STOCK PRICES AND MACROECONOMIC FACTORS: EVIDENCE FROM EUROPEAN COUNTRIES*

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ABSTRACT

This paper investigates the relationships between stock returns, changes in production, and changes in interest rates in three European countries: France, Germany, and the United Kingdom. The results obtained with annual data are much more conclusive than those obtained with quarterly data. Stock returns present a higher dependence on changes in interest rates than on changes in production. Furthermore, the influence of future changes in production on stock returns diminishes in a substantial proportion when contemporaneous changes in interest rates are taken into account. With respect to these points, the European markets behave in a similar fashion, but are in sharp contrast with the U.S. market.

KEY WORDS: Stock returns, interest rates, production.

RESUMEN

Este documento investiga las relaciones entre rendimientos de bolsa, cambios en la producción y en los tipos de interés de tres países europeos: Francia, Alemania y Reino Unido. Los resultados obtenidos a partir de datos anuales son mucho más concluyentes que los obtenidos con datos trimestrales. Los rendimientos de bolsa presentan una mayor dependencia de las fluctuaciones en los tipos de interés que de los cambios en la producción. Es más, la influencia de futuros cambios en la producción en los rendimientos de bolsa disminuye sustancialmente cuando se tienen en cuenta los cambios contemporáneos en los tipos de interés. Respecto a estos aspectos, los mercados europeos se comportan de una manera similar, pero contrastan fuertemente con el mercado estadounidense.

PALABRAS CLAVE: Rendimientos de bolsa, tipos de interés, producción.

I. INTRODUCTION.

The relationship between the behavior of the U.S. stock market and the evolution of different macroeconomic variables has been analyzed in numerous works. Although most of the research focuses on Fisher's hypothesis that real stock returns should not be correlated with inflation, several authors have tried to identify the macroeconomic factors that drive the stock market. Industrial production and interest rates are two of the most frequently analyzed economic variables. From a theoretical point of view, their connection with stock prices is unambiguous. To a large extent, these connections are confirmed by empirical research for the U.S. market.

For the European markets, the empirical evidence is much more sparse. Asprem (1989) and Wasserfallen (1989) are two important exceptions. Both examine the behavior of several European markets. While Asprem (1989) studies the response of stock markets to different economic variables, Wasserfallen (1989) considers the response to the unexpected components of these variables. The evidence reported by Asprem (1989) is not easy to interpret in many cases, while Wasserfallen (1989) points out that the relations are very weak. An important point, as will be seen later, is that both use quarterly data.

In this paper, the three European countries with the largest stock market capitalization are considered: France, Germany, and the United Kingdom. The relationships between stock returns and two types of economic variables, measures of real production and interest rates, are analyzed in each case. To carry out this analysis, section 2 briefly examines the theoretical relationships between stock returns, production, and interest rates, as well as several empirical contributions to the literature. Section 3 presents the data used in this study, testing for the stationarity of the series taken into account. Section 4 shows some empirical evidence regarding the relation between stock returns, changes in production and changes in interest rates. Finally, section 5 summarizes the main results and conclusions.

II. STOCK RETURNS, PRODUCTION AND INTEREST RATES.

Several theoretical models imply the existence of a positive relationship between stock returns and variations in production. At the same time they also imply a negative relationship between stock returns and changes in interest rates. One clear example is the present value relation,

$$P_t = \sum_{i=1}^{\infty} \frac{1}{(1+\rho)^i} E[d_{t+i} \mid \Omega_t], \qquad [1]$$

where P_t is the price of an asset in t, ρ is the discount rate, d_t is the dividend paid in t, and Ω_t is the set of available information in t. Changes in production will produce changes of the same sign in the asset price through the variations in expected future dividends. The behavior of asset prices with respect to movements in interest rates will be the opposite. Increases in interest rates will originate, for mere reasons of arbitrage, higher discount rates and consequently diminutions in asset prices in [1].

Nevertheless, interest rates and production are not independent. Decreases in interest rates will cause increases in investment and, therefore, in future production. Thus, changes in interest rates may affect stock prices in two ways: firstly, through an arbitrage or substitution effect; secondly, through variation in future production. Both effects are of the same sign and as a result stock prices will decrease in response to increases in interest rates and, conversely, they will rise in response to declines in interest rates.

In an intertemporal capital asset pricing model (ICAPM), Merton (1973) showed that asset returns depend linearly on the covariances with the state variables. Analogously, the arbitrage pricing theory (APT) explains asset returns through different factors. In these models neither the state variables nor the factors are known. Chen, Roll and Ross (1986) tried to identify these factors. They found that industrial production and variables related to the interest rates have a significant influence on the U.S. stock market.

Empirically, the relationship between stock returns and changes in real activity has been considered over many years. Thus, in the U.S. at the beginning of this century, an index of stock prices was already one of the three variables that composed the Harvard ABC curves. Later, it has always appeared as a leading series in the different selections made by

the National Bureau of Economic Research, often receiving one of the highest weights in the different indexes of leading indicators [see Granger (1989) and Auerbach (1982)].

For the U.S. market, several empirical studies have pointed out the strong relationship between stock returns and changes in production. Fama (1981), using annual data from the period 1954-1976, shows that real returns maintain a close relation with the growth rate in industrial production or with the growth rate in real gross national product. With data from 1953 to 1987, Fama (1990) obtains an adjusted coefficient of determination of 0.43 when regressing annual real returns on contemporaneous and one-year leads of quarterly growth rates in industrial production; this coefficient falls to 0.20 with quarterly returns. Fama (1990) explains the decline as follows. Each production growth rate contains information on more than one stock return, and this dispersion is stronger when shorter-period returns are taken into account. Schwert (1990) obtains similar results with observations from a whole century, 1889-1988.

Under the efficiency hypothesis, only unexpected movements on economic variables would affect stock prices. For this reason, several researchers have focused on these unexpected variations. Pearce and Roley (1985) have analyzed the effect of announcements about economic variables on daily closing prices of the Standard & Poor 500 index in the period 1977-1982. They find that surprises in real economic activity have no significant impact on stock prices. In particular, surprises in industrial production have no effect on stock prices. In contrast, they show that changes in the Federal Reserve's discount rate have a significant negative effect on stock prices during the subperiod 1979-1982.

Cutler, Poterba and Summers (1989) examine the response of stock prices to unexpected economic news in a multivariate framework. They isolate the unexpected component using VAR residuals. With monthly data from the period 1926-1986, they report a significant positive impact of industrial production on stock returns. At the same time, they report a negative, although not significant at the conventional levels, impact of interest rates on stock returns. With annual data from 1871 to 1986 the short-term interest rate is significantly negative, but not the long-term interest rate, while the coefficients of production are roughly significant at the 5% significance level. They agree with Fama (1981) and other researchers in that economic variables cannot explain a substantial portion of stock returns. Furthermore, they find that social and political news have a small effect on stock returns.

The response of stock prices to economic variables in European stock markets has been analyzed by Asprem (1989) and Wasserfallen (1989). Asprem (1989) considers ten

European markets with quarterly data from 1968 to 1984, regressing stock returns on different economic variables. In the regressions on industrial production he includes the contemporaneous change in industrial production and 1, 2 and 4 quarters future values. Although he points out that all countries, with the exception of Sweden, show at least one significantly positive coefficient, the reported empirical evidence is not easy to interpret. For two of the countries analyzed in this paper, France and the United Kingdom, only the coefficient corresponding to the four lead is significant. For France, Germany and the United Kingdom the adjusted coefficients of determination, reported in his table 3, move from 0.03 to 0.07, implying that the relations between industrial production and stock returns are not strong.

The evidence Asprem (1989) reports regarding the relationships between stock returns and interest rates is also ambiguous. He regresses stock returns on the current value and two lags of long term interest rates. For France, the estimate corresponding to the only significant coefficient is positive. For Germany, at the 5% significance level, no coefficient is significant, and the estimate with the highest t-statistic is positive. Lastly, for the United Kingdom the coefficient of determination is very high (0.40) due basically to the contemporaneous interest rate, with a t-ratio of -5.08. But the one lagged interest rate is positive and clearly significant.

Wasserfallen (1989) analyzes the reaction of stock returns to unexpected changes in economic factors in Great Britain, Germany and Switzerland, taking residuals of univariate estimated ARIMA as proxies for unexpected components. Using quarterly data from 1977-1985, he runs separate regressions of stock returns on contemporaneous and four lags of unexpected changes in economic variables, and finds very weak relationships. In particular, the coefficients of the unexpected changes in real gross national product and in industrial production are not significant. Nevertheless, the contemporaneous unexpected changes in nominal interest rates for Great Britain and Germany are negative and significant, although the coefficients of real interest rates are not significant for any country.

III. DATA AND UNIT ROOT TESTS.

Quarterly and annual data have been used for each one of the countries examined, France, Germany and the United Kingdom. For purposes of comparison, results from the U.S. market are also reported. The behavior of stock prices was measured through the following stock price indexes: CAC Industrial Index for France, Commerzbank for Germany, Financial Times 30 for the United Kingdom and Dow-Jones for the U.S. market.

The quarterly observations on economic variables were collected from several monthly issues of *International Financial Statistics*, International Monetary Fund. They cover the period 1975:1-1992:4. The variables are: industrial production (line 66..c), gross domestic product at constant prices or gross national product at constant prices (lines 99b.r and 99a.r), short term interest rate (line 60b), and long term interest rate (line 61). Annual data of the same variables for the period 1969-1992, the longest time span for which stock price indexes were available, were obtained from the 1993 yearbook of *International Financial Statistics*, International Monetary Fund. In addition, quarterly and annual data of the consumer price index (line 64) have been used in order to obtain real stock prices and real interest rates.

Two important features regarding this sample information must be stressed. First, quarterly data for gross production in the United Kingdom have not been used, as the data reported in the source cited above are not seasonally adjusted. Secondly, the data used for these countries cannot be considered as completely independent of each other, due to the integration of the respective economies.

In studying causal relations between stock prices and either production or interest rates we face the problem of the non-stationarity of the series taken into account. To avoid the problems of spurious regression in the analysis of relationships between non-stationary series, unit root tests were conducted. Following Dickey and Pantula (1987), it was tested first the null that the series is integrated of order two, $I(2)$, against that it is integrated of order one, $I(1)$, by the (augmented) Dickey-Fuller test in the regression

$$\Delta^2 X_t = \alpha + \beta \Delta X_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta^2 X_{t-i} + a_t \,, \qquad [2]$$

where X_t denotes the series examined and all the series are in logarithms, except the interest rates. At the 5% significance level, in all cases the null of two unit roots was clearly rejected against the alternative of one unit root. Given this rejection then, the null hypothesis that the series is $I(1)$ was tested against the alternative that it is $I(0)$, with the (augmented) Dickey-Fuller test again in the regression

$$\Delta X_t = \alpha + \beta X_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta X_{t-i} + a_t . \qquad [3]$$

As shown in table 1, also in all the cases the null hypothesis of one unit root could not be rejected against the alternative that the series is $I(0)$. Therefore, the evidence indicates that all the series taken into account are not stationary but that their first differences are stationary. It is worth mentioning that some of these series are seasonally adjusted, and it has been pointed out that with seasonally adjusted data these tests tend to accept the null too often. Although the number of observations reduces to one fourth, Shiller and Perron (1985) suggest conducting these tests with annual data. Bearing in mind that there are only 24 observations on the annual series, (augmented) Dickey-Fuller tests were run for them. The statistics obtained, see table 1, allow the rejection of the null of $I(1)$ only for the German long term interest series.

TABLE 1: UNIT ROOT TESTS

Series \ Country	France	Germany	U. Kingdom	U.S.
Quarterly observations				
Real Stock Prices	-0.819	-1.244	-1.096	-0.694
Industrial Production	-2.103	-1.409	-1.619	-2.107
Gross Product	-1.644	-1.241	———	-1.839
Short Term Interest Rate	-2.555	-1.905	-2.799	-1.569
Long Term Interest Rate	-1.515	-2.155	-1.660	-1.477
Annual observations				
Real Stock Prices	-1.524	-1.981	-2.478	-1.298
Industrial Production	-2.684	0.443	-1.350	-1.215
Gross Product	-1.711	-0.568	-1.078	-0.661
Short Term Interest Rate	-2.189	-1.622	-1.290	-0.832
Long Term Interest Rate	-2.466	-3.667	-2.242	-1.901

Note: (Augmented) Dickey-Fuller statistics. All variables are in logarithms, except the interest rates. The value of n (see equation [3]) is less than or equal to 3 in all the cases.

IV. EMPIRICAL EVIDENCE.

In light of the preceding results, all the series were transformed taking first differences. Therefore, we have logarithm differences, that is, relative changes, with the exception of the interest series. As all these series are $I(0)$, the results obtained are not exposed to the problems of spurious regression. To discover the relationship between stock returns and the changes in the other variables, the following regressions were estimated for each country

$$R_t = \beta_0 + \sum_{i=-n}^{n} \beta_i X_{t+i} + a_t \qquad [4]$$

where R_t is the real stock return and X_t is the change in the economic variable taken into account. Quarterly data from 1975:1 to 1992:4 were used. In these regressions, as well as in the following, the observation comprising the October 1987 crash was excluded to avoid the results being distorted by these returns. In any case the results are similar when this observation is included. Tests of the null hypothesis

$$\beta_{-n} = \beta_{-n+1} = \ldots = \beta_{-1} = 0 \qquad [5]$$

$$\beta_1 = \beta_2 = \ldots = \beta_n = 0 \qquad [6]$$

$$\beta_0 = 0 \qquad [7]$$

were conducted with $n=1$, $n=2$ and $n=4$. If stock prices move in response to lagged changes in the economic variables then [5] should be false for some n. For all the markets and for any n this hypothesis was clearly rejected. On the other hand, if the movements in stock prices anticipate future changes in the economic variables, then [6] should be rejected. In this case the results were not so clear. There is weak evidence suggesting that these stock markets anticipate changes in production and in interest rates in the following quarter, but they do not seem to anticipate changes in production or in interest rates for more than that quarter. In addition, the relation between real stock returns and contemporaneous changes in production or in interest rates is also very weak.

Because of this evidence, real stock returns have been regressed on an intercept and the contemporaneous and one lead changes in these variables. Table 2 displays these results. The results for production are not significant for Germany and the United Kingdom. Only in France does the one lead change in gross production have a statistically significant impact at the 5% level. The adjusted coefficients of determination indicate that current and future production explain a very limited proportion of variation in stock returns.

The results for the interest rates are more convincing, and they are slightly more conclusive for long term interest rates. For France and the United Kingdom all the slope estimates are negative and several of them are significant at the usual levels. The values obtained for Germany however, are negligible. Although the coefficients of determination are considerably higher than those of production, they are below 0.20. Thus, less than one fifth of the variation in real stock returns can be explained through changes in interest rates. Similar results were obtained when using nominal stock returns or real interest rates.

The next objective is to try to determine if these results are confirmed on an annual basis. For this reason the analysis with annual observations covering the same span, 1975 to 1992, has been repeated. Now the changes in production in the same period are not significant, nor are the changes in the interest rates in the following year. Thus, on the one hand, real stock returns have been regressed on a constant and one lead in changes in production and, on the other hand, on a constant and contemporaneous changes in interest rates. The results are shown in table 3, and they are generally stronger than those obtained with quarterly data. This is in accordance with numerous studies for the U.S. market and has already been pointed out by different researchers. As previously mentioned, a possible explanation for this fact was offered by Fama (1990).

When using annual observations from the period 1969-1992, the results are strengthened again, as reflected in table 4. All the slope estimates have the expected sign, and most of their coefficients are significant. For all the countries better results are obtained when using industrial production than when using gross production. In the European markets, the same is true for long term interest rates in comparison with short term interest rates. In general, the adjusted coefficients of determination and the absolute t-statistics are higher for the interest rates than for production. This suggests that changes in interest rates are more important for the European stock markets than changes in production.

TABLE 2: REGRESSIONS OF REAL RETURNS ON CHANGES IN PRODUCTION AND IN INTEREST RATES

Quarterly data from 1975:1 to 1992:4

$R_t=\alpha+\beta IP_t+\gamma IP_{t+1}+a_t$

France	α:	0.010	β:	-0.164	γ:	1.549	$\bar{R}^2$:	0.01
		(0.725)		(0.180)		(1.648)		
Germany	α:	0.006	β:	0.613	γ:	0.641	$\bar{R}^2$:	0.01
		(0.560)		(1.163)		(1.245)		
United Kingdom	α:	0.013	β:	0.469	γ:	-0.494	$\bar{R}^2$:	<0.00
		(1.213)		(0.840)		(0.856)		
United States	α:	0.007	β:	-1.420	γ:	1.794	$\bar{R}^2$:	0.16
		(0.009)		(2.861)		(3.707)		

$R_t=\alpha+\beta GP_t+\gamma GP_{t+1}+a_t$

France	α:	-0.003	β:	-0.914	γ:	3.984	$\bar{R}^2$:	0.05
		(0.168)		(0.525)		(2.303)		
Germany	α:	0.007	β:	-0.092	γ:	0.768	$\bar{R}^2$:	<0.00
		(0.482)		(0.086)		(0.726)		
United States	α:	0.001	β:	-0.424	γ:	1.786	$\bar{R}^2$:	0.02
		(0.096)		(0.425)		(1.785)		

$R_t=\alpha+\beta SI_t+\gamma SI_{t+1}+a_t$

France	α:	0.015	β:	-0.022	γ:	-0.008	$\bar{R}^2$:	0.03
		(1.155)		(1.746)		(0.616)		
Germany	α:	0.011	β:	-0.005	γ:	0.009	$\bar{R}^2$:	<0.00
		(1.191)		(0.328)		(0.542)		
United Kingdom	α:	0.011	β:	-0.012	γ:	-0.023	$\bar{R}^2$:	0.16
		(1.122)		(1.583)		(3.142)		
United States	α:	0.011	β:	-0.019	γ:	0.007	$\bar{R}^2$:	0.09
		(1.259)		(2.888)		(1.023)		

$R_t=\alpha+\beta LI_t+\gamma LI_{t+1}+a_t$

France	α:	0.013	β:	-0.038	γ:	-0.045	$\bar{R}^2$:	0.12
		(1.040)		(1.626)		(1.883)		
Germany	α:	0.010	β:	-0.018	γ:	0.003	$\bar{R}^2$:	<0.00
		(1.074)		(0.867)		(0.162)		
United Kingdom	α:	0.007	β:	-0.025	γ:	-0.048	$\bar{R}^2$:	0.19
		(0.698)		(1.901)		(3.747)		
United States	α:	0.010	β:	-0.050	γ:	0.004	$\bar{R}^2$:	0.16
		(1.282)		(3.775)		(0.319)		

Note: R_t is the real stock return in quarter t. IP_t, GP_t, SI_t, and LI_t denote the change in quarter t in industrial production, in the gross product, and in the short and long term interest rate, respectively. $\bar{R}^2$ is the adjusted coefficient of determination. Absolute values of t-statistics are in parenthesis. The observation corresponding to the fourth quarter of 1987 has been excluded.

TABLE 3: REGRESSIONS OF REAL RETURNS ON CHANGES IN PRODUCTION AND IN INTEREST RATES
Annual data from 1975 to 1992

$R_t=\alpha+\beta IP_{t+1}+a_t$			
France	α: -0.016 (0.212)	β: 5.557 (1.851)	$\bar{R}^2$: 0.14
Germany	α: 0.013 (0.223)	β: 2.737 (1.577)	$\bar{R}^2$: 0.09
United Kingdom	α: 0.028 (0.510)	β: 2.435 (1.514)	$\bar{R}^2$: 0.08
United States	α: -0.004 (0.089)	β: 1.524 (1.861)	$\bar{R}^2$: 0.14
$R_t=\alpha+\beta GP_{t+1}+a_t$			
France	α: -0.068 (0.438)	β: 6.028 (0.984)	$\bar{R}^2$: <0.00
Germany	α: -0.042 (0.487)	β: 4.515 (1.547)	$\bar{R}^2$: 0.09
United Kingdom	α: -0.023 (0.366)	β: 4.509 (1.989)	$\bar{R}^2$: 0.16
United States	α: -0.029 (0.550)	β: 2.867 (1.747)	$\bar{R}^2$: 0.12
$R_t=\alpha+\beta SI_t+a_t$			
France	α: 0.054 (1.042)	β: -0.075 (2.884)	$\bar{R}^2$: 0.31
Germany	α: 0.061 (1.352)	β: -0.045 (2.001)	$\bar{R}^2$: 0.16
United Kingdom	α: 0.055 (1.159)	β: -0.037 (1.750)	$\bar{R}^2$: 0.11
United States	α: 0.023 (0.785)	β: -0.037 (3.079)	$\bar{R}^2$: 0.35
$R_t=\alpha+\beta LI_t+a_t$			
France	α: 0.048 (1.013)	β: -0.112 (3.503)	$\bar{R}^2$: 0.41
Germany	α: 0.046 (1.031)	β: -0.084 (2.245)	$\bar{R}^2$: 0.20
United Kingdom	α: 0.030 (0.610)	β: -0.091 (1.864)	$\bar{R}^2$: 0.13
United States	α: 0.033 (1.134)	β: -0.064 (3.019)	$\bar{R}^2$: 0.34

Note: R_t is the real stock return in year t. IP_t, GP_t, SI_t, and LI_t denote the change in year t in industrial production, in the gross product, and in the short and long term interest rate, respectively. $\bar{R}^2$ is the adjusted coefficient of determination. Absolute values of t-statistics are in parenthesis. The observation corresponding to 1987 has been excluded.

TABLE 4: REGRESSIONS OF REAL RETURNS ON CHANGES IN PRODUCTION AND IN INTEREST RATES
Annual data from 1969 to 1992

$R_t=\alpha+\beta IP_{t+1}+a_t$			
France	α: -0.053 (0.846)	β: 3.727 (2.194)	$\bar{R}^2$: 0.15
Germany	α: -0.022 (0.461)	β: 2.434 (1.946)	$\bar{R}^2$: 0.12
United Kingdom	α: -0.076 (1.285)	β: 4.345 (2.702)	$\bar{R}^2$: 0.23
United States	α: -0.057 (1.761)	β: 2.248 (3.822)	$\bar{R}^2$: 0.39
$R_t=\alpha+\beta GP_{t+1}+a_t$			
France	α: -0.105 (0.931)	β: 4.705 (1.296)	$\bar{R}^2$: 0.03
Germany	α: -0.076 (1.066)	β: 3.907 (1.715)	$\bar{R}^2$: 0.08
United Kingdom	α: -0.144 (1.965)	β: 6.012 (2.450)	$\bar{R}^2$: 0.19
United States	α: -0.108 (2.409)	β: 4.478 (3.216)	$\bar{R}^2$: 0.31
$R_t=\alpha+\beta SI_t+a_t$			
France	α: 0.032 (0.664)	β: -0.059 (2.790)	$\bar{R}^2$: 0.24
Germany	α: 0.031 (0.835)	β: -0.047 (3.062)	$\bar{R}^2$: 0.28
United Kingdom	α: -0.020 (0.367)	β: -0.066 (2.586)	$\bar{R}^2$: 0.21
United States	α: -0.010 (0.344)	β: -0.046 (4.041)	$\bar{R}^2$: 0.41
$R_t=\alpha+\beta LI_t+a_t$			
France	α: 0.031 (0.728)	β: -0.114 (3.868)	$\bar{R}^2$: 0.39
Germany	α: 0.023 (0.636)	β: -0.108 (3.423)	$\bar{R}^2$: 0.33
United Kingdom	α: -0.014 (0.343)	β: -0.171 (5.440)	$\bar{R}^2$: 0.57
United States	α: -0.003 (0.110)	β: -0.078 (3.188)	$\bar{R}^2$: 0.29

Note: R_t is the real stock return in year t. IP_t, GP_t, SI_t, and LI_t denote the change in year t in industrial production, in the gross product, and in the short and long term interest rate, respectively. $\bar{R}^2$ is the adjusted coefficient of determination. Absolute values of t-statistics are in parenthesis. The observation corresponding to 1987 has been excluded.

The evidence, therefore, denotes that changes in interest rates affect stock returns in the same year and that stock returns anticipate the change of production in the following year. In section 2 it was mentioned that changes in interest rates may affect stock prices in two ways: directly, by an arbitrage effect, and through changes in future production. Thus the influence of the change in production in year $t+1$ on stock return for year t could be already included in the influence of the change in interest rate in year t on the stock return for the same year. To check this possibility real stock returns have been regressed on a constant, one lead change in industrial production, and the contemporaneous change in the long term interest rate. In the European markets, as reflected in table 5, changes in production in the following year lose their significance when current year changes in interest rates are included. The reason for this lies in the linear dependence or collinearity between changes in industrial production and changes in interest rates in the preceding year. In fact, auxiliary regressions showed a significant negative relationship between these variables in the sample period for the three countries.

TABLE 5: REGRESSIONS OF REAL RETURNS ON CHANGES IN PRODUCTION AND IN INTEREST RATES

Annual data from 1969 to 1992

$R_t=\alpha+\beta IP_{t+1}+\gamma LI_t+a_t$

France	α:	-0.005	β:	1.920	γ:	-0.100	$\bar{R}^2$: 0.41
		(0.106)		(1.249)		(3.090)	
Germany	α:	0.012	β:	1.082	γ:	-0.101	$\bar{R}^2$: 0.36
		(0.276)		(0.928)		(2.900)	
United Kingdom	α:	-0.029	β:	1.377	γ:	-0.152	$\bar{R}^2$: 0.56
		(0.628)		(0.964)		(3.978)	
United States	α:	-0.041	β:	1.669	γ:	-0.045	$\bar{R}^2$: 0.45
		(1.272)		(2.572)		(1.760)	

Note: R_t is the real stock return in year t. IP_t and LI_t denote the change in year t in industrial production and in the long term interest rate, respectively. $\bar{R}^2$ is the adjusted coefficient of determination. Absolute values of t-statistics are in parenthesis. The observation corresponding to 1987 has been excluded.

In this respect the behavior of the European markets is very similar. In France, Germany and the United Kingdom, future changes in production relevant to the stock markets are captured, in a high proportion, by contemporaneous changes in interest rates. Thus, it could be said that contemporaneous changes in interest rates are a more important source of movements on stock returns than future changes in production. This fact is quite different

from that of the U.S. market. For this country, the results in tables 4 and 5 show that changes in future production play a more prominent role, and that their influence on stock returns is only partially anticipated by contemporaneous interest rates.

Finally, it is worth mentioning that all the results in this section hold up in regard to certain modifications. The inclusion or exclusion of the observation corresponding to the crash of 1987 or the use of nominal or real returns and interest rates only imply minor differences in the results.

V. CONCLUSIONS.

In this paper the relationships between stock prices, production and interest rates have been examined in three European markets. As all these variables (or their logarithms) are $I(1)$, a causal analysis has been conducted using their first differences: real stock returns, (relative) changes in production and changes in interest rates.

On a quarterly basis, the statistical results are weak. Past changes in production or in interest rates have no influence on current stock returns. Current and one lead change in production have a feeble effect on the contemporaneous stock return. The results for changes in interest rates are somewhat stronger. On a yearly basis, the results are more definite. One lead changes in industrial production and current changes in interest rates have, separately, a clear effect on stock returns. The influence of changes in interest rates is greater than that of production. Nevertheless, the significance of the changes in production diminishes substantially when both changes in production and in interest rates are taken into account.

The explanation proposed for this fact lies in the relation between interest rates and subsequent production. Most of the influence of future changes in production on stock returns is due to current changes in interest rates. On this point, the behavior of the European markets is quite different from that of the U.S. While in this market, changes in future production are more significant than changes in interest rates, the contrary is true for the three European markets in question.

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