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THE BEHAVIOR OF EUROPEAN STOCK MARKETS

by

Bruno H. Solnik

#581-71

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Draft -- Comments Invited

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Introduction

Very little work has been done on the European markets, applying the modern concepts of investment theory, and, except for limited circles, the "beta revolution" has yet to reach the other side of the Atlantic. This can partly be explained by the lesser interest of Europeans in their capital markets and the air of mystery that tends to surround the financial world. A second and perhaps more pragmatic explanation for the small number of academic studies is the lack of public and organized sources of stock price data. The need (or fashion) for developing a systematic computerized body of data on the stock markets seems to have arisen more slowly in Europe. In this regard the body of data used for this study is to the author's knowledge unique(1). It compiles daily prices of European stocks for the period 1966-1971. The sample includes over 250 stocks from 8 European markets.

Surprisingly enough, one of the early and most basic contributions to the random work theory originated in the U.K. Kendall [23] studied industrial share indices on the London Stock Exchange for the period 1928-38; he did not find any evidence of significant serial correlation. More recently, a group of English and Scottish economists have studied U.K. stock market indices. For instance Dryden [10] applies a simple Markov scheme to successive daily numbers of advances and declines on the London Stock Exchange. The estimation technique used and the reliability of the estimates are open to criticism; besides, the conclusions drawn on individual stocks by using those aggregates are doubtful. According to Dryden's results the random

(1) The Institute for International Management (Berlin) and the London Business School (Prof. Brealey) have plans to develop computerized stock prices files but it is still in the planning process. Some brokers or advisory firms have their own data but they are rather limited in scope and not publicly available.

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walk theory is violated on the London Stock Exchange. Thus, in his own words, the probability for a share to go up one day is seven times larger if it went up the previous day than if it went down (this implies substantial positive serial correlation).

Similarly Henri Theil [36] applies information theory to the daily percentage of stocks, advancing, declining or remaining at a constant price on the Amsterdam Stock Exchange from 1959 to 1963. Like Dryden, he finds results inconsistent with a random walk hypothesis and suggesting positive serial correlation: "The best prediction (information theory criterion) for tomorrow is half way between a longrun average and today's observation." Fama [16] replicated this test on the New York Stock Exchange but did not find that present changes could help to forecast future changes in prices.

This brief review summarizes most of the existing literature in this area of modern capital theory. This limited evidence tends to suggest that European capital markets may tend to behave differently from the American market. However any serious investigation of that topic should deal not only with market indices and aggregates but with a representative number of individual securities listed on those markets.

After a short description of the European markets and of the data, the random walk hypothesis will be investigated in section II applying serial correlation tests to each European market. Those tests will be discussed and their results compared with the empirical evidence presented for the American market.

In section III the relation between risk and return is studied using the market model framework. The systematic risk of each security relative to its national market index is computed using various time intervals. The

robustness and stability over time of those estimates is then investigated.

Finally a preliminary attempt has been made in section IV to test the Capital Asset Pricing Model for each European market. Different measures have been used to determine the relation between expected returns and the risk borne by the investors. No literature seems to exist on those topics as far as European markets are concerned.

Section I: The European Capital Markets

1) A Short Description of the European Markets

With the exception of Japan all of the major non-American capital markets are concentrated in Europe, namely: United Kingdom, France, Italy, and Germany. To give some order of magnitude of the various markets, I have included in table I-1 their market value (in billions of US $). It is very hard to find consistent data among countries. For instance, some countries list their government securities on separate markets; similarly there might exist regional stock exchanges (e.g. France) for which data have not been found.

Table I-1: Market value of each country in 1966
(in billions dollars)

	Bond	Common Stock	Total
France	15	20.8	35.8
Italy	17	20.3	37.3
U.K.	57	161.3	228
Germany	21	18	49
Switzerland	3.4	5.9	9.3
Netherlands	6	3.5	9.5
Belgium	5	5	10
Sweden	7	3	10
Japan	18.5	22.2	40.7
U.S.A.	130	515	645

NB: This includes the market value of all the securities listed on all the capital markets of each country (excluding government bonds not listed on the general stock exchange), with the exceptions of:

U.K.: only London Stock Exchange

France: only Bourse de Paris

U.S.A.: on the NYSE only.

Sources:

France: Chambre syndicale des Agents de Change
Italy: Banca D'Italia
U.K.: London Stock Exchange, Annual report
Germany: Wirtschaft und Statistik
Switzerland: OECD, Committee on Invisible Transactions
Netherlands: Maandstaatistiek van het Financiewezen
Belgium: Commission de la Bourse de Bruxelles
Sweden: Sveriges Riksbank, Arsbok
Japan: Bank of Japan
U.S.A.: Survey of Current Business

One must be aware that each stock market has its own characteristics inherited from centuries of traditions.

The London Stock Exchange was by far the world's leading capital market up to world war I. It is still the most important market place in Europe (about one third of the current US equities market value). It has retained its international orientation with several hundreds of foreign stocks listed on the exchange.[1] However large fees and transaction costs coupled with taxes and constraints on foreign investors have not favored its development in the past few years. The Jobber plays a role similar to the American

[1] By rule 163(1)(e) any stock listed on any other Stock Exchange in the world can be dealt in London.

specialist; the London Stock Exchange is a private organization regulated only by its members who are collectively liable (brokers and jobbers) for any insolvency of one of its members. Interestingly the London Stock Exchange parcels out time in its own fashion; the Stock Exchange year is split into 24 "accounts" or trading periods. A normal, two-week account begins on a Monday and lasts until the Friday of the following week. Account day, the day "all bargains must be settled", checks and transfers delivered, falls on Tuesday, eleven days after the account is closed. Thus, if a purchase is made on a Monday of a new account, the investor's check must be on his broker's desk three weeks and a day later. Of course, for a sale the process is the same but reverse--it is the seller who waits for payment. "Contango", known also as carry over, is an arrangement to postpone payment (or delivery) to the following account period. It is less widely used than in continental Europe.

Its tradition, organization and volume of transactions makes the Bourse de Paris the most important capital market in continental Europe. Its structure serves as a prototype for the markets of Belgium, Italy, Spain and Greece much as the basic organizational pattern of Germany's exchanges served as the model for those of Austria, Switzerland and the Scandinavian countries. There are two ways of dealing in France. The investor can put francs on the table and purchase stock in the cash market, the "Marché au Comptant", or he can deal for settlement at the end of the month in the forward market, the "Marché à Terme" which is cheaper and generally used today. For larger stocks, prices are arrived at by yelling, screaming, and stamping; in brief it is an auction market called "à la criée". As this is the only way a transaction can take place, this system

is very fair to investors. In the forward market no interests are to be paid for taking a position, although a broker would typically require from a small investor that 25% of the transaction amount be covered by stocks or cash in his account. Should one desire to carry forward an open position to the following month, it is possible to do so. No extra costs are involved if buyers match sellers. If this is not the case, interests will have to be paid--usually between 1¼ and 4 percent a year. Depending on whether the stock has risen or not, your account is then credited or debited. The whole operation is easy and does not involve large costs.

Milan is the largest Italian market; it is a public institution controlled by the government. Although banks are not allowed as members of the Exchange, they play an important role and they may deal after transaction hours; these transactions are not official nor recorded by the Exchange. Transactions are settled once a month but a carrying forward is possible. It is merely considered as an extension of credit with according interest payments. Like many other things in Italy, brokerage rates are negotiable.

One thing is certain about German stock exchanges: Hamburg ranks third. Frankfort and Düsseldorf compete for first place and the rivalry is keen. The banks replace the traditional broker; they are not restricted to trading through the exchange. They may also use the "Freie Makler" (free market) any time of the day or night. Because the banks are free to trade on this "telephone market" after hours, volume figures give only a partial figure of shares traded. This feature made the German market unattractive to small or foreign investors. There does not exist any "terme", option or forward market; however investors can still borrow directly from the banks without any legally determined margin requirement.

The Amsterdam "Beurs" maintains the old tradition of internationalism of the Dutch merchants. Officially, the Exchange is open only from 1:00 to 2:15 p.m. but arbitrage with other European and American bourses takes place all day. The six "internationals" dominate the Amsterdam Exchange (Royal Dutch, Unilever, Philips, AKU, Hoogovens and KLM) and represent 33% of the market value. Any broker can act as a specialist (hoekman) on the floor of the exchange. The man simply appoints himself, telling his colleagues he will henceforth deal in X securities. This procedure is symptomatic of the informality with which the Dutch approach business dealings. However he rarely takes a position in the security.

Of the three major Swiss exchanges Zurich, Basel and Geneva, Zurich is the largest and most active. Except for the quotation process, called the criee, the Exchange organization is similar to their German neighbors; banks are the only members.

Brussels is the seat of the Common Market and de facto capital of Europe; it is also the capital of the Belgians. They owe their Bourse to a Napoleon decree of the nineteenth Messidor, year IX of the revolution and its organization is still comparable to its French equivalent. Brussels is certainly a big international market and over a hundred foreign securities are quoted but for most of the 700 Belgian or African stocks listed the market is very thin.

If Milan is the noisiest stock exchange in Europe, Stockholm is the quietest. It is against the rules of the exchange for anyone to speak except the Exchange officials. All transactions are handled by an electric switch board designed fifty years ago by the famous L. M. Ericsson. However more than three fifths of the transactions do not go through the Exchange as

Table I-2: Characteristics of the European Market

	Predominant type of share	Cash or "terme" system	Foreign securities listed	Specialist	Bourse Monopoly	Banks are members of the Exchange
France	Bearer	T,C	Yes	No	Yes	No
Italy	Nominal	C,T	No	No	No	No
UK	Nominal	T	Yes	Yes	Yes	No
Germany	Bearer	C	Yes	No	No	Yes
Netherlands	Bearer	C	Yes	Yes	No	Yes
Belgium	Bearer	T,C	Yes	No	Yes	No
Switzerland	Bearer	T,C	Yes	No	No	Yes
Sweden		C	No	No	No	Yes

NB: "Bourse monopoly" means that security transactions are a stock exchange monopoly (transactions have to take place on the Exchange).

banks and brokers can deal with each other. A neutral country, Sweden has developed very strong restrictions against foreign investment. The Swede public is neither in a very investing mood because of unfavorable tax laws.

These short descriptions are completed in Table I-2 by the presentation of some basic characteristics of the European capital markets. A more detailed description of the functioning of those markets can be found in OECD [33], J. J. Houriet [18] or EEC [11]. Above all, it should be kept in mind that the characteristics of various European markets differ substantially.

2) The Data

A tape file of prices and daily returns on 268 stocks of nine European countries has been constructed.(1) This includes daily observations for a five year period from March 1966 to March 1971. A few stocks have been introduced later in the sample (generally on January 2, 1967) but all stocks have March 22, 1971 as their last observation.

Capital adjustment of all sorts (splits, rights,...) have been carefully incorporated and double checked. This feature can be very important as in some countries firms pay most of their earning in that fashion.

Dividends have been integrated in the computation of the returns

$(r_t = \frac{P_t + d_t - P_{t-1}}{P_{t-1}})$ for all the major capital markets (France, UK, Germany, Italy, Belgium), however they have not been included for the Netherlands, Sweden and Switzerland.

(1) We wish to thank "Eurofinance" for providing a tape of prices which constituted the core of the present body of data.

In order to eliminate possible errors in the data, a fairly sophisticated screening process had been designed.[1]

The list of stocks included in the sample are given in Annex A, Table A-1 to A-7. It consists of:

France	65 stocks
UK	40 stocks
Germany	35 stocks
Italy	30 stocks
The Netherlands	24 stocks
Belgium	17 stocks
Switzerland	17 stocks
[2]Sweden	6 stocks

It should be emphasized that this sample includes all larger stocks and generally represents a large percentage of the total market. In the case of Italy, the thirty stocks represent 77% of the total market figure. The same figure is reached for the Netherlands (82%). For France, UK, and Germany it still represents over 50% of the market value of all outstanding shares. For each country a daily index is also included for the same period. They are either the only representative indices on those markets or the most widespread in the public:

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[1] In constructing their CRESP file, Fisher and Lorie used a filter screening process which they called Super-king. To establish the efficiency of the technique used on this European file and upon a suggestion of F. Modigliani, the screening process has been named "Super Napoleon".

[2] The six Swedish stocks are major European stocks. Although 5 Spanish stocks are included in the tape, they are of minor importance and not considered in this study.

Table I-2:

Stock Market Indices (daily)

France	I.N.S.E.E.
Italy	24 ORE
UK	Financial Times, Industrial Ordinary
Germany	Herstatt Index
Netherlands	ANP/CBS
Switzerland	Schweizerische Kreditanstalt
Belgium	Indice de la Bourse de Bruxelles
Sweden	Jacobson & Ponsbach

Section II: Test of the Random Walk Hypothesis

1) A Review

The amount of empirical results to present in this study is overwhelming. As a rule the French market will be used as a basis for the discussion; similarities or differences with other European markets will then be emphasized. Of course one topic of considerable importance is the comparison between the characteristics of behavior of those European markets and the American capital market.

As outlined in the introduction, the development of the random walk concept originated in some empirical findings (Kendall [23], Osborne [34], et al.) that successive price variations were uncorrelated. The refinement of the random walk theory suggested that in fact returns (or changes in log prices) should be serially uncorrelated. This simple test performed on the NYSE yielded very strong empirical support to the random walk hypothesis. The most comprehensive work in this area is the study by Fama [14] on the 30 Dow Jones Industrial stocks on a five year period (1956-62); for all differentiating intervals the serial correlation coefficients were small and generally not significantly different from zero. This matter seemed to have been settled for good but recently it has been the object of growing interest from the rebalancing strategy proponents such as Evans [12], Latané and Young [25] or Cheng and Deets [6]. In their recent article, Cheng and Deets emphasized that the rebalancing strategy will work better than the Buy and Hold strategy (abstracting from the arithmetic vs. geometric mean controversy) if returns exhibit negative serial correlation. An investor following the rebalancing strategy maintains a portfolio with stocks in fixed (usually equal) money value proportions. Thus if a stock's price

goes down (relatively) one will buy more of its shares to maintain its proportion in the portfolio; if the returns exhibit negative serial correlation, then its price will tend to go up the next period and the rebalancing investor will be better off than the Buy and Hold investor. This is only one of the factors suggested to be in favor of the rebalancing strategy but it is widely claimed (Cheng and Deets, Jennings [20], etc.).

Reviewing the literature it appears that Cootner [8] and Moore [32] found a preponderance of negative signs for weekly changes, as did King [24] for monthly price relatives. Although Fama [14] gets to the same conclusions for four- and nine-trading day changes, he finds opposite results (i.e. positive serial correlation) for daily or long term returns. Fama's argument is that it all depends on the period used, as all stocks tend to follow the market rather closely and thus will have collectively a rather positive or negative correlation, on the sample, generated by the movement of the market. On the other side rebalancing strategists assert that serial correlation will constantly be negative (both arguments are not exclusive).

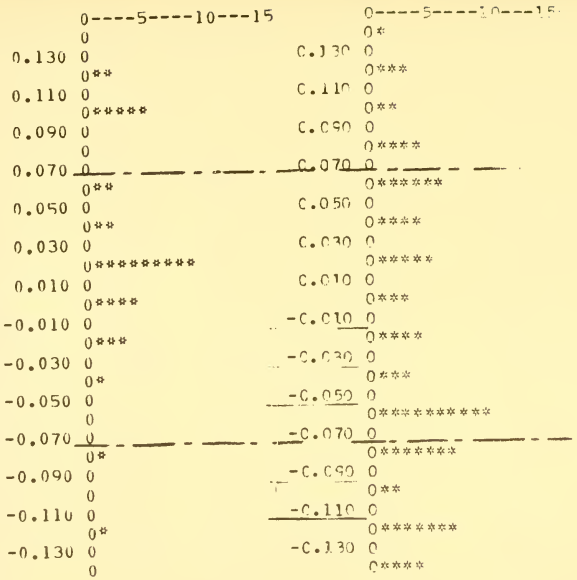
In this section, I will first study the distribution of the serial coefficients for each European country and compare it with the results found by Fama on a corresponding period (5 years of data). Then the stationarity over time of serial correlation coefficients for individual securities will be investigated.

2) The Results

The period covered consists of 1310 daily observations. For each country, we get a distribution of serial coefficients as illustrated in the case of France by Table II-1 and Figure 1.

Table II-1

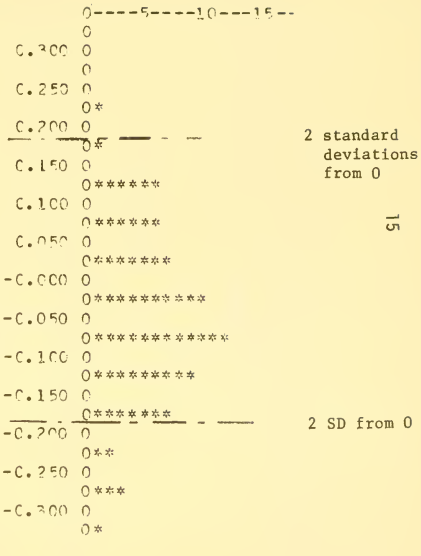
COMPANY NAME	SERIAL CORRELATION			
	DAY	WEEK	2-WEEKS	MONTH
S.N.P.A.	0.023	0.002	-0.074	0.024
BANQUE DE L'INDOCHINE	0.008	0.042	-0.126	0.010
FINANCIERE DE PARIS	0.085	0.001	-0.067	0.021
CIMENTS LAFARGE	0.064	0.073	-0.089	-0.192
CITROEN	-0.036	-0.051	-0.031	-0.066
FRANCAISE DES PETROLES	-0.015	-0.040	-0.063	-0.065
C.G.E.	0.116	0.043	-0.049	-0.023
GALERIES LAFAYETTE	-0.069	0.036	0.048	0.085
AIR LIQUIDE	0.062	-0.015	-0.134	-0.029
MACHINES BULL	0.042	0.103	0.105	0.159
MICHELIN	0.080	0.073	0.050	0.116
PECHINEY	0.049	-0.033	-0.153	-0.077
PEUGEOT	0.107	0.000	-0.096	0.073
PRINTEMPS (AU)	-0.018	0.011	0.064	0.083
RENAULT (LA)	0.014	0.138	0.231	0.152
RHONE-POULENC	0.062	0.047	0.018	0.095
ST GOBAIN-PUT A MOUSSON	0.042	-0.017	0.051	0.096
THOMSON BRANDT	0.065	0.064	0.043	0.129
USINE NORMANDIE	0.057	-0.030	0.103	0.010
[illegible]	-0.034	-0.035	-0.001	0.103
NEUVEL (DE)	0.007	-0.144	-0.021	-0.036
ROUSSEL UCLAF NEUVESEL	0.111	0.078	0.146	0.056
TUBEZ	0.083	0.062	0.041	0.113
[illegible]	0.092	0.031	0.072	-0.020
ERICSSON (FRANCE)	0.012	-0.012	-0.024	-0.009
TELECOMMUNICATIONS	0.016	-0.105	-0.032	0.086
S.FRALX	-0.125	-0.108	0.018	0.209
UNION DE CREDIT(BATIMENT)	-0.089	-0.073	-0.029	0.060
[illegible]	-0.113	-0.058	-0.159	-0.084
AUXILIAIRE D'ENTREPRISES	-0.062	-0.030	-0.240	-0.145
C.C.F.	-0.032	0.037	0.050	0.150
[illegible]-MECANIQUE	-0.078	-0.107	-0.178	-0.090
T.[illegible]	-0.113	-0.154	-0.265	-0.160
[illegible]	0.082	0.072	0.040	0.107
[illegible]	-0.114	-0.125	0.116	-0.002
SA [illegible]ES DE LA SEINE	-0.173	-0.206	-0.120	-0.066
[illegible] DE PRODUCTIONS	-0.171	-0.314	0.023	-0.135
[illegible] BLEITLEMANN	-0.112	-0.147	-0.114	0.102
[illegible]	-0.032	-0.026	0.060	0.056
[illegible] R.D. (LA)	0.018	-0.006	-0.211	-0.274
PAT[illegible]ELLE VIE	-0.060	-0.090	-0.191	-0.006
[illegible] (LE)	0.002	-0.073	-0.128	0.020
[illegible]-PRIMAGE	-0.062	-0.114	-0.252	-0.187
[illegible] ET [illegible]	-0.112	-0.146	-0.174	-0.128
[illegible]	-0.112	-0.172	-0.166	-0.032
[illegible]	-0.078	-0.076	-0.151	0.099
[illegible]	-0.052	-0.337	-0.060	0.082
[illegible]	-0.072	-0.010	-0.089	0.045
[illegible]	0.066	0.081	-0.027	0.160
[illegible]	-0.006	-0.100	-0.050	-0.012
NOUVELLES GALERIES	-0.012	-0.145	-0.085	-0.071
[illegible]	-0.051	-0.054	-0.071	-0.088
[illegible] (LE)	-0.076	-0.103	-0.006	0.055
[illegible]	-0.045	-0.039	-0.174	0.059
PAPETERIES S.A. (LA)	-0.084	-0.127	-0.167	-0.174
PIVES LILLE CAIL	-0.135	-0.176	-0.008	0.094
U.T.A.	-0.005	-0.110	-0.181	-0.145
[illegible]TECHNIQUE (LA)	-0.051	0.041	-0.031	-0.013
[illegible] (LE)	-0.051	-0.076	-0.137	0.023
[illegible]FRANCE	-0.045	-0.151	-0.077	0.119
[illegible]	-0.052	-0.031	-0.119	-0.012
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCHNEIDER	-0.055	-0.092	[illegible]	0.121
[illegible]	0.194	-0.012	0.135	-0.048
TELEMECANIQUE ELECTRIQ	-0.055	-0.035	0.127	-0.018



Daily Serial Correlation

U.S.A. 30 Dow Jones Industrials (Fama)

France. 65 stocks



Biweekly correlation

France: 65 stocks

Figure 1

If the returns have finite variance, and in a large sample of time observations, the standard deviation of P_t the serial correlation coefficient is given by the Anderson formula:[1]

$$SD = \frac{1}{\sqrt{N - \tau}}$$

where N is the sample size (1310 for daily returns) and τ is the lag considered (1 unit in these tests).

The distribution of serial correlation coefficients in France is typical of all European countries. In Figure 1 the distribution found by Fama for daily returns on a comparable period is adjacent to the one which was found for France; the dashed line represents two standard deviations from zero.

It can be noticed that in the case of France (like all European countries) the distribution for daily changes is much flatter than for America, without any mode around zero. Also the percentage of stocks showing a serial correlation larger than twice the standard deviation is greater. Finally, and still in the case of French daily returns, there exist some stocks with fairly high coefficients (in absolute value) in comparison with the American case.[2]

Still looking at Figure 1, it appears that those deviations from the random walk hypothesis get less significant for longer time intervals.

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[1] See Kendall [23].

[2] Although coefficients greater than two standard deviations are statistically significant, the real magnitude of their effect is still very small.

Table II-2: Daily returns, serial correlation

	Ser. corr. Average	# of positive terms	# of terms $\geqslant$ 2 St.Dev.
France	-0.019	33/65	41/65
Italy	-0.023	14/30	9/30
U.K.	0.072	34/40	21/40
Germany	0.078	28/35	23/35
Nederland	0.031	17/24	9/24
Belgium	-0.018	7/17	5/17
Switzerland	0.012	11/17	4/17
Sweden	0.056	3/6	1/6

Standard Diviation $\simeq$ 0.035 (estimated)
of the coefficients

Table II-3: Biweekly returns, serial correlation

	Serial corr. Average	# of positive terms	# of terms $\geqslant$ 2 st. dev.
France	-0.050	21/65	6/65
Italy	0.050	21/30	3/30
U.K.	0.005	20/40	3/40
Germany	0.038	17/35	4/35
Nederland	0.052	16/24	3/24
Belgium	0.019	10/17	1/17
Switzerland	-0.063	3/17	1/17
Sweden	0.070	6/6	0/6

Standard Deviation $\simeq$ 0.09 (estimated)

The third plot of Figure 1 shows the distribution for biweekly returns; the distribution of correlation coefficients assumes a shape more in line with the random walk theory and the percentage of stocks having a coefficient larger than two standard deviations (dashed line) gets very small (although some coefficients are fairly high).

Summary statistics on the distribution for each country are given in Table II-2 and Table II-3. In each of these tables, the first column gives the average over the sample of stocks, the second column gives the percentage of stocks with a positive serial correlation and the third column indicates the number of stocks with a correlation coefficient whose absolute value is larger than twice the standard deviation. The conclusions that can be reached for any European country are similar to the previous ones.

As far as the predominance of negative serial correlation is concerned no evidence can be found on those European results. In the case of biweekly returns for example, only two countries exhibit a tendency towards negative time dependence; France and Switzerland are the only countries to have a larger proportion of stocks with negative serial correlation during the recent years.

Let us now look at the stability of this time dependence relationship of returns on stocks.

3) Stability of the Estimates

For this serial correlation to be used in any meaningful way it should be stable over time. In the random walk framework, one would expect that this time dependence would be purely accidental and that a stock exhibiting

more serial correlation than another in one period would not have any reason (50% chance) to do so in the next period. In this section we look for the predictability of those serial correlation coefficients on an individual basis.

In order to do so, the total period has been split into two subperiods:

period 1: March 1966 - November 1968

period 2: December 1968 - March 1971

The coefficients have been computed separately on those two periods. Then cross-section (product moment) correlations of serial correlation coefficients between the two periods have been computed and are shown in Table II-4.

Table II-4: Correlation Between Estimates of the Two Periods

	SC_1/SC_2 daily	SC_1/SC_2 biweekly
France	0.48	0.27
Italy	0.31	0.34
U.K.	0.14	0
Germany	0.58	0.37
Netherlands	0.10	0.20
Belgium	0.32	0.42
Switzerland	0.36	0.38
Sweden	0.88	-0.48

Surprisingly enough, there is some evidence of stability of those serial correlation coefficients of individual stocks. Thus a stock which tends to exhibit positive (respectively negative) serial correlation in one period keeps this characteristic in the following periods. Only in the case of Great Britain (the most efficient market?) is this property not displayed.

4) Comments

The evidence presented above would tend to categorize the European stocks into two classes:

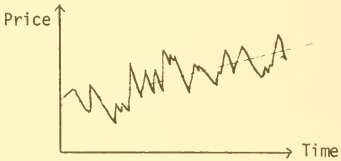
a) stocks with long period fluctuations around the mean [1] (low frequency),

b) stocks with short period fluctuations around the mean (high frequency).

A plot in terms of stock prices would give

Class a

Positive serial correlation of returns



Class b

Negative serial correlation of returns

A question which might still need to be clarified is to what extent

[1] A somewhat identical interpretation calls for varying short term means. A quick look at the picture shows that these two interpretations describe exactly the same behavior.

the existence of time dependence in return is detrimental to the efficiency of the market. Fama [15] defines efficiency as a property of the market to "fully reflect all available information". According to that definition the knowledge of historical prices could not help anyone to make extra profits in an efficient market. One possible intuitive explanation is that some stocks over-react (negative serial correlation) to new information while others adjust slowly (positive correlation) to the information. Several strategies have been designed to take profit of time dependencies of this or of a more general kind. The rebalancing strategy, using negative dependencies, has been described earlier. On the opposite side, various filter techniques (Alexander [1]) have been designed to take advantage of positive time dependencies.

Section III: The Market Model Applied to European Markets

1) The Market Model

Since the investor is assumed to hold a diversified portfolio of stocks, the measure of security risk which is of interest is not the risk of a security if held separately but the contribution of that security to the overall risk of the portfolio. In other words, the investor is concerned only with that component of security risk which cannot be diversified away. This led to the wide acceptance of one measure of risk, namely the coefficient of non-diversifiable risk or more simply the beta coefficient of the market model.

The interpretation of the beta coefficient as a measure of risk rests upon the empirical validity of the market model. This model asserts that the return on an asset, for any period, is a linear function of a market factor common to all assets and of factors unique to that asset:

$$R_{it} = \alpha_i + \beta_i I_t + \varepsilon_{it}$$

with

$$E(\varepsilon_{it}) = 0$$

$$\text{cov}(\varepsilon_{it}, I_t) = 0$$

(1) $$\text{cov}(\varepsilon_{it}, \varepsilon_{jt}) = 0 \qquad \text{for } i \neq j.$$

Then $$\beta_i = \frac{\text{cov}(R_{it}, I_t)}{\text{var}(I_t)} .$$

The result of the portfolio diversification effect is that the appropriate risk measure for a security is its contribution to the portfolio risk and not its total risk; β_i is a measure of the relative, systematic

(1) In fact when an index of the market is used as a proxy for the market factor, $\text{cov}(\varepsilon_{it}, I_t)$ is not exactly equal to zero.

riskiness of security i.

Let us write the return on each security as:

$$\tilde{r}_{it} = \beta_i \tilde{I}_t + \varepsilon_{it}$$

and consider a portfolio invested equally in n securities:

$$\tilde{W}_t = (\frac{1}{n} \sum_{i=1}^{n} \beta_i)\tilde{I}_t + \frac{1}{n} \sum_{i=1}^{n} \varepsilon_{it} = \beta_{\underline{p}} \tilde{I}_t + \varepsilon_{wt}.$$

The risk of this portfolio will be given by:

$$\mathrm{var}(\tilde{W}_t) = (\frac{1}{n} \Sigma \beta_i)^2 \mathrm{var}(\tilde{I}_t) + \frac{1}{n^2} \sum_{i,j} \mathrm{cov}(\varepsilon_{it}, \varepsilon_{jt}).$$

According to the market model this reduces to:

$$\mathrm{var}(\tilde{w}_r) = \beta_{\underline{p}}^2 \mathrm{var}(\tilde{I}_t) + \frac{1}{n^2} \sum_{i=1}^{n} \mathrm{var}(\varepsilon_{i,t}).$$

This can be written as:

$$\mathrm{var}(\tilde{w}_r) = \beta_{\underline{p}}^2 \mathrm{var}(\tilde{I}_t) + \frac{\overline{\sigma^2(\varepsilon)}}{n}$$

where the bar indicates an average. When the number of securities included in the portfolio increases, the last term becomes negligible. Evans and Archer [13] have shown empirically that diversification eliminates this last term very quickly (ten securities achieve a diversification of 93% of the residual risk). Thus for a diversified portfolio the total risk will approximate $\beta_{\underline{p}}^2 \mathrm{var}(I_t)$ and $\beta_{\underline{p}}$ becomes a measure of risk for the portfolio

(since var(I_t) is the same for all portfolios) and β_i, as it contributes to β_p, is a measure of risk for the security i.

Although the linearity assumption of the market model should not be confused with the Capital Asset Pricing Model of Sharpe [35] or Lintner [27], this theory of equilibrium provides a theoretical support for the market model.

Finally, the empirical validity of the model has been extensively substantiated by its wide application to common stocks listed on the New York Stock Exchange. No attempt will be made now to summarize the almost infinite number of studies in this area. However comparisons with results on the American market will be drawn in this section whenever relevant. A reader not familiar with this approach could consult Blume [4] and [5], King [24].

The same methods are used on the European markets and the systematic risk of a stock (Beta) is measured by the regression of the returns of the stock on some comprehensive index of national wealth, e.g. the return on a domestic stock market index. Those regressions have been run separately for each country.

2) Selection of a Time Interval

(i) The Problems

A problem remains to be solved regarding the estimation of systematic risk; it has to do with the time intervals and the length of the period used to compute those estimates. As pointed out by Treynor, Priest, Friend and Higgins[1]

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[1] Their results are summarized in Fisher [17].

and others, the correlation between returns of individual common stocks and returns of an index are not very large. This implies that reliable estimates of the regression coefficients will only be obtained with a large number of observations. Using monthly observations for instance, will require a certain number of years of data (e.g. ten). However as time passes the structure and characteristics of the firm will change and the systematic risk cannot be expected to remain constant. This would tend to suggest using shorter time intervals (weekly returns, possibly daily) to minimize the obsolescence problem. However as Fisher [7] pointed out, the errors in measurement can get very large for short time intervals and the returns on a stock and on the index appear to become less correlated.

Several explanations can be found for this phenomenon which gets even more important in the European markets which are supposedly thinner and less efficient.

1) Errors of measurement in the index and the returns are the major factors prompting the use of longer time intervals to compute the β's. Their influence is much more important for shorter intervals as the index is likely to move less than during longer periods and the relative importance of the measurement errors will decrease. Several other errors linked to the imperfections of the index or to the precision of the model will tend to reduce the observed correlation. For example the relevant interval could be the chronological day and not the trading day. Some authors remark that stocks might react differently to different "qualitative" changes in the index; this specialization phenomenon would favor multi-index models but in the market model it would simply add to the random term.

2) Black pointed out the problem of non-simultaneity of quotation. The problem of non-simultaneity of quotation should be emphasized in the case of the European market. Except for London, most capital markets follow the principle of sequential quotation (one stock price is quoted after the other) with very little subsequent transactions in the day. This would imply some kind of two periods model including adjustment on past information:

$$R_{i,t} = \alpha + \beta I_t + \gamma I_{t-1} + \varepsilon_t.$$

In any event all indices are imperfect in this case because they are not homogenous in time. In the same spirit, it has been suggested that some stocks adjust faster than others which means that it would take more than a day for some stocks to adjust (distributed lag model). This kind of short term lag would vanish when longer time intervals are used to compute the β_i. In fact one test of market efficiency would be to see how quickly stocks adjust to information.

Recently M. Scholes advanced the idea that more speculative stocks would adjust faster to new information. Well informed investors would invest in high beta stocks because they will be the most sensitive to this new piece of information once it becomes public.

3) Some more basic technical imperfections appear on the European markets and on the data base which we are using. First in some instances, prices have been rounded up; this (small) error gets relatively smaller for large price variation, i.e. longer time period. It should be remembered that those markets are less well organized than the American market; on most of them no market index is computed during the session. Late in the

afternoon a general index is computed using slightly different stock prices from those with which we are dealing. This could be caused by some systematic bias in the construction of the index such as using 1 P.M. quotation prices or averages of the day or rounding up the prices, etc. It has been decided to keep those indices because they are representative of the total market. Using an average return over the sample of stocks included in this study would completely eliminate the small stocks influence.

4) The usual argument in favor of using monthly returns versus daily or weekly returns is that it "reduces the noise" and thus yields better estimates. It will be shown that, if the model is true, this is a fallacy.

Let us write the model for daily returns as:

$$R_{i,t} = \alpha_i + \beta_i I_t + \varepsilon_t. \tag{1}$$

Weekly returns (five trading days) will be given by a series of sums of five successive daily returns. This relation is exactly true only if one uses logarithm of price relatives which are additive, otherwise it is only approximate. Let us assume that this is the case.

$$\frac{1}{5} \sum_{k=1}^{5} R_{i,t+k} = \alpha_i + \beta_i \left(\frac{1}{5} \sum_{k=1}^{5} I_{t+k}\right) + \frac{1}{5} \sum_{k=1}^{5} \varepsilon_{t+k}$$

or

$$\bar{R}_{it'} = \alpha_i + \beta_i \bar{I}_{t'} + \varepsilon_{t'} \tag{2}$$

with var $\varepsilon_{t'} = \frac{1}{5}$ var ε_t. Let us call

$\hat{a}_i$ $\hat{b}_i$ the estimates of the regression using weekly returns $\bar{R}_{it'}$

a_i^* b_i^* the estimates of the regression using daily returns R_{it}.

If the least square assumptions hold for (1), they also hold for (2). Both estimates are unbiased:

$$E(b_i^*) = E(\hat{b}_i) = b_i$$

but

$$\text{var } b_i^* = \frac{\text{var } \varepsilon_t}{\sum_t (I_t - \bar{I})^2} = \frac{\sigma^2}{\sum_t (I_t - \bar{I})^2}$$

$$\text{var } \hat{b}_i = \frac{\text{var } \bar{\varepsilon}_{t'}}{\sum_{t'} (\bar{I}_{t'} - \bar{I})^2} = \frac{\sigma^2}{5 \sum_{t'} (\bar{I}_{t'} - \bar{I})^2} .$$

The comparisons of the variances of b_i^* and $\hat{b}_i$ will tell us which one is the more <u>efficient</u> and therefore which one should be used. The comparison of the two variances is equivalent to the comparison of their denominators, but:

$$\sum_t (I_t - \bar{I})^2 = \sum_t (I_t - \bar{I}_{t'} + \bar{I}_{t'} - \bar{I})^2$$

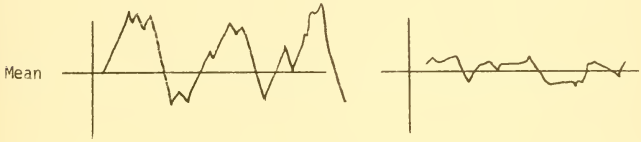
$$= \sum_t (I_t - \bar{I}_t)^2 + 5 \sum_{t'} (\bar{I}_{t'} - \bar{I})^2$$

the denominator of $\text{var}(b_i^*)$ is greater than that of $\text{var}(\hat{b}_i)$ and the ratio between:

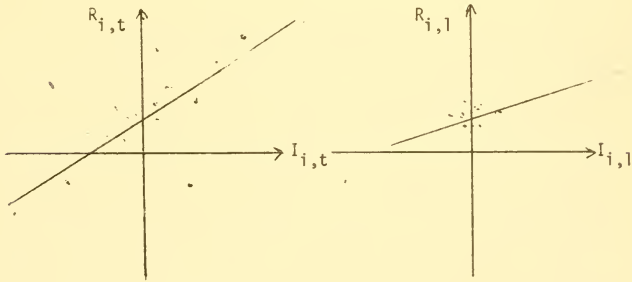
$$\sum_t (I_t - \bar{I}_t)^2 \quad \text{and} \quad 5 \sum_t (I_{t'} - \bar{I})^2$$

is a measure of the loss of precision due to the grouping.[1]

It should now be clear that the longer the time interval used, the less efficient the estimators (for the same horizon). Intuitively this means that averaging eliminates most of the extreme points useful in the estimation. If, for example, all monthly returns are identical, the variance of the estimates become infinite. In other words the gain in noise reduction is always more than offset by the loss of information.



Daily Return (same units) Monthly Return



In summary, measurement errors suggest the use of longer time intervals to compute the coefficient of systematic risk; however both the obsolescence

[1] See Malinvaud [29], pp. 281-285.

problem and estimated efficiency considerations require the use of short time intervals, possibly days. The solution should lie somewhere in between.

(ii) The Experiment

In his recent work, Fisher [17] used as a criterion the stability of the beta estimates and tried to determine the "best" number of observations for his regressions, i.e. the length of the period on which the parameters are estimated, using (arbitrarily) monthly returns. He first applied ordinary least squares and then a Kalman filter technique and found that ten years of data should be used, although the evidence produced for the dominance of 10 years over 5 or 15 years is not overpowering. I have tried to approach the problem by a different (but as slippery) slope; fixing the period used, 5 years of data, I computed the characteristics of the estimates using different time intervals for the returns, namely day, week, 2 weeks, month.

The averages over each country of the beta estimates computed on different time intervals are given in Table III-1. This table shows the strong influence of the measurement errors on daily computations. However it appears that their influence gets very small within a week and the subsequent improvement in using larger intervals to compute the β's is rather small. Quite naturally the measurement errors bias the estimates towards zero. These errors are still present for longer time intervals, but as expected their relative weight declines quickly for increasing time intervals. Thus for monthly returns only two observations out of the 20 trading days (the first and last day) will be affected by those errors and the magnitude of price variation insures against those slight imperfections.

The average standard deviations for β are given in Table III-2 and confirm the econometric argument developed in paragraph (i)-4. The smallest

Table III-1:

Beta computed on different time-intervals (average on the sample)

	day	week	2-weeks	month
France	0.59	0.77	0.82	0.84
Italy	0.72	0.92	0.95	1.00
U.K.	0.79	0.96	0.98	1.04
Germany	0.63	0.86	1.05	1.03
Netherlands	0.54	0.76	0.78	0.80
Belgium	0.35	0.70	0.73	1.11
Switzerland	0.46	0.90	0.93	1.01
Sweden	0.84	0.99	0.97	1.00

Table III-2: Standard Deviation of the Estimate as Given by O.L.S.

	day	week	2-weeks	month
France	.047	.088	.112	.120
Italy	.033	.063	.106	.124
U.K.	.042	.087	.124	.168
Germany	.033	.068	.099	.166
Netherlands	.059	.099	.150	.167
Belgium	.053	.115	.155	.188
Switzerland	.043	.114	.152	.174
Sweden	.048	.084	.104	.137

variances are found for daily computations. These look like the most efficient estimates of β (minimum variance). However these are biased estimates because of measurement errors.

Finally, it is interesting to look at the percentage of the variation of stock returns explained by the market factors; summary results are given in Table III-3. These figures follow the same pattern as the β estimates themselves. Due to the measurement errors the R^2 is increasing with the time interval used. Let us assume for a moment that the adjustment of stock prices is not instantaneous but that it takes a few days to fully reflect some information. According to Fama's definition [15] such a market is not fully efficient. A possible model to explain such a price behavior could be[1]:

$$R_{it} = \alpha_i + \beta_i I_t + \gamma_i I_{t-1} + \cdots + \eta_i I_{t-k} + \varepsilon_{it}.$$

Then the R^2 coefficient of the market model (R_{it} versus I_t) would be expected to increase with the interval as the delay in adjustment will get smaller relative to it. Then, whenever the lags are important, one would find a low R^2 for the market model using daily observations and slowly increasing with the interval. Under this interpretation the R^2 coefficients on an efficient market will quickly reach their stable value (for increasing time intervals). In fact a clear difference appears in Table III-3 between the "big four" (France, U.K., Germany and Italy). These four markets seem to adjust more quickly to new information. A quick test is obtained by

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(1) In a perfect market one would expect the adjustment to be instantaneous with $\gamma_i = \ldots = \eta_i = 0$.

computing the ratio

$$\mu = \frac{R^2 \text{ month}}{R^2 \text{ day}} .$$

	μ
France	2.5
Italy	2
U.K.	1.6
Germany	2.2
Netherlands	3.7
Belgium	9
Switzerland	3.8
(1) Sweden	2.5

table III-3

R-square of the regression: % of the variance explained by the market factor (average on the sample)

	day	week	2-weeks	month	# of stocks in the sample
France	0.13	0.25	0.30	0.33	(65)
Italy	0.27	0.44	0.46	0.55	(30)
U.K.	0.25	0.37	0.37	0.41	(40)
Germany	0.22	0.36	0.45	0.50	(35)
Netherlands	0.08	0.19	0.23	0.29	(24)
Belgium	0.04	0.14	0.16	0.36	(17)
Switzerland	0.13	0.30	0.35	0.47	(17)
Sweden	0.21	0.40	0.45	0.49	(6)

(1) Only on 6 International stocks.

These interpretation and conclusions are purely tentative but seem to be in agreement with the evidence presented here. This topic ought to be investigated in more detail.

In conclusion it appears that the influence of measurement errors is small after a week (a variation of an average beta from 0.92 to 0.95 can be considered as unimportant). It thus seems indicated to pick weekly or biweekly intervals. The case of Germany, which clearly indicates two weeks as the best interval prompted the use of biweekly intervals.

3) Some Summary Statistics on the European Markets

The various estimates and statistics based on biweekly returns for each stock are given in Appendix A, Tables A-1 to A-7. These results have been summarized in Table III-4, which gives averages over the countries for the major parameters.

Table III-4: Summary results for biweekly computations (all returns expressed in %)

	Alpha	Beta	Dispersion of Betas	R**2	Mean (1) return	St. Dev. of returns	# of stocks
France	0.174	0.82	0.256	0.30	0.33	4.9	65
Italy	0.162	0.95	0.240	0.46	0.03	4.0	30
U.K.	0.035	0.98	0.250	0.37	0.43	5.55	40
Germany	0.245	1.05	0.185	0.45	0.46	4.4	35
Netherlands	0.043	0.78	0.212	0.23	0.39	4.6	24
Belgium	0.230	0.73	0.243	0.16	0.31	3.2	17
Switzerland	-0.040	0.93	0.247	0.35	0.39	4.2	17
Sweden	0.263	0.97	0.192	0.45	0.43	4.4	6

(Stand. dev.)

(i) To make intercountry comparisons meaningful, the role of the indices should first be investigated. If the index is the sum of a certain number of stocks S_i with weight w_i, then for those stocks we should have:

$$\Sigma\ w_i \beta_i = 1.$$

If the index is an equal weighted average

$$\frac{1}{n} \Sigma\ \beta_i = 1.$$

However if the index is a market weighted average

$$\frac{1}{n} \Sigma\ \beta_i \neq 1.$$

It is even likely that $\frac{1}{n} \Sigma\ \beta_i >> 1$ as the more speculative stocks (high beta stocks) will have a relatively smaller weight in the index and because larger stocks are generally more conservative. On the other hand if the index is a broadly based, equal weight average then the average of the beta of a sample of large (and conservative) stocks will be less than one. This is the case for France and as expected the average beta is significantly smaller than one. In the case of the London Stock Exchange the index used is the Financial times (30 Industrial) whose collection of stocks (equal weights) is consistent with our sample, thus explaining that $\frac{1}{n} \Sigma\ \beta_i = 0.98$.

The same kind of argument can be developed for each country.[1]

The percentage of variation of stock prices explained by the market factor varies from one country to the other. A study by King [24] provides some evidence on the relation between market fluctuations and the variability of a typical security's rate of return on the New York Stock Exchange. Sixty-three common stocks were analyzed, with rates of return computed on a monthly basis from June 1927 to December 1960. The amount of systematic risk has decreased since the pre-war periods. Table III-5 shows King's results. In a more recent work and using a larger sample of stocks (thus less comparable to this study) Blume [4] found results consistent with the previous ones. The mean proportion of security risk due to the market factor was of the order of 30% for the period 1961-1968.

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(1) The indices universally used in Europe do not include the dividends, thus the average Alpha, as given by the CAPM, would be expected to be:

$$\bar{\alpha} = (1 - \bar{\beta})R_F + \bar{D} \times \bar{\beta}$$

where $\bar{\alpha}$ mean Alpha

$\bar{\beta}$ mean Beta

R_F risk free rate

$\bar{D}$ mean dividend rate on the index.

In the case of France and for biweekly returns the order or magnitude would be:

R_F	~ 8½-9% yearly	0.36% biweekly
$\bar{D}$	~ 2½% --	0.10% --

$$\bar{\alpha} = (1 - \bar{\beta})R_F + \bar{D} \times \bar{\beta} \simeq .18 \times .36 + .10 = 0.065 + .10 \simeq 0.165$$

which matches fairly well with the regression estimate of 0.174.

Table III-5: Proportion of Security Risk Attributable to Market Factors

Period	Average proportion of variance attributable to market variations
from King	
June 1927-Sept. 1935	58.4%
Oct. 1935-Feb. 1944	55.7%
March 1944-July 1952	41.2%
Aug. 1952-Dec. 1960	30.7%
from Blume	
1926-1933	51%
1933-1940	49%
1940-1947	36%
1947-1954	32%
1954-1961	25%
1961-1968	28%

When using monthly returns, 33% of the variance of French stocks can be explained by the market factor while for Germany and Italy over 50% of the risk was systematic (i.e. undiversifiable) during the recent years. All these numbers are in line with the American results. It can be noticed that the smallest proportion of systematic risk is found for smaller markets such as Belgium or Netherlands.

The average mean, standard deviation of returns and dispersion of betas are given for each country in Table III-4. The close similarities between all German stocks can be seen in the much smaller dispersion of their beta coefficients. I will not comment more on these statistics as they are a

characteristic of the samples of stocks and cannot be directly compared.

4) Stability of the Risk Measures

The problem of stability (and thus predictability) of the systematic risk has been studied by Blume [5] in his doctoral dissertation. Using monthly returns and long periods (set of 7 years) he found high cross-sectional correlation, even for individual stocks. The product moment correlation for individual stocks was 0.618. More recently Robert Levy [26] replicated those tests on the NYSE using weekly returns on shorter periods (one year or less). He found that short term betas were less stable. Using yearly periods from 1962 through 1970 he found a product moment correlation of 0.486.

If the Betas on the European markets were as predictable as on the NYSE we would expect the correlation coefficients to lie somewhere in between these two numbers due to the length of the periods we are using (30 months). As before two subperiods were considered:

March 1966-November 1968

December 1968-March 1971.

Summary indications on the behavior of the European markets in those periods are given in Table III-6. Similarly the mean values of β and R^2 for the sampler of stocks included in this study are given in Table III-7. Finally the product moment correlation coefficient of α, β and σ between the two periods are given in Table III-8.

Table III-6: Market summary , biweekly computations
(includes only the returns on the Index)

	Mean Return(%)			Standard deviation		
	total period	1st period	2nd period	total period	1st period	2nd period
France	0.16	-0.12	0.49	3.29	3.55	2.94
Italy	-0.10	-0.22	0.03	2.68	2.46	2.91
U.K.	0.14	0.90	-0.48	3.37	3.10	3.44
Germany	0.19	0.40	-0.05	2.80	2.97	2.58
Netherlands	0.32	0.44	0.18	2.62	2.26	2.98
Belgium	0.05	-0.04	0.15	1.72	1.63	1.81
Switzerland	0.56	1.25	0.17	2.86	2.50	3.01
Sweden	0.14	0.29	-0.04	3.12	2.83	3.41

(1) Dividends have not been taken for the Netherlands, Switzerland and Sweden.

Table III-7: stability of the estimates over time

period 1: march 1966-November 1968
period 2: December 1968-March 1971

summary results

	beta		R-square	
	1st period	2nd period	1st period	2nd period
France	0.80	0.82	0.33	0.27
Italy	0.98	0.92	0.52	0.43
U.K.	0.93	0.99	0.34	0.38
Germany	1.00	1.14	0.50	0.42
Netherlands	0.69	0.81	0.15	0.27
Belgium	1.05	0.55	0.26	0.11
Switzerland	0.78	0.96	0.26	0.38
Sweden	0.95	1.04	0.31	0.56

Table III-8: Correlation Between Estimates of the Two Periods

	α_1/α_2	β_1/β_2	σ_1/σ_2
France	0	0.70	0.70
Italy	0.245	0.50	0.77
U.K.	0.33	0.56	0.50
Germany	-0.11	0.20	0.10
Netherlands	0.15	0.39	0.38
Belgium	0	0.23	0.80
Switzerland	0.30	0.61	0.61
Sweden	-0.28	0.92	0.68

The betas seem fairly predictable (at least to the same degree as on the American markets). Similarly the total risk or standard deviation of the individual securities look fairly stable; in the case of France, both correlation coefficients are equal to 0.70[1], which is higher than its American equivalent. It must be emphasized that the part of systematic risk in total risk (R^2) is also very stable; a similar cross-sectional test for French stocks gives a correlation of 0.89. As far as the alphas are concerned, no evidence of their predictability can be found.

[1] The German stocks betas are clustered around 1 as evidenced by their low dispersion (0.185). This makes the correlation coefficient very sensitive to any (small) shift of the beta estimate to the other side of the mean.

Section IV: The Capital Asset Pricing Model Applied to European Capital Markets

One would expect the market to place a positive price on risk bearing. Traditionally different measures of risk have been used to determine the relation between expected returns and the risk borne by the investor (total risk or variance, systematic risk,...). More recently an equilibrium model has been developed and widely used. It is generally called the Capital Asset Pricing Model (CAPM) and is in line with the diversification arguments presented earlier. This model will first be described, then the relation between returns and risk will be empirically investigated on the European markets.

1) The Capital Asset Pricing Model

Sharpe [35] and Lintner [27], building on the market model, have developed a theory of equilibrium in the capital markets. Using numerous assumptions of perfection of the markets, it is possible to develop a relationship between expected returns and non-diversifiable risk measures. If R_F is the risk-free rate, $E(R_i)$ the expected return on a security i and $E(R_M)$ the expected return on the market, it can be shown that the following equilibrium relation holds for all securities:

$$E(R_i) - R_F = \beta_i (E(R_M) - R_F)$$

with

$$\beta_i = \frac{\mathrm{Cov}\ (R_i, R_M)}{\sigma_M^2} \quad .$$

This model is based on a set of fairly restrictive assumptions:

a - The market is composed of risk-averting investors maximizing their one period expected utility. They make all their decisions on the basis of only two parameters, the mean and standard deviation of the probability distribution of their terminal wealth.[1] The mean and variances of returns are supposed to exist over the period considered.

b - Expectations and portfolio opportunities are "homogenous"; that is, all investors have the same expectations and opportunities.

c - Capital markets are perfect in the sense that all assets are infinitely divisible; there are no transaction costs or taxes, and borrowing and lending rates are equal to each other and the same for all investors.

As far as the empirical testing of this model is concerned, a difficulty arises in the fact that ex ante expectations are unobservable. This model should thus be reformulated in terms of realized returns based on the assumptions that expectations are realized ex post on the average[2]:

$$R_{Mt} = E(R_{Mt}) + \varepsilon_t \, .$$

This leads to the model:

$$\bar{R}_i - R_F = \beta_i(\bar{R}_M - R_F) + \varepsilon_t$$

where the bar denotes average over the period.

2) Test of the CAPM on the European Markets

(i) Traditionally it had been considered that higher returns could be expected on a security investment with higher level of total risk

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[1] This would imply either a quadratic utility curve or a joint normal distribution of returns. However Merton [30] derived the same formula under a less restrictive set of assumptions (continuous time model).

[2] See for example, Jensen [21].

(usually approximated by the variance of returns). The diversification concept has substituted the systematic risk or β as the appropriate measure of risk in the risk/expected return relation (CAPM). However there are still proponents of the former relation[1]. Using annual rates of returns of a large sample of stocks for the period 1946-63, G. Douglas [9] concludes that the market places a positive price on risk bearing and that total risk is as good a measure of risk as systematic risk. However a serious problem of estimation is present due to the correlation between systematic and total risk (β and σ). Lintner [28] tried to get around that problem; he first computed the β_i of each security of a sample of 30, common stocks over a 10 year period, 1954-63, using annual returns. He then regresses the mean annual return for each company, $\bar{R}_i$, on the β_i obtained from the first-pass regressions and on $S^2(e_i)$ the residual variance around the first-pass regressions. His results are

$$R_i = 0.108 + \underset{(0.009)}{0.063\beta_i} + \underset{(0.035)}{0.237S^2(e_i)}.$$

More recently Miller and Scholes [31] replicated this study on 631 stocks of the CRSP files. Their results are slightly different for the same period:

$$\bar{R}_i = \underset{(0.006)}{0.127} + \underset{(0.006)}{0.042\beta_i} + \underset{(0.026)}{0.310S^2(e_i)}$$

$$R^2 = 0.33.$$

---

[1] Their empirical work has to be based on individual securities, as the total risk reduces to the systematic risk for diversified portfolio.

As $\bar{R}_M \simeq 0.193$ it appears that the intercept term is larger than expected and the coefficient of β smaller than its value indicated by the CAPM. Miller and Scholes then investigated econometric biases which could explain these deviations from the Capital Asset Pricing Model and found their magnitude to be largely sufficient to create those results:

--The residual and systematic risks are still correlated.

--The skewness of returns exaggerates the importance of $S^2(e_i)$.

--β_i is only an estimate for the true systematic risk; this error in variable strongly biases the coefficient of β_i towards 0 and the coefficient of residual risk upwards.[1] This factor should be emphasized in the Lintner-Miller & Scholes results as they are using annual observations to compute the Betas.

All this would imply a significant relation between mean return and residual variance ex post even if none exists ex ante.

The same tests have been run for European markets. The estimated coefficients (and their standard deviations) of the regressions of mean returns versus total risk (standard deviation σ) and mean returns versus systematic risk (β_i) and residual risk (standard error of the first-pass regressions) are given in Table IV-1.

Let us more specifically consider the last set of regressions. In the case of France:

$$\bar{R}_i = \underset{(0.2)}{0.23} - \underset{(0.1)}{0.3} + \underset{(0.04)}{0.09}\ S.E.$$

$$R^2 = .11.$$

---

[1] The estimates are not even consistent or assymptotically unbiased.

table IV-1: cross-sectional results

	regression results ($\bar{R}_i = a + b\sigma_i$)	regression results ($\bar{R}_i = a + b\beta_i + cSE_i$)	# Of obs.
France	$0.20 + 0.02\sigma$ (0.2) (0.04) $R^2 = .05$	$0.28 \quad -0.3\beta + 0.09\ SE$ (0.2) (0.1) (0.04) $R^2 = .11$	65
Italy	$-0.03 + 0.02\sigma$ (0.22) (0.05) $R^2 = .00$	$0.18 \quad -0.3\beta + 0.04\ SE$ (0.32) (0.34) (0.05) $R^2 = .03$	30
U.K.	$0.18 + 0.04\sigma$ (0.42) (0.07) $R^2 = .00$	$0.18 + 0.36\beta - 0.02\ SE$ (0.42) (0.37) (0.10) $R^2 = .03$	40
Germany	$0.77 \quad -0.007\sigma$ (0.33) (0.07) $R^2 = .03$	$0.74 \quad -0.2\beta \quad -0.006\ SE$ (0.34) (0.2) (0.06) $R^2 = .03$	35
Netherlands	$1.1 \quad -0.17\sigma$ (0.4) (0.08) $R^2 = .16$	$0.8 + 0.7\beta \quad -0.27\ SE$ (0.3) (0.3) (0.07) $R^2 = .38$	24
Belgium	$-0.23 + 0.17\sigma$ (0.30) (0.09) $R^2 = .19$	$-0.19 \quad -0.65\beta + 0.18\ SE$ (0.32) (0.44) (0.11) $R^2 = .19$	17
Switzerland	$-0.6 + 0.1\sigma$ (0.5) (0.11) $R^2 = .05$	$-0.08 + 0.8\beta \quad -0.07\ SE$ (0.47) (0.3) (0.10) $R^2 = .30$	17
Sweden	$-1.0 + 0.3\sigma$ (0.84) (0.19) $R^2 = .42$	$-0.9 + 1.6\beta \quad -0.1\ SE$ (0.55) (0.4) (0.2) $R^2 = .81$	6

As the return on the market was less than the risk free rate in that period the negative sign of the coefficient of β was to be expected. As emphasized previously, the errors in variables due to the measurement of β and SE in first-pass regressions (and the negative correlation of their errors) can easily explain the (spurious) importance of the residual risk. Besides the residual risk coefficient is only non-negligible (and significant) in the case of France, the Netherlands and Belgium. For all other countries, and especially Germany or England, it is both small and unsignificant.

One interesting feature should be noticed: in all countries systematic and residual risks seem to have opposite influence on the returns of a security. This means that, if, for example, the market goes up ($E(R_M) - R_F > 0$) investors would be penalized to hold "residual risk"; on the opposite, on a down market, securities with high residual risk seem to provide a good protection. Thus while the β_i is a multiplicator factor, residual risk SE_i seems to be a stabilizator factor against large variations and intended as a protection against big losses. However it is most likely that those findings are simply caused by some statistical bias.

(ii) As these regressions did not present any consistent evidence that the systematic risk was not the appropriate concept as far as the pricing of risk is concerned, the Capital Asset Pricing Model will be investigated in more detail.

The analysis has been conducted for each country with individual securities. As previously the expected returns have been approximated by the mean returns on the period and the following cross-sectional regression has been

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(1) Except Germany where $c \simeq 0$.

run for each country:

$$\bar{R}_i = \mu + \nu\beta_i + \varepsilon_i \qquad \begin{array}{l} i=1,N \\ N = \text{number of stocks} \end{array}$$

where the β_is are the estimates obtained in the first-pass regressions.

The results are given in Table IV-2 along with some plausible estimations of the regression coefficients assuming that the Capital Asset Pricing Model holds. Those proxy estimates are:

Risk free rate R_F: for $\hat{\underline{\mu}}$ (biweekly return)

[Mean return on the market (including dividends)] - [risk free rate]: for $\hat{\underline{\nu}}$.

The results of Table IV-2 can be compared with the extensive evidence on the American market presented by Jacob [19] or Blume [5].

On the French market, the relation between mean return and β is given by:

$$\bar{R}_i = \underset{(0.10)}{0.56} - \underset{(0.16)}{0.28}\beta_i .$$

The signs of the coefficients are in agreement with the CAPM predictions although the intercept term is somewhat larger than the risk free rate, inducing the slope to be larger (in absolute value) than forecasted. For most countries the coefficients are comparable in sign and magnitude with their CAPM a priori estimates.(1) In the regression for Swiss stocks the intercept term is negative but not very significant (while the slope coefficient is very significant).

(1) The sample of Swedish stocks consists of only 6 stocks and one should have little confidence on the results found for that market.

Table IV-2: Cross-sectional results

	Regression results ($\bar{R}_i$ vs β_i) (estimates, standard error, R**2)			A priori plausible estimates R_F	$E(R_M)-R_F$	# of observ.
France	0.56 (0.1)	-	$0.28\beta_i$ (0.16) $R^2 = .04$	0.36	-0.1	65
Italy	0.23 (0.31)	-	$0.20\beta_i$ (0.31) $R^2 = .01$	0.24	-0.2	30
U.K.	0.12 (0.33)	+	$0.32\beta_i$ (0.32) $R^2 = .02$	0.2	0.2	40
Germany	0.70 (0.20)	-	$0.28\beta_i$ (0.23) $R^2 = .04$	0.36	-0.05	35
Netherlands	+0.03 (0.3)	+	$0.39\beta_i$ (0.30) $R^2 = .05$	0.6	0.32	24
Belgium	0.05 (0.30)	+	$0.30\beta_i$ (0.39) $R^2 = .05$	0.6	0.16	17
Switzerland	-0.3 (0.3)	+	$0.70\beta_i$ (0.30) $R^2 = .28$	0.12	0.70	17
Sweden	-1.0 (0.3)	+	$1.4\beta_i$ (0.3) $R^2 = .79$	0.6	0.50	6

$E(R_M)-R_F$ = [Return on the Index] + [Dividend yield] - [Risk-Free Rate]

In general the R^2 of those market line regression are low but comparable to those found by Jacob [19] on the American market. If the assumptions of least squares were met it can easily be shown that the market line should be estimated using individual securities as any grouping of securities (portfolios) will hield less efficient estimates; Malinvaud [29] and others have shown that the only portfolio approach which would yield (almost) efficient estimators would be the grouping of securities into portfolios by ascending order of their dependent variable β. However we are faced with the problem of errors in variable which imply biases in the OLS estimates. In this case the OLS estimates are not even consistent. Malinvaud suggests the application of a grouping technique coupled with the use of an instrumental variable. The grouping procedure requires the ranking of securities by ascending order of their β's and their inclusion in large portfolios.(1) Black, Jensen and Scholes [3] developed this technique and applied it successfully to the American market. In a later stage of this research the same method will be applied to the four major European stock exchanges.

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(1) This technique nas the advantage to yield assymptotically both consistent (for very large portfolios) and efficient (for very many portfolios) estimates. The tradeoff between those two properties appears clearly especially when the number of securities is small as it is in the case of our sample. None of this property clearly dominates the other.

Conclusion

For the first time, this article applies the mean-variance and CAPM framework to European capital markets. A sample of over 250 European stocks has been studied for the period 1966-1971.

First, the random walk hypothesis has been tested on each European market and the results confronted with comparable evidence on the American market. The distributions of serial correlation coefficients do not look fully consistent with the random walk hypothesis; in that respect, the European markets seem less efficient than the New York Stock Exchange. Surprisingly, individual serial correlation coefficients seem to be rather predictable on all markets: a stock displaying a price pattern with positive (resp. negative) serial correlation in one period will keep this characteristic in the following periods.

In the traditional market model framework, we then studied the relation between risk and return. The systematic risk of each security relative to its national market index has been computed using various time intervals and the robustness of those estimates tested. In general the use of daily returns did not yield satisfactory estimates but it turned out that the markets reflecting new information the most quickly were those which a priori would be thought to be the most efficient (and certainly the more liquid), i.e. U.K., France, Germany and Italy. The R-square coefficients of the regressions of the stocks return versus the market return are of the order of magnitude of their American equivalent. The stability over time of the betas and of various statistics for individual stocks has also been investigated with similar results.

Finally an attempt has been made to evaluate the market line of the Capital Asset Pricing Model for each European market. The results are generally consistent with a priori expectations. Different measures of risk have been used to determine the relation between expected returns and the risk borne by the investor.

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	ALPHA	BETA	T-A	T-B	R**2	S.E.OF RESID.	MEAN RETURN	S.ER	SERIAL CORRE.	N.OF OBS.
S.A.P.A.	0.17	0.57	0.57	6.35	0.24	3.37	0.361	3.93	-0.07417	131
BANQUE DE L'INDOCHINE	0.52	1.27	1.54	12.52	0.55	3.83	0.724	5.65	-0.12610	131
FINANCIERE DE PARIS	0.14	1.06	0.46	11.09	0.49	3.60	0.316	4.99	-0.06709	131
CIMENTS LAFARGE	-0.02	0.93	-0.09	13.00	0.53	3.01	0.130	4.22	-0.08884	131
CITROEN	-0.40	0.93	-1.11	8.56	0.36	4.09	-0.364	5.69	-0.03084	131
FRANCAISE DES PETROLES	0.09	0.91	0.28	10.76	0.44	3.37	0.220	4.49	-0.06255	131
C.G.E.	-0.16	0.95	-0.60	11.65	0.51	3.06	-0.006	4.35	-0.04027	131
GALERIES LAFAYETTE	-0.34	0.92	-0.84	6.64	0.35	4.64	-0.207	5.33	-0.04704	131
AIR LIQUIDE	-0.01	1.12	-0.03	13.05	0.57	3.33	0.173	4.80	-0.13430	131
MACHINES BULL	-0.22	1.31	-0.45	8.02	0.38	5.63	-0.006	7.06	-0.10484	131
MICHELIN	0.45	0.99	1.70	12.34	0.54	3.03	0.613	4.44	-0.05028	131
PEUGEOT	0.02	0.83	0.06	10.25	0.45	3.37	0.153	4.10	-0.15238	131
PEJGEOT	0.56	0.89	1.79	9.30	0.40	3.58	0.705	4.59	-0.09576	131
PRINTEMPS (AU)	-0.30	1.14	-0.95	9.34	0.40	4.60	-0.105	5.91	-0.06445	131
PEUGOUT (LA)	0.62	0.56	1.44	4.31	0.13	4.80	0.700	5.10	-0.23125	131
RHONE-POULENC	-0.06	1.02	-0.21	11.08	0.49	3.66	0.104	4.80	-0.01777	131
ST GOBAIN-PONT A MOUSSON	0.14	0.99	0.42	8.64	0.37	4.22	0.310	5.38	-0.05144	131
THOMSON BRANDT	0.01	1.40	0.02	10.66	0.47	4.94	0.238	6.73	-0.04058	131
UGINE KUHLMANN	-0.07	0.95	-0.21	8.93	0.38	4.03	0.081	5.08	-0.10340	131
USINOR	0.44	1.10	1.37	9.74	0.42	4.24	0.614	5.56	-0.00120	131
WENDEL (DE)	0.22	1.11	0.60	9.88	0.43	4.23	0.403	5.57	-0.02117	131
BOUSSOIS SOUCHON NEUVESEL	0.21	0.88	0.72	9.81	0.43	3.40	0.250	4.46	0.14587	131
SUEZ	-0.17	0.85	-0.63	10.15	0.44	3.15	-0.036	4.20	0.04072	131
SAGEM	0.49	0.42	1.42	4.10	0.12	3.88	0.550	4.09	0.07294	131
ERICSSON (FRANCE)	0.64	0.61	1.74	5.56	0.20	4.08	0.771	4.53	-0.02399	125
TELECOMMUNICATIONS	0.14	0.29	0.34	3.15	0.07	4.69	0.201	4.91	-0.03248	131
SIGNAUX	0.13	0.57	0.31	4.60	0.14	4.66	0.219	4.99	-0.01820	131
UNION DE CREDIT(BATIMENT)	-0.01	0.75	-0.02	6.48	0.25	4.34	0.112	4.95	-0.02902	131
PENARROYA	0.11	0.90	0.26	6.69	0.26	5.08	0.261	5.84	-0.15937	131
AUXILIAIRE D'ENTREPRISES	0.82	0.90	1.91	6.82	0.27	4.99	0.980	5.77	-0.24002	131
C.S.F.	-0.33	1.20	-0.78	9.30	0.40	4.36	-0.136	6.24	0.05040	131
ELECTRO-MECANIQUE	0.83	1.21	1.50	7.22	0.29	6.31	1.026	7.42	-0.17774	131
T.R.T.	0.25	0.64	0.67	5.66	0.20	4.27	0.356	4.73	-0.26455	131
HACHETTE	-0.09	0.97	-0.25	10.31	0.45	3.54	0.079	4.74	0.04018	131
EUROPE No 1	-0.40	0.67	-1.24	6.59	0.34	2.91	-0.105	3.55	0.11575	95
SABLIERES DE LA SEINE	0.01	0.21	0.02	2.72	0.11	2.83	0.112	2.93	-0.12041	111
EUROPEENNE DE BRASSERIES	0.05	0.49	0.09	3.10	0.08	5.37	0.211	5.55	-0.02155	111
CLUB MEDITERRANEE	0.47	0.15	1.09	1.12	0.01	4.23	0.536	4.22	-0.11388	100
SOMMER	0.31	0.68	0.86	6.13	0.26	3.77	0.536	4.34	0.05960	111
PATERNELLE R.D. (LA)	0.54	0.51	1.12	3.43	0.10	5.07	0.713	5.29	-0.21101	111
PATERNELLE VIE	0.31	0.29	0.81	2.44	0.05	3.96	0.403	4.03	-0.19067	111

Appendix

France (continued)

	ALPHA	BETA	T-A	T-B	R**2	S.E.OF REGR.	MEAN RETURN	S.ER	SERIAL CORRE.	N.OF OBS.
NICKEL (LE)	0.01	0.71	1.93	5.21	0.17	0.06	0.011	0.06	-0.12870	131
GERVAIS-DANONE	0.04	0.61	0.11	5.15	0.23	3.73	0.307	4.19	-0.25151	93
MOET ET CHANDON	0.33	0.54	0.88	4.76	0.20	3.58	0.565	3.96	-0.17400	93
LOCABAIL	-0.05	0.93	-0.09	3.53	0.15	5.64	0.300	6.04	0.16623	71
COMPAGNIE BANCAIRE	0.20	0.84	0.60	8.20	0.34	3.86	0.340	4.73	-0.15095	131
CREDIT NATIONAL	-0.13	0.50	-0.48	6.03	0.27	3.19	-0.037	3.71	-0.09032	131
SOVAC	0.03	0.81	0.00	7.10	0.29	4.33	0.133	5.06	-0.08929	131
EVIAN	-0.31	0.94	-0.51	7.72	0.33	4.50	-0.053	5.50	-0.02677	131
PERRIER	0.20	0.82	0.48	6.51	0.25	4.77	0.333	5.45	-0.05018	131
NOUVELLES GALERIES	-0.57	0.96	-1.63	9.09	0.39	3.99	-0.413	5.07	-0.08528	131
PARIS-FRANCE	-0.13	0.00	-0.37	8.63	0.37	3.03	0.018	4.90	-0.07050	131
CREUSOT (LE)	0.52	0.98	0.95	5.85	0.21	6.29	0.679	7.01	-0.00633	131
ROUSSEL UCLAF	0.44	0.78	1.36	7.96	0.33	3.68	0.565	4.47	-0.13431	131
PATERNELLE S.A. (LA)	0.28	1.00	0.58	6.85	0.27	5.51	0.442	6.39	-0.14671	131
FIVES LILLE CAIL	0.33	0.74	0.87	6.58	0.25	4.34	0.453	4.98	-0.30802	131
U.T.A.	0.26	0.83	0.56	5.80	0.21	5.31	0.307	5.94	-0.18061	131
RADIOTECHNIQUE (LA)	-0.11	1.13	-0.29	9.84	0.43	4.32	0.074	5.67	-0.03119	131
OREAL (L')	0.56	0.72	1.63	7.12	0.28	3.79	0.656	4.44	-0.13683	131
LOCAFRANCE	0.86	0.71	1.99	5.54	0.19	4.86	0.961	5.37	-0.07745	131
L.M.T.	0.93	0.66	3.02	7.09	0.29	3.50	1.032	4.09	-0.11803	131
MATRA	0.12	0.60	0.32	5.53	0.19	4.08	0.213	4.50	-0.25011	131
SCHNEIDER	-0.06	1.03	-0.25	8.93	0.38	4.26	0.070	5.38	-0.08857	131
C.I.T	0.89	0.62	2.26	4.19	0.20	2.68	1.269	4.05	0.13539	72
TELEMECANIQUE ELECTRIQUE	0.55	0.45	1.47	3.79	0.15	3.43	0.751	3.67	0.12745	84

BIWEEKLY,T. PERIOD

	ALPHA	BETA	T-A	T-B	R**2	S.E.OF REGR.	MEAN RETURN	S.ER	SERIAL CORRE.	N.OF OBS.
ANIC	-0.04	1.19	-0.18	13.76	0.59	2.65	-0.163	4.14	0.08397	131
ASSICURAZIONI GENERALI	0.72	1.13	4.57	19.25	0.74	1.80	0.604	3.52	0.10814	131
BREDA FINANZIARA	0.10	0.92	0.33	8.50	0.36	3.33	0.001	4.13	0.02213	131
MONTECATINI EDISON	-0.1	0.89	-1.22	17.10	0.69	1.60	-0.261	2.87	0.08629	131
CARLO ERBA	0.42	0.90	1.34	7.72	0.32	3.59	0.329	4.31	0.03831	131
FIAT (ORDINARY)	0.23	1.04	1.42	17.53	0.70	1.83	0.120	3.34	0.09964	131
GENERALE IMMOBILIARE	0.09	0.94	0.44	11.97	0.53	2.40	-0.005	3.46	0.01768	131
ITALSIDER	-0.15	0.37	-0.70	4.78	0.15	2.37	-0.184	2.55	-0.07569	131
ERCOLE MARELLI	-0.01	0.76	-0.05	8.83	0.38	2.63	-0.090	3.31	0.04042	131
MOTTA	-0.81	1.38	-2.16	9.83	0.43	4.31	-0.954	5.65	0.08088	131
OLIVETTI	0.06	1.35	0.32	18.52	0.73	2.23	-0.076	4.24	0.02722	131
PIRELLI S.P.A.	-0.05	1.22	-0.25	16.32	0.67	2.29	-0.175	3.97	-0.00885	131
RINASCENTE (LA)	-0.01	0.95	-0.08	17.13	0.69	1.71	-0.110	3.06	0.03344	131
SNIA VISCOSA	-0.17	1.23	-0.83	15.80	0.66	2.39	-0.300	4.07	0.12493	131
FINSIDER	-0.12	0.73	-0.73	12.07	0.53	1.85	-0.192	2.68	0.02259	131
MEDIOBANCA	0.66	1.00	3.21	12.99	0.57	2.36	0.560	3.55	0.02949	131
CENTRALE (LA)	-0.22	1.04	-0.92	11.50	0.51	2.77	-0.330	3.91	-0.01251	131
DALMINE	-0.56	0.69	-2.39	7.87	0.32	2.68	-0.631	3.23	-0.06599	131
MONTE AMIATA	1.26	1.09	2.01	4.69	0.15	7.13	1.143	7.65	0.33370	131
C.I.G.A.	0.52	0.93	1.98	9.63	0.42	2.97	0.420	3.87	0.27774	131
MAGNETI MARELLI	0.62	0.96	2.09	8.87	0.42	3.11	0.538	4.04	-0.00926	111
MIRA LANZA	0.52	1.10	2.22	12.53	0.55	2.70	0.412	3.99	0.04241	131
BASTOGI	0.15	1.12	0.47	9.64	0.42	3.59	0.032	4.66	0.19587	131
CERAMICA POZZI	-0.05	1.11	-0.06	3.59	0.09	9.51	-0.165	9.90	0.00600	131
MONDADORI	0.37	0.88	1.30	8.47	0.36	3.21	0.275	3.97	-0.03737	131
CONDOTTE D'ACQUA	0.32	0.69	1.04	6.01	0.22	3.53	0.249	3.97	0.04787	131
S.I.P.	0.36	0.47	2.58	9.03	0.39	1.60	0.313	2.03	-0.11977	131
S.T.E.T.	0.44	0.56	2.96	10.10	0.44	1.70	0.383	2.26	-0.07148	131
CEMENTIR	-0.38	1.12	-1.14	9.25	0.44	3.48	-0.468	4.60	0.21204	111
ALITALIA	-0.32	0.74	-1.05	6.67	0.39	2.58	-0.331	3.26	-0.03424	72

A-2

BIWEEKLY, 1. PERIOD

	ALPHA	BETA	T-A	T-B	R**2	S.E.OF REGR.	MEAN RETURN	S.ER	SERIAL CORRE.	N.OF OBS.
DISTILLERS	0.46	0.81	1.20	7.04	0.31	4.06	0.578	4.85	-0.15332	111
ASSOCIATED PORTLAND CEMEN	0.02	1.06	0.07	11.18	0.53	3.35	0.173	4.87	-0.00852	111
I.C.I.	0.31	0.86	1.11	10.30	0.49	2.95	0.434	4.11	-0.02222	111
BANK ORGANISATION	1.59	0.90	3.33	6.33	0.27	5.03	1.719	5.83	0.04542	111
G.U.S.	0.30	0.67	1.15	8.61	0.40	2.77	0.397	3.56	0.05497	111
MARKS & SPENCER	0.60	0.63	2.07	7.29	0.33	3.05	0.691	3.69	-0.01322	111
GEC/EE	0.64	1.18	1.70	10.58	0.51	3.97	0.811	5.60	0.11200	111
PLESSEY	0.15	1.16	0.37	9.36	0.45	4.38	0.319	5.83	-0.19623	111
THORN ELECTRICAL INDUSTRI	0.57	1.17	1.60	11.09	0.53	3.75	0.726	5.42	0.04514	111
BEECHAM GROUP	0.88	0.88	2.73	9.17	0.44	3.41	1.009	4.49	-0.03085	111
I.C.L.	0.02	1.12	0.04	6.73	0.29	5.89	0.182	6.94	-0.02300	111
B.L.M.C.	-0.33	1.44	-0.77	11.52	0.55	4.43	-0.120	6.53	-0.02376	111
BOWATER PAPER	-0.44	0.63	-1.15	5.55	0.22	4.05	-0.353	4.54	-0.07246	111
REED PAPER	-0.33	0.77	-0.76	5.94	0.24	4.62	-0.224	5.27	-0.00249	111
COURTAULDS	0.27	0.93	0.75	8.61	0.40	3.82	0.404	4.90	-0.10592	111
BRITISH PETROLEUM	0.28	0.60	0.58	4.25	0.14	5.04	0.363	5.39	-0.04812	111
SHELL TRANSPORT (REGISTER	0.57	0.89	1.58	8.27	0.39	3.80	0.695	4.80	0.01809	111
TESCO STORES	0.71	1.11	1.44	7.58	0.35	5.19	0.866	6.35	-0.11315	111
E.M.I.	0.29	0.97	0.72	7.95	0.37	4.31	0.432	5.37	0.00043	111
UNILEVER LTD.	0.40	0.89	0.98	7.39	0.33	4.26	0.524	5.18	-0.03176	111
(R.T.Z)	0.93	0.86	1.96	6.08	0.25	5.00	1.053	5.74	0.05897	111
MARLEY TILE	-0.20	1.33	-0.34	7.87	0.36	6.01	-0.005	7.46	-0.11318	111
REDLAND HOLDINGS	-0.15	1.08	-0.30	7.46	0.34	5.12	0.006	6.24	0.15247	111
RUGBY PORTLAND CEMENT	0.62	0.98	1.47	7.68	0.35	4.53	0.774	5.58	0.00352	111
ALBRIGHT AND WILSON	-0.71	1.29	-1.09	6.58	0.28	6.93	-0.531	8.12	0.00480	111
GLAXO	0.83	0.90	1.95	7.24	0.32	4.43	0.952	5.34	-0.03520	111
TUBE INVESTMENTS	0.22	0.80	0.59	7.23	0.32	3.90	0.332	4.71	0.02441	111
HAWKER SIDDELEY	-0.17	1.28	-0.47	11.86	0.56	3.83	0.012	5.75	0.13843	111
G.K.N	0.42	1.09	1.48	12.87	0.60	3.01	0.579	4.73	-0.02015	111
B.I.C.C	0.04	0.47	0.10	4.79	0.20	3.39	0.023	3.75	0.01792	93
FISONS	0.58	1.16	1.25	8.88	0.46	4.50	0.552	6.08	-0.04341	93
BRITISH OXIGEN	0.38	1.23	0.94	10.99	0.57	3.85	0.342	5.81	-0.09664	93
BURMAH OIL	0.38	0.78	0.73	5.45	0.25	4.95	0.354	5.64	0.09588	93
SLATER WALKER	1.92	1.72	3.01	9.61	0.50	6.15	1.874	8.63	0.31197	93
TUNNEL CEMENT	-0.83	0.84	-1.60	5.78	0.27	4.99	-0.850	5.77	0.17742	93
ENGLISH CHINACLAY	0.72	1.01	1.14	5.61	0.26	6.17	0.700	7.08	-0.15734	93
METAL BOX	0.19	0.58	0.58	6.19	0.30	3.22	0.178	3.80	0.00759	93
DUNLOP	0.05	0.96	0.12	8.18	0.42	4.02	0.025	5.24	0.03034	93
LUCAS	0.24	1.07	0.45	7.29	0.37	5.07	0.209	6.31	0.19071	93
GESTETNER	1.02	0.85	1.66	4.96	0.21	5.92	0.995	6.59	0.03098	93

BIWEEKLY,T. PERIOD

	ALPHA	BETA	T-A	T-B	R**2	S.E.OF REGR.	MEAN RETURN	S.DB	SERIAL CORRE.	N.OF OBS.
A.E.G.	-0.13	1.17	-0.57	14.58	0.62	2.59	0.007	4.17	0.05893	131
ALLIANZ VERSICHERUNG	0.09	1.05	0.98	10.33	0.45	3.27	0.494	4.38	-0.00251	131
B.A.S.F.	-0.13	0.90	-0.62	11.76	0.52	3.45	0.041	3.50	-0.04872	131
BAYER	-0.16	1.26	-0.68	14.93	0.63	2.71	0.083	4.45	-0.08062	131
DAIMLER-BENZ	0.58	1.19	2.12	12.23	0.54	3.11	0.807	4.53	0.11693	131
DEMAG	0.20	1.33	0.93	12.66	0.55	3.69	0.551	5.18	-0.09969	131
DEUTSCHE BANK	0.51	1.10	2.02	12.32	0.54	2.87	0.720	4.20	0.04606	131
DEGUSSA	0.20	1.00	1.03	10.01	0.44	3.19	0.481	4.23	-0.00624	131
DRESDNER BANK	0.44	1.20	1.98	15.57	0.64	2.52	0.663	4.19	0.06738	131
FARBWERKE HOECHST	0.04	1.06	0.21	14.06	0.61	2.41	0.249	3.80	-0.00396	131
HOESCH	0.23	1.17	0.75	10.75	0.47	3.49	0.455	4.77	0.05521	131
KARSTADT	0.13	0.84	0.55	9.78	0.43	2.76	0.295	3.61	0.27238	131
KAUFHOF	0.00	1.14	-0.01	11.50	0.51	3.18	0.217	4.50	0.05358	131
K.H.D.	0.19	1.18	0.57	9.65	0.42	3.93	0.423	5.11	-0.10114	131
LUFTHANSA	0.12	0.90	0.26	5.40	0.18	5.32	0.295	5.85	-0.09190	131
M.A.N.	0.21	1.00	0.73	9.74	0.42	3.31	0.405	4.33	0.15330	131
MUNCHENER RUCKVERSICHERUN	0.07	1.10	0.16	6.90	0.27	5.10	0.284	5.92	-0.01791	131
NECKERMANN	-0.05	0.98	-0.13	7.17	0.28	4.38	0.140	5.14	0.05823	131
PREUSSAG	0.09	1.20	0.28	10.68	0.47	3.61	0.322	4.92	-0.05022	131
R.W.E.	0.19	1.07	0.83	13.36	0.58	2.56	0.392	3.93	0.11000	131
SCHERING	0.57	1.04	2.32	11.96	0.53	2.78	0.767	4.01	-0.00367	131
SIEMENS A.G.	0.01	1.24	0.06	16.42	0.69	2.42	0.251	4.21	0.03897	131
AUGUST THYSSEN-HUTTE	0.22	1.06	0.72	9.80	0.43	3.46	0.421	4.53	-0.01149	131
VOLKSWAGEN	0.16	1.12	0.62	12.17	0.53	2.96	0.377	4.31	0.15790	131
BEIERSDORF	0.45	0.58	1.47	5.34	0.18	3.51	0.571	3.85	0.18519	130
B.B.C. (MANNHEIM)	-0.21	1.30	-0.69	12.10	0.53	3.44	0.042	4.99	0.01077	131
VEBA	0.50	0.91	2.05	10.45	0.46	2.81	0.681	3.78	-0.06338	131
G.H.H.	0.13	1.12	0.46	11.14	0.49	3.24	0.347	4.50	0.03248	131
VARTA	0.68	1.01	2.40	10.07	0.44	3.23	0.875	4.29	-0.00545	131
HOLZMANN	0.31	0.90	0.93	7.52	0.30	3.85	0.489	4.58	0.13394	131
METALLGESELLSCHAFT	0.47	0.87	1.69	8.69	0.37	3.21	0.642	4.01	0.16642	131
BAYERISCHE VEREINSBANK	0.39	1.34	1.17	10.64	0.51	3.50	0.971	4.95	0.26258	111
BAYER HYPOTHEKEN BANK	0.49	0.91	1.93	9.52	0.45	2.65	0.887	3.57	0.18609	111
B-M-W	0.77	0.77	1.93	4.75	0.20	3.81	0.946	4.21	0.05707	93
DYCKERHOFF ZEMENT	0.36	1.13	0.74	6.00	0.28	4.43	0.605	5.17	-0.13118	93
HEIDELBERG ZEMENT	0.37	0.54	0.98	3.54	0.12	3.62	0.497	3.82	-0.13215	93

BIWEEKLY,T. PERIOD

	ALPHA	BETA	T-A	T-B	R**2	S.E.OF REGR.	MEAN RETURN	S.ER	SERIAL CORRE.	N.OF OBS.
A K Z O	0.08	0.64	0.22	4.35	0.13	4.41	0.291	4.68	0.07525	131
HOOGOVENS	-0.14	0.84	-0.39	6.26	0.23	4.02	0.133	4.55	0.14500	131
NATIONALE NEDERLANDEN	0.39	0.86	1.14	6.75	0.26	3.85	0.665	4.44	0.00309	131
PHILIPS	-0.14	0.89	-0.44	7.52	0.30	3.54	0.147	4.22	0.14854	131
ROYAL DUTCH	0.09	0.74	0.30	6.75	0.26	3.28	0.325	3.79	-0.01720	131
K.L.M.	-0.61	0.74	-0.99	3.17	0.07	7.02	-0.374	7.23	0.10431	131
UNILEVER N.V.	-0.20	0.77	-0.62	6.29	0.23	3.67	0.048	4.17	0.05087	131
ALBERT HEIJN	0.36	0.95	1.03	7.24	0.29	3.95	0.667	4.65	0.14675	131
HEINEKEN	0.85	1.05	2.85	9.33	0.40	3.38	1.189	4.35	-0.06422	131
BIJENKORF	-0.21	0.73	-0.69	6.37	0.24	3.46	0.028	3.93	0.08899	131
FOKKER	-0.09	1.00	-0.23	7.09	0.28	4.23	0.236	4.95	0.10399	131
V.M.F.	-0.50	0.76	-1.12	4.48	0.13	5.11	-0.259	5.45	-0.16125	131
ELSEVIER	1.04	0.62	3.21	5.06	0.17	3.69	1.243	4.01	0.07182	131
AMRO BANK	0.15	0.52	0.45	3.97	0.12	3.61	0.407	3.82	-0.04652	113
ALGEMENE BANK	-0.04	0.34	-0.17	3.48	0.10	2.67	0.135	2.79	0.01323	111
GIST BROCADES	0.17	1.16	0.44	8.00	0.37	3.92	0.769	4.90	0.11540	111
VAN DER GRINTEN	0.33	1.03	0.91	7.49	0.34	3.75	0.866	4.57	0.24090	111
BUHRMANN-TETTERODE	-0.34	0.66	-0.82	4.22	0.14	4.25	0.004	4.54	-0.10603	111
SCHOLTEN HONIG	-0.93	1.06	-1.74	5.19	0.20	5.53	-0.383	6.12	-0.09641	111
SLAVENBURG'S BANK	0.05	0.34	0.20	3.73	0.11	2.47	0.224	2.60	-0.01281	111
VAN NELLE	0.27	0.47	0.73	3.39	0.10	3.80	0.513	3.96	-0.02481	111
BREDERO	0.06	0.78	0.17	6.10	0.29	3.20	0.305	3.76	0.24013	93
PAKHOED HOLDING	-0.10	0.73	-0.18	3.77	0.15	4.74	0.149	5.08	0.04349	81
NAARDEN	0.48	0.87	1.62	7.81	0.42	2.73	0.725	3.56	0.17895	85

BIWEEKLY,T. PERIOD

	ALPHA	BETA	T-A	T-B	R**2	S.E.OF REGR.	MEAN RETURN	S.EP	SERIAL CORRE.	N.OF OBS.
E.R.E.S.	0.32	0.46	1.83	4.52	0.14	1.99	0.340	2.12	-0.08639	131
INNO-B.M.	-[illegible].27	.94	-.77	4.14	[illegible].12	4.[illegible]	-.229	4.23	[illegible].10003	131
INTERCOM	0.32	0.37	3.01	3.97	0.11	1.84	0.339	1.93	0.06603	131
ROYALE BELGE (LA)	0.08	0.73	0.32	4.69	0.15	3.06	0.118	3.29	[illegible].15588	131
PETROFINA	0.71	1.10	3.07	8.10	0.34	2.66	0.764	3.24	0.14464	131
GEVAERT	0.00	1.18	-[illegible]. 2	7.9[illegible]	.32	2.98	[illegible]. 49	3.59	[illegible].19336	131
STE GENERALE DE BELGIQUE	0.05	0.78	0.24	6.90	0.27	2.21	0.082	2.57	0.05797	131
STE GENERALE DE BANQUE	-0.09	0.57	-0.54	5.97	0.22	1.87	-0.062	2.10	0.09113	131
BANQUE DE BRUXELLES	-.7	.61	-[illegible].34	5.1[illegible]	[illegible].17	2.36	-[illegible]. 42	2.56	0.05575	131
ARBED	0.34	0.93	1.01	4.76	0.15	3.85	0.381	4.14	0.29890	131
COCKERILL-OUGREE	0.79	1.15	1.29	3.14	0.11	5.66	1.013	5.91	[illegible].21[illegible]	86
G.B.ENTREPRISES	1.09	0.67	3.14	3.31	0.03	3.98	1.122	4.11	-0.14398	131
KREDIETBANK	0.31	0.70	1.53	5.74	0.23	2.13	0.508	2.41	-0.02667	111
C.B.R.	-.[illegible]9	[illegible].86	-[illegible].3[illegible]	5.23	[illegible].2[illegible]	2.9[illegible]	[illegible].158	3.21	-.[illegible]85	111
SOLVAY	-0.25	0.50	-0.83	2.79	0.08	2.77	-0.159	2.87	-0.15264	87
HOBOKEN	0.21	0.57	0.66	2.87	0.08	3.11	0.295	3.21	-0.08840	93
TRACTION ET ELECTRICITE	[illegible].44	[illegible].43	1.45	2.34	[illegible].16	2.81	[illegible].525	2.87	-0.15240	85

BIWEEKLY,T. PERIOD

	ALPHA	BETA	T-A	T-B	R**2	S.E.OF REGR.	MEAN RETURN	S.ER	SERIAL CORRE.	N.OF OBS.
HOFFMANN-LA ROCHE (REG. S	0.48	1.01	1.40	3.45	0.47	3.09	0.052	4.20	0.05510	82
SWISSAIR (BEARER)	-0.10	0.47	-0.17	2.34	0.06	5.19	0.119	5.30	-0.33402	82
NESTLE (REGISTERED SHARES	0.07	0.89	0.17	5.06	0.31	3.86	0.495	4.58	-0.03802	82
CIBA-GEIGY (HIS'T CIBA) (	0.46	1.03	1.03	6.63	0.35	4.01	0.937	4.93	-0.01130	82
CREDIT SUISSE	0.02	1.00	0.06	9.40	0.53	2.72	0.481	3.92	-0.19311	82
ALUMINIUM SUISSE (REG. SH	-0.28	0.76	-0.63	5.00	0.24	3.94	0.077	4.45	-0.01999	82
B.B.C. (SUISSE)	-0.69	0.90	-1.89	7.13	0.39	3.27	-0.275	4.12	-0.11917	82
CIBA-GEIGY (HIS'T CIBA) (	0.14	1.01	0.31	6.37	0.34	4.13	0.614	5.01	-0.12013	82
CIBA-GEIGY (HIS'T GEIGY)	-0.08	1.57	-0.16	8.78	0.49	4.63	0.545	6.41	-0.18444	82
CIBA-GEIGY (HIS'T GEIGY)	-0.31	1.08	-0.56	5.66	0.20	4.97	0.190	5.81	-0.00533	82
NESTLE (BEARER)	0.04	0.93	0.14	9.23	0.52	2.61	0.472	3.70	0.02516	82
HOFFMANN-LA ROCHE (P.S.C.	0.46	0.95	1.16	6.89	0.37	3.53	0.908	4.47	0.00486	82
SWISSAIR (REGISTERED)	-0.36	0.86	-0.76	5.21	0.25	4.26	0.035	4.87	-0.00403	82
SULZER (REGISTERED SHARES	-0.24	0.38	-0.77	3.56	0.14	2.78	-0.062	2.96	-0.02058	82
ALUMINIUM SUISSE (BEARER)	-0.34	0.87	-0.81	5.92	0.30	3.79	0.060	4.49	-0.02815	82
UNION DE BANQUES SUISSES	-0.05	0.92	-0.14	7.71	0.43	3.08	0.378	4.02	-0.00340	82
URSINA FRANCK-A6	0.10	1.08	0.21	6.81	0.37	4.13	0.598	5.12	-0.00994	82

Sweden

BIWEEKLY,T. PERIOD

	ALPHA	BETA	T-A	T-B	R**2	S.E.OF REGR.	MEAN RETURN	S.ER	SERIAL CORRE.	N.OF OBS.
A.S.E.A.	-0.26	0.68	-0.83	6.73	0.24	3.62	-0.168	4.17	0.09895	131
ERICSSON (L.M.)	0.28	0.86	1.26	11.98	0.53	2.56	0.400	3.69	0.05593	131
VOLVO	0.40	1.21	1.31	12.32	0.54	3.49	0.567	5.12	0.03256	131
ELEKTROLUX'B'	0.54	1.18	1.31	8.69	0.45	3.93	0.774	5.26	0.05328	93
ATLAS COPCO	0.09	0.83	0.33	8.92	0.47	2.70	0.260	3.65	0.05590	93
S.K.F (KULLAGER"B")	0.53	1.06	1.39	8.31	0.43	3.69	0.747	4.84	0.12257	93

OCT 24 '74

JUN 12 '75

Date Due

DEC 30 '75	MAY 31 1995	
~~JUL 27 '76~~	FEB 18 200[illegible]	
NOV 03 '76		
MAR 18 '77		
AUG 17 '78		
OCT 4 '79		
NOV 13 '79		
JUN 24 '82		
OCT 06 1982		
AUG 22 '84		

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