns. The new Miron-Romer measure of industrial production is less closely related to stock price movements than the older Babson and Federal Reserve Board measures.

FAMA (1990) SHOWS THAT MONTHLY, quarterly, and annual stock returns are highly correlated with future production growth rates for 1953–1987. Moreover, the degree of correlation increases with the length of the holding period. He argues that the relation between current stock returns and future production growth reflects information about future cash flows that is impounded in stock prices. Fama uses multiple regression tests to control for variation in expected stock returns that is reflected in dividend yields on stocks $D(t)/V(t)$, default spreads on corporate bonds $DEF(t)$, and term spreads on bonds $TERM(t)$. Finally, he analyzes the effects of shocks to expected returns on stock returns. Combining these sources of variation in stock returns, he explains up to 59 percent of the variation in annual stock returns from 1953–1987. Nevertheless, as Fama (1990, pp. 18–19) notes,

> One could also argue, however, that the regressions overstate explanatory power. The variables used to explain returns are chosen largely on the basis of goodness-of-fit rather than the directives of a well-developed theory. . . . It is possible that with fresh data, the explanatory power of the variables used here would be lower than that measured for 1953–87.

Thus, one purpose of this paper is to investigate the stability of the relations estimated by Fama using different data.

A second goal of this paper is to compare the new Miron-Romer (1989) index of industrial production for 1884–1940 with the Babson index of the physical

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volume of business activity from Moore (1961, p. 130) for 1889–1918. In both cases, the Federal Reserve Board (Fed) index of industrial production is used to create a continuous series through 1988. The correlation of these measures of real activity with stock returns is one basis for deciding which series is best.

I. The Data

Following Fama, the tests try to explain variation in real returns to a value-weighted portfolio of common stocks. Nominal stock returns are from Schwert (1990) for 1889–1925, from the Center for Research in Security Prices (CRSP) for 1926–1987, and from the Standard & Poor's composite portfolio (adjusted for dividends) for 1988. Briefly, Schwert (1990) uses capital gain returns from the end-of-month values of the Dow Jones composite portfolio and adds dividend yields from the Cowles (1939) portfolio to measure total stock returns. Real returns are nominal returns adjusted for the inflation rate of the Bureau of Labor Statistics' Producer Price Index (PPI).[1] The tests use continuously compounded real returns $R(t, t + T)$ for horizons T of 1 month, one quarter, and 1 year.

A. Expected Return Variables

I use the variables from Fama (1990) and Fama and French (1989) to forecast stock returns:

(a) $D(t)/V(t)$ is the sum of the dividend yields on the stock portfolio for the past 12 months (this definition differs slightly from Fama's).
(b) $DEF(t)$ is the default spread, the difference between the annual yield on the Moody's portfolio of Baa corporate bonds and the yield on the Aa portfolio (Fama uses the difference between the yield on a value-weighted sample of corporate bonds and the yield on a Aaa portfolio based on proprietary data from Ibbotson Associates).
(c) $TERM(t)$ is the term spread, the difference between the annual yield on the Aa corporate bond portfolio and the 1-month Treasury bill rate (Fama uses the difference between the Aaa corporate bond yield and the 1-month Treasury bill yield).

For 1919–1988, the corporate bond yields from Moody's are reported by the Federal Reserve (1976a,b) and Citibase (1978). They are averages of daily figures within the month. For 1889–1918, I use Macaulay's (1938, Table 10, pp. A141–A161) railroad bond yield index, adjusted to splice with the Moody's Aa yields in 1919. Thus, the data to calculate the default yield spread are not available until 1919.

The Treasury bill rates are from CRSP for 1926–1987 and from Citibase for 1988. For 1889–1925, I use the 4–6 month commercial paper rates in New York from Macaulay (1938, Table 10, pp. A141–A161) adjusted to splice with the Treasury bill series in 1926 (see Schwert (1989) for details).

[1] Fama (1990) uses the Consumer Price Index, which is only available since 1913. Monthly values of the PPI are available for 1890–1988. Before 1890, I use the inflation rate of the Warren and Pearson (1933) index of producer prices. I am grateful to Grant McQueen for making these data available to me.

Table I shows the means, standard deviations, and several autocorrelations of monthly real stock returns $R(t, t+1)$ and the three expected return proxies, $D(t)/V(t)$, $DEF(t)$, and $TERM(t)$. The autocorrelations of the stock returns are small, but the autocorrelations of the expected return proxies are large in all sample periods, never <0.9 at lag 1.

B. Industrial Production

The new Miron-Romer index of industrial production is a value-weighted average of indexes for 13 industrial products (iron, coal, petroleum, sugar, cattle, hogs, coke, flour, wool, coffee, tin, rubber, and silk). The index is not seasonally adjusted. The method of construction is the same as the Federal Reserve Board index of industrial production, except the Fed index covers about 80 products in the 1919–1940 period. This contrasts with the Babson index, which is seasonally adjusted and which is influenced by the value of imports and exports in addition to physical production.

Table I shows summary statistics for the quarterly production growth rates using both the Babson-Fed data ($P^b(t, t+3)$ and the Miron-Romer data ($P^{mr}(t, t+3)$. The autocorrelations of the production growth rates are small after lag 3. Part of the autocorrelations for lags 1–3 is the result of the use of overlapping quarterly observations. For the 1889–1925 and 1926–1952 samples, the Babson-Fed and Miron-Romer production growth rates have similar means, although the Miron-Romer series has larger standard deviations and smaller autocorrelations at lags 1–3. The autocorrelations of the Babson-Fed series are similar to those for the Federal Reserve series for 1953–1988. Thus, based on these sample statistics there is reason to believe that the Babson-Fed series will behave more like the Federal Reserve series in the regression tests.

Following Fama (1990), I estimate first order autoregressions for $DEF(t)$ and $TERM(t)$. I interpret the residuals from these regressions as shocks to expected returns, $DSH(t, t+T)$ and $TSH(t, t+T)$. That is, the new information about future expected returns that comes available in period t. Because these variables don't play an important role in explaining stock returns, the results of these autoregressions are not shown (they are available from the author on request). The autoregressive parameters for the default spread are all near 0.97, showing strong persistence in $DEF(t, t+T)$. The autoregressive parameters for the term spread are about 0.9 for monthly data and 0.8 for quarterly data, still showing strong persistence in $TERM(t, t+T)$. Except 1926–1952, the residuals from these models are close to 0. The autocorrelations of $DSH(t, t+T)$ and $TSH(t, t+T)$ for 1926–1952 show more complex cyclical variation in the default and term spreads during the Great Depression. Nevertheless, the residuals from these regressions are reasonable proxies for the unexpected changes in expected returns.

Because the variables proxying for expected stock returns are persistent, a positive shock to expected returns implies higher expected stock returns in the distant future. Stock prices will be negatively related to expected return shocks unless expected future cash flows increase by enough to offset this increase in expected returns. French, Schwert, and Stambaugh (1987), Campbell and Shiller (1989), and Fama and French (1989) discuss this phenomenon.

Table I

Summary Statistics for Monthly Real Stock Returns, Dividend Yields, Default Spreads, Term Spreads, and Quarterly Industrial Production Growth, 1889–1988 and Subperiods

The summary statistics are the means, standard deviations, and autocorrelations at lags 1 through 6, 12, 24, 36, and 48. $R(t, t+1)$ is the continuously compounded monthly real return to a market portfolio of common stocks. $D(t)/V(t)$ is the sum of the monthly dividend yields to the stock portfolio for the past 12 months. $DEF(t)$ is the difference between the Moody's Baa and Aa annual corporate bond yields in month t (it is only available since 1919). $TERM(t)$ is the difference between the Moody's Aa annual corporate bond yield and the one-month Treasury bill yield in month t. $P^b(t, t+3)$ and $P^{mr}(t, t+3)$ are the quarterly logarithmic growth rates of the Babson and Miron-Romer indexes of industrial production. The growth rate of the Federal Reserve Board's Index of industrial production $P(t, t+3)$ is used at the end of these series (1919 for Babson and 1941 for Miron-Romer). Under the hypothesis that the true autocorrelations are zero, the standard errors of the autocorrelation estimates are $T^{-1/2}$ where T is the sample size (0.05 for $T = 400$).

Variable	Sample Size	Mean	Std Dev	Autocorrelations for Monthly Lag 1	2	3	4	5	6	12	24	36	48
				1889–1988									
$R(t, t+1)$	1199	0.005	0.053	0.07	0.02	−0.08	0.05	0.11	−0.02	−0.01	0.02	0.04	−0.01
$D(t)/V(t)$	1199	0.047	0.011	0.99	0.98	0.97	0.96	0.94	0.93	0.80	0.59	0.49	0.43
$DEF(t)$	840	0.011	0.007	0.98	0.94	0.91	0.89	0.89	0.88	0.76	0.60	0.48	0.38
$TERM(t)$	1199	0.019	0.015	0.94	0.87	0.82	0.77	0.73	0.71	0.56	0.44	0.38	0.24
$P^b(t, t+3)$	1199	0.009	0.052	0.81	0.49	0.19	0.06	0.03	0.03	−0.20	−0.11	−0.01	0.08
$P^{mr}(t, t+3)$	1199	0.010	0.097	0.48	0.26	−0.16	−0.05	−0.15	−0.15	0.08	0.03	0.01	0.06
				1889–1925									
$R(t, t+1)$	443	0.005	0.046	0.03	0.10	0.01	0.07	0.17	−0.05	−0.05	−0.01	0.07	0.03
$D(t)/V(t)$	443	0.050	0.011	0.99	0.98	0.96	0.95	0.94	0.92	0.79	0.60	0.56	0.53
$DEF(t)$	84	0.019	0.003	0.93	0.86	0.79	0.71	0.64	0.54	0.09	−0.13	−0.04	−0.40
$TERM(t)$	443	0.009	0.012	0.90	0.73	0.57	0.44	0.36	0.30	0.04	0.04	0.22	−0.21
$P^b(t, t+3)$	443	0.009	0.056	0.77	0.44	0.17	0.11	0.09	0.03	−0.23	−0.14	0.03	0.04
$P^{mr}(t, t+3)$	443	0.010	0.116	0.47	0.24	−0.20	−0.08	−0.17	−0.16	0.14	0.04	0.14	0.16

Table I—*Continued*

Variable	Sample Size	Mean	Std Dev	Autocorrelations for Monthly Lag 1	2	3	4	5	6	12	24	36	48
				1926–1952									
$R(t, t+1)$	324	0.005	0.070	0.08	−0.00	−0.19	0.03	0.08	0.02	−0.02	0.04	0.03	−0.05
$D(t)/V(t)$	324	0.052	0.010	0.99	0.97	0.95	0.92	0.89	0.86	0.57	0.06	−0.26	−0.33
$DEF(t)$	324	0.013	0.008	0.96	0.91	0.86	0.83	0.83	0.83	0.67	0.44	0.30	0.16
$TERM(t)$	324	0.026	0.013	0.95	0.94	0.93	0.91	0.90	0.88	0.77	0.47	0.15	−0.09
$P(t, t+3)$	324	0.010	0.071	0.84	0.51	0.19	0.01	−0.04	0.02	−0.17	−0.08	−0.04	0.11
$P^{mr}(t, t+3)$	324	0.010	0.125	0.47	0.26	−0.15	−0.02	−0.14	−0.14	0.02	0.00	−0.13	−0.11
				1953–1988									
$R(t, t+1)$	432	0.006	0.044	0.10	−0.02	0.06	0.06	0.12	−0.05	0.05	−0.02	0.02	0.01
$D(t)/V(t)$	432	0.040	0.009	0.99	0.98	0.97	0.96	0.94	0.92	0.80	0.63	0.54	0.45
$DEF(t)$	432	0.007	0.003	0.97	0.93	0.90	0.87	0.83	0.79	0.60	0.36	0.20	0.22
$TERM(t)$	432	0.024	0.015	0.90	0.83	0.77	0.71	0.68	0.66	0.45	0.26	0.10	0.11
$P(t, t+3)$	432	0.009	0.024	0.85	0.60	0.33	0.19	0.09	0.04	−0.17	−0.21	−0.06	0.09

II. Stock Returns and Production Growth Rates

Fama (1981), Geske and Roll (1983), Kaul (1987), Barro (1989, 1990), and Fama (1990), among others, find strong relations between current stock returns and future real activity. As noted by Fama (1990), there are at least three explanations for such relations. First, information about future real activity may be reflected in stock prices well before it occurs—this is essentially the notion that stock prices are a leading indicator for the well-being of the economy. Second, changes in discount rates may affect stock prices and real investment similarly, but the output from real investment doesn't appear for some time after it is made. Third, changes in stock prices are changes in wealth, and this can affect the demand for consumption and investment goods. Like Fama (1990), I do not try to discriminate among these non-mutually exclusive hypotheses. Instead, I focus on the extent to which Fama's results hold up in different sample periods with different data.

A. Relations of Current Production with Lagged Stock Returns

Table II contains estimates of the regression

$$P(t - T, t) = a + \sum_{k=1}^{8} b_k R(t - 3k, t - 3k + 3) + e(t - T, t), \qquad (1)$$

where $P(t - T, t)$ is the logarithmic production growth rate from period $t - T$ to t and $R(t - 3k, t - 3k + 3)$ is the continuously compounded real stock return for the quarter from $t - 3k$ to $t - 3k + 3$. This regression is estimated for monthly ($T = 1$), quarterly ($T = 3$), and annual ($T = 12$) production growth rates. The regressions for annual data use overlapping quarterly observations. The results for 1953–1988 are close to those for 1953–1987 in Fama's (1990) Table II. The small differences are the result of using one additional year of data and using PPI rather than CPI inflation to construct real stock returns. There is a strong positive relation between real stock returns for the past 12 months and current production growth. The t statistics for the coefficients of lagged returns are generally >3. The R^2 for the monthly, quarterly, and annual regressions are 0.14, 0.29 and 0.43, respectively.

Fama (1990) shows that stock returns and production growth rates will not be perfectly correlated even if information about future production causes all the variation in stock prices. In essence, because stock prices reflect the value of cash flows at all future horizons, current stock returns are related to variation in all future growth rates. This means that part of the variation in $R(t, t - k)$ is unrelated to $P(t, t + T)$, which is analogous to an "errors-in-variables" problem. Fama shows that regressions such as (1) will have R^2 statistics well below one because of the errors-in-variables problem. He also shows that the size of this bias decreases when using longer holding periods T. Essentially, the overlap between the information in stock returns and production growth rates is larger over longer holding periods. A similar problem occurs when returns are regressed on future production growth rates.

The results for 1889–1925 show that the Babson-Fed production growth rates are more highly correlated with past real stock returns than the Miron-Romer

Table II

Regressions of Monthly, Quarterly, and Annual Production Growth Rates on Contemporaneous and One Year of Lags of Quarterly Real Returns on the Market Portfolio of Common Stocks, 1889–1988 and Subperiods

$P(t-T, t)$ is the monthly ($T = 1$), quarterly ($T = 3$), or annual ($T = 12$) logarithmic growth rate of industrial production from $t-T$ to t. The Babson industrial production data are used for 1889–1918, then spliced with the Federal Reserve's data for 1919–1988. The Miron-Romer industrial production data are used for 1889–1940, then spliced with the Federal Reserve's data for 1941–1988. $R(t-k, t-k+3)$ is the continuously compounded real return to the stock market portfolio for the quarter from $t-k$ to $t-k+3$. The regressions for monthly and quarterly data use nonoverlapping observations. The regressions for annual data use overlapping quarterly observations. $S(e)$ is the standard deviation of the residuals, and R^2 is the coefficient of determination. The t statistics $t(b)$ are corrected for heteroskedasticity and autocorrelation using the techniques of White (1980) and Hansen (1982).

$$P(t-T, t) = a + \sum_{k=1}^{8} b_k R(t-3k, t-3k+3) + e(t-T, t)$$

	Babson Data						Miron-Romer Data					
	Monthly $P(t-1, t)$		Quarterly $P(t-3, t)$		Annual $P(t-12, t)$		Monthly $P(t-1, t)$		Quarterly $P(t-3, t)$		Annual $P(t-12, t)$	
	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$
					1889–1988							
Constant	0.00	1.03	0.00	1.15	0.02	1.74	0.00	0.90	0.00	0.79	0.02	1.79
$R(t-3, t)$	0.06	3.15	0.11	2.08	−0.02	−0.20	0.05	2.46	0.02	0.38	−0.15	−1.76
$R(t-6, t-3)$	0.02	2.14	0.12	3.75	0.10	1.22	0.07	3.47	0.27	4.26	0.06	0.77
$R(t-9, t-6)$	0.01	0.69	0.02	0.51	0.19	2.27	−0.02	−1.22	−0.05	−1.03	0.17	2.53
$R(t-12, t-9)$	0.04	2.62	0.12	2.66	0.38	4.37	0.05	2.19	0.12	2.13	0.40	4.33
$R(t-15, t-12)$			0.01	0.25	0.27	5.23			0.09	1.66	0.46	5.17
$R(t-18, t-15)$					0.09	1.31					0.08	0.98
$R(t-21, t-18)$					0.12	2.19					0.02	0.28
$R(t-24, t-21)$					−0.06	−1.48					−0.02	−0.31
R^2	0.10		0.17		0.22		0.02		0.11		0.21	
$S(e)$	0.02		0.05		0.11		0.07		0.09		0.13	
Sample Size	1199		399		396		1199		399		399	

Table II—*Continued*

	Babson Data						Miron-Romer Data					
	Monthly $P(t-1, t)$		Quarterly $P(t-3, t)$		Annual $P(t-12, t)$		Monthly $P(t-1, t)$		Quarterly $P(t-3, t)$		Annual $P(t-12, t)$	
	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$
1889–1925												
Constant	0.00	0.71	0.00	0.68	0.02	1.48	0.00	0.57	0.00	0.31	0.02	1.31
$R(t-3, t)$	0.03	1.06	0.02	0.34	−0.20	−1.75	0.06	1.41	0.04	0.38	−0.28	−1.79
$R(t-6, t-3)$	0.06	3.55	0.23	3.75	0.09	0.76	0.08	2.07	0.45	4.82	0.13	0.80
$R(t-9, t-6)$	0.04	2.21	0.03	0.62	0.21	1.91	0.03	0.74	−0.09	−0.86	0.27	2.08
$R(t-12, t-9)$	0.02	1.34	0.11	1.87	0.43	4.73	0.01	0.32	0.22	1.63	0.64	5.00
$R(t-15, t-12)$			0.08	1.33	0.42	4.22			0.03	0.24	0.58	3.65
$R(t-18, t-15)$					0.18	1.19					0.00	0.00
$R(t-21, t-18)$					0.22	1.67					0.09	0.60
$R(t-24, t-21)$					0.09	0.98					−0.06	−0.63
R^2	0.07		0.19		0.31		0.01		0.13		0.31	
$S(e)$	0.03		0.05		0.11		0.08		0.11		0.14	
Sample Size	443		147		144		443		147		147	

Table II—*Continued*

	Federal Reserve Board Data						Miron-Romer Data					
	Monthly $P(t-1, t)$		Quarterly $P(t-3, t)$		Annual $P(t-12, t)$		Monthly $P(t-1, t)$		Quarterly $P(t-3, t)$		Annual $P(t-12, t)$	
	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$
					1926–1952							
Constant	0.00	0.55	0.00	0.54	0.02	0.73	0.00	0.48	0.00	0.41	0.03	0.73
$R(t-3, t)$	0.10	3.89	0.22	3.23	0.13	0.97	0.07	2.34	0.05	0.63	−0.09	−0.66
$R(t-6, t-3)$	0.00	0.04	0.09	1.58	0.20	1.28	0.07	2.00	0.24	2.08	−0.02	−0.19
$R(t-9, t-6)$	−0.02	−1.62	−0.04	−0.84	0.27	1.49	−0.07	−2.16	−0.12	−1.41	0.10	0.69
$R(t-12, t-9)$	0.05	2.41	0.11	2.00	0.42	2.74	0.07	2.10	0.10	0.98	0.42	2.25
$R(t-15, t-12)$			0.00	0.03	0.19	2.16			0.17	2.31	0.54	3.58
$R(t-18, t-15)$					−0.06	−0.91					0.03	0.22
$R(t-21, t-18)$					−0.01	−0.13					−0.09	−0.71
$R(t-24, t-21)$					−0.14	−2.02					−0.00	−0.04
R^2	0.25		0.28		0.24		0.04		0.14		0.17	
$S(e)$	0.03		0.06		0.15		0.09		0.13		0.20	
Sample Size	324		108		108		324		108		108	
					1953–1988							
Constant	0.00	1.89	0.00	1.89	0.02	2.76						
$R(t-3, t)$	0.01	1.13	−0.01	−0.43	−0.12	−3.48						
$R(t-6, t-3)$	0.03	3.23	0.09	3.73	0.03	0.74						
$R(t-9, t-6)$	0.02	3.52	0.08	5.41	0.13	2.81						
$R(t-12, t-9)$	0.02	3.21	0.05	3.79	0.22	5.20						
$R(t-15, t-12)$			0.03	2.80	0.26	5.76						
$R(t-18, t-15)$					0.19	7.38						
$R(t-21, t-18)$					0.09	3.47						
$R(t-24, t-21)$					0.03	0.96						
R^2	0.14		0.29		0.43							
$S(e)$	0.01		0.02		0.05							
Sample Size	432		144		144							

data. The R^2 statistics are 0.07 and 0.19 for monthly and quarterly growth rates, compared with 0.01 and 0.13 for the Miron-Romer production growth rates. The R^2 is 0.31 for both measures of annual production growth. This suggests there is extra short-term variation in the Miron-Romer production series that is unrelated to stock returns (like a transient measurement error). The difference in R^2 statistics is even larger for 1926–1952, where the Fed series has R^2 values of 0.25 and 0.28 for monthly and quarterly growth rates compared with 0.04 and 0.14 for the Miron-Romer growth rates. This is the only sample period where there is not a large increase in explanatory power moving from quarterly to annual production growth rates.

Thus, the positive relation between production growth rates and past real stock returns documented by Fama is not quite as strong for 1889–1952. Nevertheless, because the production data are arguably noisier in the earlier periods, it is not surprising that R^2 and t statistics are lower. It is interesting that the new Miron-Romer production growth rates are more weakly related to stock returns than the Babson-Fed series, at least for monthly and quarterly horizons.

B. Relations of Stock Returns with Future Production Growth Rates

Table III contains estimates of the regression

$$R(t, t+T) = a + \sum_{k=1}^{8} b_k P(t+3k, t+3k+3) + e(t, t+T), \qquad (2)$$

where $R(t, t+T)$ is the continuously compounded real stock return from period t to $t+T$ and $P(t+3k, t+3k+3)$ is the logarithmic production growth rate for the quarter from t $-$ $3k$ to $t - 3k + 3$. This regression is estimated for monthly ($T = 1$), quarterly ($T = 3$), and annual ($T = 12$) returns. The regressions for annual data use overlapping quarterly observations. The results for 1953–1988 are close to those for 1953–1987 in Fama's (1990) Table III. The small differences are the result of using one additional year of data and using PPI rather than CPI inflation to construct real stock returns. There is a strong positive relation between real stock returns and production growth for the next several quarters. The t statistics for the coefficients of leads of production growth are often >2. The R^2 for the monthly, quarterly, and annual regressions are 0.07, 0.23, and 0.41, respectively.

The results for 1889–1925 show that real stock returns are more highly correlated with the Babson-Fed production growth rates than the Miron-Romer data, although the differences are small. For 1926–1952 the R^2 statistics are 0.12, 0.28, and 0.25 for monthly, quarterly, and annual Fed growth rates, compared with 0.07, 0.16, and 0.13 for the Miron-Romer growth rates. Thus, in predicting real stock returns, the Fed series has a substantial advantage even for annual horizons for 1926–1952.

The results in Table III are similar to those in Table II. There is a reliable positive relation between current stock returns and future production growth rates. The strength of the relation is larger for longer horizons. The R^2 statistics are higher in Fama's 1953–1987 sample than in the earlier periods, but the differences are not large. Finally, the Federal Reserve Board's production growth

Table III

Regressions of Monthly, Quarterly, and Annual Real Stock Returns on Contemporaneous and One Year of Leads of Quarterly Production Growth Rates, 1889–1988 and Subperiods

$R(t, t+T)$ is the monthly ($T = 1$), quarterly ($T = 3$), or annual ($T = 12$) continuously compounded real return to the stock market portfolio from t to $t + T$. $P(t+k, t+k+3)$ is the quarterly logarithmic growth rate of industrial production from $t + k$ to $t + k + 3$. The Babson industrial production data are used for 1889–1918, then spliced with the Federal Reserve's data for 1919–1988. The Miron-Romer industrial production data are used for 1889–1940, then spliced with the Federal Reserve's data for 1941–1988. The regressions for monthly and quarterly data use nonoverlapping observations. The regressions for annual data use overlapping quarterly observations. $S(e)$ is the standard deviation of the residuals, and R^2 is the coefficient of determination. The t statistics $t(b)$ are corrected for heteroskedasticity and autocorrelation using the techniques of White (1980) and Hansen (1982).

$$R(t, t+T) = a + \sum_{k=1}^{8} b_k P(t+3k, t+3k+3) + e(t, t+T)$$

	Babson Data						Miron-Romer Data					
	Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$		Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$	
	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$
					1889–1988							
Constant	0.00	0.83	0.00	0.89	0.03	1.43	0.00	1.34	0.01	1.16	0.03	1.64
$P(t, t+3)$	0.25	4.77	0.34	1.71	−0.07	−0.30	0.12	4.98	0.07	1.26	−0.12	−0.77
$P(t+3, t+6)$	−0.02	−0.55	0.40	3.73	0.38	1.50	0.05	2.36	0.35	4.95	0.24	1.28
$P(t+6, t+9)$	0.06	1.83	−0.06	−0.48	0.51	1.85	0.04	2.31	0.10	1.49	0.44	2.40
$P(t+9, t+12)$	0.10	2.64	0.47	2.11	1.22	3.91	0.07	2.15	0.23	2.81	0.70	3.42
$P(t+12, t+15)$			−0.04	−0.23	0.78	4.32			0.16	2.76	0.79	4.22
$P(t+15, t+18)$					0.16	0.81					0.33	1.82
$P(t+18, t+21)$					0.48	2.64					0.21	1.23
$P(t+21, t+24)$					−0.15	−0.61					0.06	0.45
R^2	0.08		0.16		0.22		0.06		0.15		0.19	
$S(e)$	0.05		0.09		0.19		0.05		0.09		0.19	
Sample Size	1192		398		395		1192		398		395	

Table III—*Continued*

	Babson Data						Miron-Romer Data					
	Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$		Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$	
	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$
1889–1925												
Constant	0.00	0.41	0.00	0.48	0.01	0.44	0.00	0.92	0.00	0.66	0.02	0.70
$P(t, t+3)$	0.19	2.91	0.10	0.63	−0.16	−0.76	0.11	5.49	0.16	2.73	0.06	0.35
$P(t+3, t+6)$	0.05	1.43	0.52	3.26	0.37	1.39	0.06	3.65	0.34	6.74	0.40	2.20
$P(t+6, t+9)$	0.05	1.53	0.06	0.77	0.54	1.87	0.05	2.80	0.16	3.98	0.58	3.51
$P(t+9, t+12)$	0.13	3.86	0.27	2.47	1.07	4.18	0.05	2.30	0.23	4.14	0.84	5.98
$P(t+12, t+15)$			0.21	2.55	0.98	6.02			0.10	1.48	0.83	6.22
$P(t+15, t+18)$					0.52	2.66					0.43	3.08
$P(t+18, t+21)$					0.61	3.13					0.30	2.37
$P(t+21, t+24)$					0.43	1.90					0.11	1.13
R^2	0.09		0.20		0.33		0.08		0.23		0.31	
$S(e)$	0.04		0.07		0.16		0.04		0.07		0.16	
Sample Size	439		147		144		439		147		144	

Table III—*Continued*

	Federal Reserve Board Data						Miron-Romer Data					
	Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$		Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$	
	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$
1926–1952												
Constant	0.00	0.45	0.01	0.46	0.04	0.83	0.00	0.53	0.01	0.52	0.04	0.80
$P(t, t+3)$	0.33	4.51	0.61	2.54	0.26	0.88	0.12	2.72	−0.01	−0.15	−0.17	−0.75
$P(t+3, t+6)$	−0.13	−3.74	0.27	1.93	0.66	1.44	0.01	0.37	0.30	2.38	0.12	0.49
$P(t+6, t+9)$	0.04	0.87	−0.28	−1.76	0.43	0.98	0.01	0.42	−0.04	−0.34	0.28	1.06
$P(t+9, t+12)$	0.05	0.78	0.48	1.64	1.12	2.26	0.09	1.32	0.21	1.41	0.48	1.49
$P(t+12, t+15)$			−0.21	−0.99	0.43	1.82			0.19	2.48	0.64	2.12
$P(t+15, t+18)$					−0.23	−0.84					0.16	0.58
$P(t+18, t+21)$					0.24	1.16					0.12	0.47
$P(t+21, t+24)$					−0.67	−2.00					0.02	0.08
R^2	0.12		0.28		0.25		0.07		0.16		0.13	
$S(e)$	0.07		0.12		0.24		0.07		0.13		0.26	
Sample Size	324		108		108		324		108		108	
1953–1988												
Constant	−0.00	−0.31	−0.00	−0.03	0.01	0.15						
$P(t, t+3)$	0.10	1.16	−0.55	−1.19	−0.97	−1.76						
$P(t+3, t+6)$	0.34	2.77	1.14	2.73	0.30	0.77						
$P(t+6, t+9)$	0.13	1.60	0.85	3.34	1.18	3.50						
$P(t+9, t+12)$	0.16	2.30	0.44	1.96	2.15	5.80						
$P(t+12, t+15)$			0.08	0.42	2.31	3.00						
$P(t+15, t+18)$					1.11	1.77						
$P(t+18, t+21)$					0.66	2.24						
$P(t+21, t+24)$					0.63	1.23						
R^2	0.07		0.23		0.41							
$S(e)$	0.04		0.08		0.15							
Sample Size	429		143		143							

rates are more highly correlated with stock returns than the new Miron-Romer data. Apparently the smaller sample of products used by Miron and Romer in the 1926–1940 period causes the production growth rates to be measured with more noise.

III. Expected Returns and Shocks to Expected Returns

Table IV contains estimates of the regression

$$R(t, t+T) = a + b_1 X(t) + b_2 TERM(t) + b_3 DSH(t, t+T) + b_4 TSH(t, t+T) + e(t, t+T), \tag{3}$$

where $R(t, t+T)$ is the continuously compounded real monthly ($T=1$), quarterly ($T=3$), or annual ($T=12$) stock return from t to $t+T$. $TERM(t)$ is the term spread. Either the dividend yield $X(t) = D(t)/V(t)$ or the default spread $X(t) = DEF(t)$ is included, because Fama (1990) and Fama and French (1989) show that these variables proxy for similar movements in expected stock returns. The expected return shocks $DSH(t, t+T)$ and $TSH(t, t+T)$ are included because theory suggests there should be a negative relation between unexpected returns and shocks to expected returns. Because these shocks are residuals from autoregressions, they are uncorrelated with the expected return proxies $DEF(t)$ and $TERM(t)$. As noted by Fama (1990), it does not make sense to include the shock to the dividend yield $D(t)/V(t)$. The dividend yield shock almost equals the unexpected change in the stock price, which is most of the variation in the return $R(t, t+T)$. It would give an almost perfect R^2, but not contribute to our understanding of the behavior of stock prices.

The results for 1953–1988 are not quite the 1953–1987 results in Fama's Table IV. This is because of the slight difference in the definitions of the variables.[2] For example, the coefficients for the default spread $DEF(t)$ are smaller and never reliably different from zero for 1953–1988 in Table IV. Also, the coefficient of the default spread shock $DSH(t, t+T)$ is positive for monthly and quarterly horizons for 1953–1988. Fama estimates negative coefficients for these shocks for all horizons, and the t statistic for the quarterly horizon is -2.14. There are two important differences between Fama's definition of the default spread and mine. First, Fama measures the difference between the yield on a market portfolio of corporate bonds (which would have an average rating between A and Baa) and the Aaa yield, and I use the difference between the Baa and Aa yields. Second, Fama uses point-sampled data from Ibbotson Associates and I use the Moody's yield indexes, which are averages of the daily values within the month. Time-averaging will have little effect on the properties of the default yield $DEF(t)$, because it is so persistent, but it will have large effects on the estimates of the shocks $DSH(t, t+T)$. Because of the time-aggregation problem, it is not surprising that the annual estimates of the default shock coefficient 1953–1988 are reliably negative, although the monthly and quarterly estimates are positive.

[2] Using Fama's data and my computer programs I was able to replicate the results in Fama (1990) exactly.

The coefficients of determination for 1953–1988 are 0.04, 0.09, and 0.21 using dividend yields for monthly, quarterly, and annual horizons (Fama's R^2 statistics are 0.04, 0.13, and 0.33). They are 0.03, 0.07, and 0.13 using default spreads compared with Fama's 0.03, 0.10, and 0.28. Thus, especially for annual horizons, the slight differences in variable definitions have a large effect on the explanatory power of the models.

Because of the sensitivity of Fama's 1953–1987 results to slight changes in variable definitions, one might suspect that the relations would be even weaker in different sample periods. To the contrary, the results for 1919–1952 in Table IV are even stronger than Fama found for 1953–1987. There is not much evidence that the term spread $TERM(t)$ or its shock $TSH(t, t + T)$ contributes to the explanation of stock return variation. The dividend yield $D(t)/V(t)$ has a positive coefficient, but the t statistics are <2. The default spread $DEF(t)$, however, is strongly related to stock returns with t statistics of 2.26 and 3.14 for quarterly and annual horizons. Moreover, the shocks to the default spread $DSH(t, t + T)$ have large negative coefficients with t statistics from -4.8 to -8.3. The R^2 statistics are higher than Fama's results for 1953–1987.

Thus, the results in Table IV confirm the Fama (1990) and Fama and French (1989) results for a somewhat longer sample period and slightly different definitions of the variables. If anything, the proportion of variation in stock returns that is related to changing expected returns is larger before the 1953–1987 sample period.

IV. Expected Returns, Shocks to Expected Returns, and Future Production Growth

Table V contains estimates of the regression

$$R(t, t + T) = a + b_1X(t) + b_2TERM(t) + b_3DSH(t, t + T) + \sum_{k=1}^{8} c_kP(t + 3k, t + 3k + 3) + e(t, t + T), \qquad (4)$$

which is a combination of equations (2) and (3), except the shock to the term spread $TSH(t, t + T)$ is omitted because it has no incremental explanatory power in Table IV. This regression shows how the three different types of variables combine to explain variation in stock returns. The Miron-Romer production growth rates are omitted from Table V because the comparisons with the Babson-Fed growth rates are similar to those in Tables III and IV.

The results for 1953–1988 are similar to Fama's. The coefficient and t statistic for the dividend yield $D(t)/V(t)$ are larger than in Table IV. The term spread variable $TERM(t)$ contributes nothing to the regression. The shocks to the default spread $DSH(t, t + T)$ have positive coefficients, even for the annual horizons, and for the shorter horizons the t statistics are >2. This is opposite of what the theory predicts. Finally, the coefficients of future production growth rates are reliably larger than zero. They are essentially the same as the estimates of equation (2) in Table III.

Table IV

Regressions of Monthly, Quarterly, and Annual Real Stock Returns on Proxies for Expected Returns and Shocks to Expected Returns, 1919–1988

$R(t, t+T)$ is the monthly ($T = 1$), quarterly ($T = 3$), or annual ($T = 12$) continuously compounded real return to the stock market portfolio from t to $t + T$. $D(t)/V(t)$ is the sum of the monthly dividend yields to the stock portfolio for the past 12 months. $DEF(t)$ is the difference between the Moody's Baa and Aa annual corporate bond yields in month t (it is only available since 1919). $TERM(t)$ is the difference between the Moody's Aa annual corporate bond yield and the one-month Treasury bill yield in month t. $DSH(t, t+T)$ and $TSH(t, t+T)$ are estimates of the shocks to the default spread $DEF(t)$ and the term spread $TERM(t)$. They are residuals from first order autoregressive (AR(1)) models for monthly ($T = 1$) or quarterly data on $DEF(t)$ and $TERM(t)$. Annual $DSH(t, t+T)$ and $TSH(t, t+T)$ are overlapping sums of four quarterly shocks. The regressions for monthly and quarterly data use nonoverlapping observations. The regressions for annual data use overlapping quarterly observations. $S(e)$ is the standard deviation of the residues, and the R^2 is the coefficient of determination. The t statistics $t(b)$ are corrected for heteroskedasticity and autocorrelation using the techniques of White (1980) and Hansen (1982).

$$R(t, t+T) = a + b_1X(t) + b_2TERM(t) + b_3DSH(t, t+T) + b_4TSH(t, t+T) + e(t, t+T)$$

	$X(t) = D(t)/V(t)$						$X(t) = DEF(t)$					
	Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$		Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$	
	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$
1919–1988												
Constant	−0.02	−2.22	−0.07	−2.53	−0.17	−1.75	0.00	0.17	−0.00	−0.17	−0.01	−0.27
$X(t)$	0.50	3.32	1.65	3.45	4.67	2.58	0.52	1.22	1.84	1.51	9.51	2.49
$TERM(t)$	0.07	0.45	0.31	0.74	0.99	0.60	−0.01	−0.07	0.03	0.07	−0.65	−0.33
$DSH(t, t+T)$	−11.30	−4.97	−17.28	−6.24	−22.50	−6.58	−11.31	−5.04	−17.06	−6.54	−27.57	−9.97
$TSH(t, t+T)$	0.18	0.45	0.27	0.25	−0.13	−0.10	0.13	0.33	0.10	0.09	0.38	0.26
R^2	0.10		0.25		0.28		0.09		0.23		0.27	
$S(e)$	0.05		0.09		0.19		0.05		0.09		0.19	
Sample Size	839		279		276		839		279		276	

Table IV—*Continued*

	$X(t) = D(t)/V(t)$						$X(t) = DEF(t)$					
	Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$		Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$	
	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$
					1919–1952							
Constant	−0.02	−0.94	−0.06	−1.04	−0.04	−0.18	0.01	0.76	0.00	0.14	−0.04	−0.56
$X(t)$	0.60	1.84	1.73	1.72	2.61	0.76	0.87	1.58	3.40	2.26	16.38	3.14
$TERM(t)$	−0.23	−0.80	−0.40	−0.50	−1.14	−0.35	−0.52	−1.80	−1.41	−1.90	−5.00	−1.68
$DSH(t, t+T)$	−14.20	−7.77	−18.92	−6.61	−19.01	−4.83	−14.35	−8.30	−18.92	−6.85	−29.67	−7.71
$TSH(t, t+T)$	0.23	0.29	−2.29	−0.84	−3.17	−0.78	0.03	0.04	−2.99	−1.01	−1.92	−0.45
R^2	0.18		0.43		0.36		0.18		0.45		0.47	
$S(e)$	0.06		0.10		0.21		0.06		0.10		0.19	
Sample Size	407		135		132		407		135		132	
					1953–1988							
Constant	−0.02	−2.29	−0.07	−2.20	−0.27	−2.36	−0.01	−1.02	−0.02	−0.79	−0.04	−0.47
$X(t)$	0.53	2.34	1.56	2.06	6.61	2.74	0.56	0.74	0.34	0.13	2.36	0.32
$TERM(t)$	0.31	2.11	1.09	2.73	3.00	1.69	0.31	1.93	1.25	2.63	3.54	1.78
$DSH(t, t+T)$	3.97	1.52	4.72	1.19	−18.43	−2.63	4.28	1.67	5.61	1.43	−13.54	−2.14
$TSH(t, t+T)$	0.46	1.08	0.84	1.09	0.04	0.03	0.47	1.12	0.97	1.29	0.06	0.04
R^2	0.04		0.09		0.21		0.03		0.07		0.13	
$S(e)$	0.04		0.08		0.17		0.04		0.08		0.17	
Sample Size	432		144		141		432		144		141	

Table V

Regressions of Monthly, Quarterly, and Annual Real Stock Returns on Proxies for Expected Returns, Shocks to the Default Spread, and Contemporaneous and One Year of Leads of Quarterly Production Growth Rates, 1919–1988

$R(t, t+T)$ is the monthly ($T = 1$), quarterly ($T = 3$), or annual ($T = 12$) continuously compounded real return to the stock market portfolio from t to $t + T$. $D(t)/V(t)$ is the sum of the monthly dividend yields to the stock portfolio for the past 12 months. $DEF(t)$ is the difference between the Moody's Baa and Aa annual corporate bond yields in month t (it is only available since 1919). $TERM(t)$ is the difference between the Moody's Aa annual corporate bond yield and the one-month Treasury bill yield in month t. $DSH(t, t+T)$ is an estimate of the shocks to the default spread $DEF(t)$ (residuals from a first order autoregressive (AR(1)) model for monthly ($T = 1$) or quarterly data on $DEF(t)$). Annual $DSH(t, t+T)$ are overlapping sums of four quarterly shocks. $P(t+k, t+k+3)$ is the quarterly logarithmic growth rate of the Federal Reserve's index of industrial production from $t+k$ to $t+k+3$. The regressions for monthly and quarterly data use nonoverlapping observations. The regressions for annual data use overlapping quarterly observations. $S(e)$ is the standard deviation of the residuals, and R^2 is the coefficient of determination. The t-statistics $t(b)$ are corrected for heteroskedasticity and autocorrelation using the techniques of White (1980) and Hansen (1982).

$$R(t, t+T) = a + b_1X(t) + b_2TERM(t) + b_3DSH(t, t+T) + \sum_{k=1}^{8} c_kP(t+3k, t+3k+3) + e(t, t+T)$$

	$X(t) = D(t)/V(t)$						$X(t) = DEF(t)$					
	Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$		Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$	
	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$
1919–1988												
Constant	−0.01	−1.65	−0.05	−2.05	−0.20	−2.60	0.00	0.61	0.00	0.16	0.02	0.61
$X(t)$	0.39	2.66	1.37	2.94	5.83	4.21	0.37	1.04	1.50	1.39	6.37	2.03
$TERM(t)$	−0.07	−0.46	−0.02	−0.04	−0.10	−0.07	−0.13	−0.81	−0.28	−0.58	−1.14	−0.71
$DSH(t, t+T)$	−9.25	−3.92	−15.00	−5.74	−19.05	−5.55	−9.22	−3.92	−14.73	−5.53	−20.14	−4.96
$P(t, t+3)$	0.18	3.07	0.07	0.34	−0.51	−2.20	0.18	3.16	0.09	0.47	−0.43	−1.75
$P(t+3, t+6)$	−0.02	−0.41	0.24	2.01	−0.22	−0.93	−0.01	−0.28	0.26	2.17	−0.16	−0.59
$P(t+6, t+9)$	0.03	0.56	0.01	0.11	0.04	0.16	0.03	0.71	0.04	0.46	0.17	0.63
$P(t+9, t+12)$	0.08	1.80	0.25	1.67	0.55	2.16	0.08	1.82	0.25	1.60	0.49	1.60
$P(t+12, t+15)$			0.04	0.34	0.62	3.01			0.05	0.39	0.64	2.98
$P(t+15, t+18)$					0.04	0.17					0.05	0.21
$P(t+18, t+21)$					0.21	1.01					0.19	0.99
$P(t+21, t+24)$					−0.12	−0.52					−0.12	−0.52
R^2	0.13		0.29		0.39		0.13		0.27		0.34	
$S(e)$	0.05		0.09		0.18		0.05		0.09		0.19	
Sample Size	835		277		274		835		277		274	

Table V—*Continued*

	$X(t) = D(t)/V(t)$						$X(t) = DEF(t)$					
	Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$		Monthly $R(t, t+1)$		Quarterly $R(t, t+3)$		Annual $R(t, t+12)$	
	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$	b	$t(b)$
					1919–1952							
Constant	−0.00	−0.11	−0.03	−0.38	−0.21	−0.89	0.01	1.37	0.01	0.58	0.01	0.10
$X(t)$	0.31	0.94	1.12	1.01	5.95	1.54	0.65	1.27	2.79	1.87	12.18	2.68
$TERM(t)$	−0.43	−1.62	−0.85	−1.13	−1.61	−0.64	−0.63	−2.26	−1.68	−2.45	−4.79	−2.17
$DSH(t, t+T)$	−12.20	−6.27	−18.13	−6.48	−17.35	−4.57	−12.34	−6.47	−18.52	−5.86	−22.69	−5.86
$P(t, t+3)$	0.18	2.88	0.13	0.67	−0.31	−1.32	0.19	3.01	0.15	0.74	−0.29	−1.23
$P(t+3, t+6)$	−0.04	−0.72	0.16	1.47	−0.08	−0.31	−0.03	−0.59	0.19	1.70	−0.11	−0.38
$P(t+6, t+9)$	0.00	0.02	−0.04	−0.46	0.04	0.13	0.01	0.18	0.00	0.03	0.21	0.75
$P(t+9, t+12)$	0.07	1.61	0.16	0.99	0.48	1.73	0.06	1.39	0.12	0.71	0.22	0.69
$P(t+12, t+15)$			0.12	0.91	0.45	2.45			0.11	0.93	0.42	2.61
$P(t+15, t+18)$					−0.03	−0.12					−0.07	−0.27
$P(t+18, t+21)$					0.24	0.97					0.15	0.69
$P(t+21, t+24)$					−0.12	−0.51					−0.06	−0.27
R^2	0.22		0.45		0.44		0.23		0.47		0.49	
$S(e)$	0.06		0.10		0.20		0.06		0.10		0.20	
Sample Size	407		135		132		407		135		132	
					1953–1988							
Constant	−0.03	−3.64	−0.08	−3.96	−0.31	−3.87	−0.01	−1.85	−0.02	−1.42	−0.03	−0.55
$X(t)$	0.72	3.90	2.03	4.04	7.32	4.75	1.42	2.13	2.63	1.42	−2.23	−0.44
$TERM(t)$	−0.06	−0.37	−0.02	−0.05	0.50	0.31	−0.13	−0.69	−0.04	−0.07	2.11	1.06
$DSH(t, t+T)$	6.58	2.21	10.68	2.74	2.81	0.52	7.00	2.38	11.64	2.65	6.28	0.77
$P(t, t+3)$	0.19	2.29	−0.20	−0.48	−0.62	−1.08	0.19	2.19	−0.21	−0.46	−0.94	−1.35
$P(t+3, t+6)$	0.35	3.08	1.20	2.81	0.16	0.34	0.34	2.96	1.19	2.76	0.18	0.30
$P(t+6, t+9)$	0.13	1.45	0.90	3.33	1.26	3.21	0.12	1.40	0.88	3.12	1.30	2.48
$P(t+9, t+12)$	0.16	2.33	0.43	1.95	2.15	5.03	0.16	2.14	0.41	1.80	2.18	3.73
$P(t+12, t+15)$			0.05	0.33	2.38	3.56			0.06	0.31	2.31	3.10
$P(t+15, t+18)$					1.12	2.12					0.87	1.38
$P(t+18, t+21)$					0.70	2.31					0.62	1.86
$P(t+21, t+24)$					0.70	1.91					0.74	1.38
R^2	0.11		0.30		0.56		0.10		0.27		0.44	
$S(e)$	0.04		0.08		0.13		0.04		0.08		0.14	
Sample Size	428		142		142		428		142		142	

Thus, accounting for information about future production growth strengthens the relation between dividend yields and future stock returns, but it weakens the relations of stock returns with term spreads, default spreads, and shocks to default spreads. The coefficients of determination are 0.11, 0.30, and 0.56 for monthly, quarterly, and annual horizons using dividend yields (compared with 0.09, 0.27, and 0.59 from Fama's (1990) Table V).

The results for 1919–1952 are stronger at monthly and quarterly horizons than for 1953–1988, and they are similar at the annual horizon. The coefficients of determination are between 0.44 and 0.49 for the quarterly and annual horizons using either dividend yields $X(t) = D(t)/V(t)$ or default spreads $X(t) = DEF(t)$ in the regression. Unlike 1953–1988, the shock to the default spread $DSH(t, t + T)$ has a large negative t statistic between −4.6 and −6.5 across all horizons. Thus, information about future production growth does not subsume the shock to expected returns in the 1919–1952 period. Both the default spread and the dividend yield have t statistics >2 for most of these specifications, especially for the longer horizons.

V. Conclusions

The results reported by Fama (1990) hold up in earlier sample periods. There is a strong positive relation between real stock returns and future production growth rates, even when variables that proxy for time-varying expected returns and shocks to expected returns are included in the regressions. Although there are many reasons that stock returns could be related to future real activity, the fact that these relations show up in 100 years of data strengthens Fama's conclusions. This is surprising because the pre-1953 data undoubtedly contain more measurement error than the data used by Fama. It is unlikely that "data-mining" could explain Fama's results.

As a by-product of this work I have compared the new index of industrial production by Miron and Romer (1989) with the older indexes by Babson and the Federal Reserve Board. The Miron-Romer production growth rates are more variable and have smaller autocorrelations than the Babson and Federal Reserve data. They are also more weakly related to real stock returns at monthly and quarterly horizons. At annual horizons there is no difference between the Miron-Romer series and the Babson and Federal Reserve series in explanatory power. These results suggest there is transitory noise in the Miron-Romer series that is unrelated to stock returns. At least for this purpose, the new Miron-Romer is not an improvement over the older Babson and Federal Reserve data.

The tests in this article measure relations between current stock returns and future production growth rates. Thus, it is not possible to explain the better performance of the Babson-Fed data based on a reaction of stock prices to the new information contained in the Babson or Fed indexes.[3] The future values of the Babson index were just as unknown to the stock market as the future values

[3] Even if the Babson index is inferior to the new Miron-Romer index, it was available to market participants in the 1889–1918 period. Stock prices might well have reflected the information in past Babson production growth rates because it was the best available at that time.

of the Miron-Romer index. Apparently, the import-export information in the Babson series and the larger sample of commodities included in the Federal Reserve series strengthens their relations with stock returns.

REFERENCES

Barro, Robert J., 1989, The stock market and the macroeconomy: Implication of the October 1987 crash, in R. W. Kamphius, R. C. Kormendi, and J. W. H. Watson, eds.: *Black Monday and the Future of Financial Markets* (Dow Jones Irwin, Homewood, IL).

———, 1990, The stock market and investment. *Review of Financial Studies* 3, 115–131.

Campbell, John Y. and Robert Shiller, 1988, The dividend-price ratio and expectations of future dividends and discount factors, *Review of Financial Studies* 1, 195–228.

Citibase Economic Database, 1978, 1946–1986 [machine-readable magnetic datafile] (Citibank, N. A., New York).

Cowles, Alfred III and Associates, 1939, *Common Stock Indexes*, 2nd ed., Cowles Commission Monograph no. 3 (Principia Press, Inc., Bloomington, IN).

Dow Jones & Co., 1972, *The Dow Jones Averages, 1885–1970*, Maurice L. Farrell, ed. (Dow Jones & Co., New York).

Fama, Eugene F., 1981, Stock returns, real activity, inflation, and money, *American Economic Review* 71, 545–565.

———, 1990, Stock returns, expected returns, and real activity, *Journal of Finance* 45, 1089–1108.

——— and Kenneth R. French, 1989, Business conditions and expected returns on stocks and bonds, *Journal of Financial Economics* 25, 23–49.

Federal Reserve Board, 1976a, *Banking and Monetary Statistics, 1914–1941* (U. S. Government Printing Office, Washington, DC).

———, 1976b, *Banking and Monetary Statistics, 1941–1970* (U. S. Government Printing Office, Washington, DC).

———, 1986, *Industrial Production, 1986 Edition* (U. S. Government Printing Office, Washington, DC).

French, Kenneth R., G. William Schwert, and Robert F. Stambaugh, 1987, Expected stock returns and volatility, *Journal of Financial Economics* 19, 3–29.

Geske, Robert and Richard Roll, 1983, The monetary and fiscal linkage between stock returns and inflation. *Journal of Finance* 38, 1–33.

Hansen, Lars, P., 1982, Large sample properties of generalized method of moments estimators, *Econometrica* 50, 1029–1054.

Kaul, Gautum, 1987, Stock returns and inflation: The role of the monetary sector, *Journal of Financial Economics* 18, 253–276.

Macaulay, Frederick R., 1938, *The Movements of Interest Rates, Bond Yields and Stock Prices in the United States Since 1856* (National Bureau of Economic Research, New York).

Miron, Jeffrey A. and Christina D. Romer, 1989, A new monthly index of industrial production, Manuscript, University of Michigan.

Moore, Geoffrey H., ed., 1961, *Business Cycle Indicators, Vol. II, Basic Data on Cyclical Indicators* (Princeton University Press, Princeton, NJ).

Schwert, G. William, 1989, Why does stock market volatility change over time?, *Journal of Finance* 44, 1115–1153.

———, 1990, Indexes of United States stock prices from 1802–1987, *Journal of Business* 63, Forthcoming.

Standard & Poor's, 1986, *Security Price Index Record, 1986 ed.* (Standard & Poor's Corp., New York).

Warren, G. F. and F. A. Pearson, 1933. Wholesale prices, 1720 to 1889, inclusive, in *Bulletin No. 572*, 111–114 (Bureau of Labor Statistics, U. S. Government Printing Office, Washington, DC).

White, Halbert, 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica* 48, 817–838.