Facoltà di Economia
Università degli Studi - L'Aquila

*****

Fundamentals Efficiency of the Italian Stock Market: Some Long Run Evidence

Giuseppe Alesii*

2nd January 2005

Abstract

Fundamentals efficiency of the Italian Stock Market is tested generalizing the dividend yield regression method á la (Fama and French, 1988a) and the VAR approach á la (Hodrick, 1992). These econometric methods have been applied on a long run time series of returns, 1913-1999, and on some time series of fundamentals, namely D/P, E/P, and P/B reconstructed for the first time for a representative sample of Italian stocks over such a long period.

We find a strong evidence of high predictability of stock returns in the long run with respect to the fundamentals information set, expecially with respect to the P/B ratio. Hence, this paper confirms common knowledge that the Italian Stock Market is highly inefficient in pricing the fair or fundamental value of listed companies.

*Ricercatore a v. di Finanza Aziendale, **ADDRESS**: Universitá de L'Aquila, Facoltá di Economia, Piazza del Santuario 19, Roio Poggio 67040 AQ, Italy, Phone: (intl-code-for Italy) + 0862+434877; Fax idem+0862+434803; e-mail: galesii@luiss.it. The author wishes to thank for their assistance in collecting data Federica Cialone and Massimo Gimminiani.

Fundamentals Efficiency of the Italian Stock Market: Some Long Run Evidence

Abstract

Fundamentals efficiency of the Italian Stock Market is tested generalizing the dividend yield regression method á la (Fama and French, 1988a) and the VAR approach á la (Hodrick, 1992). These econometric methods have been applied on a long run time series of returns, 1913-1999, and on some time series of fundamentals, namely D/P, E/P, and P/B reconstructed for the first time for a representative sample of Italian stocks over such a long period.

We find a strong evidence of high predictability of stock returns in the long run with respect to the fundamentals information set, expecially with respect to the P/B ratio. Hence, this paper confirms common knowledge that the Italian Stock Market is highly inefficient in pricing the fair or fundamental value of listed companies.

Contents

1 Introduction **1**

2 Data **1**

2.1 Data Collection and Fundamentals Time Series Reconstruction 1
2.2 Descriptive Statistics of the Fundamentals Time Series 5

3 Econometric Methods and Results **10**

3.1 Individual Fundamentals Regressions 10
3.2 Regressions with all the Fundamentals 16
3.3 VAR approach with Individual Fundamentals 19
3.4 Small Sample Properties Tests 21

4 Conclusions **25**

List of Figures

1 Time Series of ROE and of payout ratio, 1894-1998 3
2 Time series of D/P, E/P and P/B, 1913-1998 4
3 Nominal discount rate Bank of Italy, 1894 - 1999 5

List of Tables

1 Data Description: Years 1913-1998; Observations 1020 7
2 Data Description: Years 1913-1953; Observations 480 8
3 Data Description: Years 1953-1999; Observations 528 9
4 Fundamentals Univariate Regressions 15
5 Fundamentals Multivariate Regressions 18
6 Individual Fundamentals in a VAR Approach 22
7 Small Sample Properties of Wald Tests Applied to VAR Estimates 24

.

1 Introduction

We have tested the predictability of stock returns of the Italian stock market with respect to the "fundamentals" information set. These tests have been performed generalizing the dividend yield approach, see for instance (Fama and French, 1988a) or (Goetzmann and Jorion, 1993) and (Goetzmann and Jorion, 1995), with respect to other fundamental ratios such as price earnings, E/P, and price to book ratio, P/B. Concurrently, the same approach has been used to generalize the VAR method á la (Hodrick, 1992).

This generalization required the reconstruction not only of long run returns, at least 60 years as in (Hodrick, 1992), but also of the "fundamentals" information set that the investor had available simultaneously with every stock return observation. Because of this, both long and short term interest rates together with inflation and corporate financial ratios were reconstructed over the period 1913-1999.

The main conclusions are that the Italian stock market is highly inefficient with respect to fundamentals. In other words, stock returns are highly predictable with linear models reporting fundamental ratios as regressors. Among the ratios used in this study, price to book seem to be the best predictor summing up the properties of the other two, D/P and E/P.

This paper is organized as follows. In paragraph 2 we have described the procedures followed to collect data and reconstruct the fundamental ratios. Since these time series and the method adopted to construct them are the main original contribution of this paper, their statistical properties are thoroughly investigated to show that fundamentals are not collinear and using them alternatively or concurrently in regressions can have some additional predictive ability with respect to the usual dividend yield regression.

In paragraph 3 we report the econometric methods adopted and results obtained. In paragraph 4 we draw the main conclusions and set the blueprint for further extensions and enhancements of the present study.

2 Data

2.1 Data Collection and Fundamentals Time Series Reconstruction

Any approach to testing fundamental efficiency of the stock market requires long run time series. As a matter of fact, fundamentals are low frequency data, at most quarterly as in any US stock exchange, at least annual as in the Italian stock markets. As a consequence, it is necessary to deal with time series which go very far back in time even if this means mixing altogether several tax regimes and corporate governance systems. [1]

On the other hand, in order to give more power to the estimators, a larger number of observations can be obtained sampling relevant time series with a finer frequency than the year. Considering the calendar anomalies induced by a futures like negotiations system used till 1994, see (Barone, 1990), we have adopted monthly sampling for the analysis below to cover the period 1913-1999.

These considerations lead us to the reconstruction of a monthly time series of stock returns splicing together general stock market indexes.[2] Between 1913 and 1954 the general index considered is the one reported in (Rosania, 1954), called Bank of Italy Rosania (BIR) henceforth. It has been constructed between 1913 and 1937 in ex post backfilling and in the remaining period its base has been updated and published regularly in several publications of the Bank of Italy.[3] This general index reports not only the price levels, corrected for the last dividend paid, but also the dividend yield corresponding to the stocks included in the base of the index.[4] The BIR index was spliced with the general index computed by Banca Nazionale del Lavoro with base 12/31/1953=100. This is a fixed base index which was discontinued in the first months of the year 2000 by BNL being its base no more representative of the stock exchange as a whole. We have chosen the BNL '53=100 index since this too was computed with a dividend yield.[5]

In order to compute other fundamental ratios, namely price earnings and price to book ratio, we have consulted a number of yearbooks.[6] About 21.000 balance sheets between 1894 and 1999 were analyzed. Since nor Bank of Italy nor BNL disclose the names of the companies included in their indexes, we could not reconcile precisely the general indexes mentioned above with the balance sheets of the companies composing them. Although that is true, companies for which we collected accounting data were, in number, never less than 50% of the listed stocks. Moreover, this coverage percentage increases when considering capitalization, being those sampled the largest listed companies. In conclusion, collected accounting data are certainly representative of the profitability and dividend policy of the companies included in the two general indexes which have been spliced together.

[1]See, for instance, the already mentioned study by (Hodrick, 1992) which covers the period 1926-1987, i.e. 60 years of monthly observations.

[2]We have discarded some longer but annual time series, see (Panetta and Violi, 1995) or (Siciliano, 2000), and references reported therein.

[3]Namely, infra annual Statistical Bulletins and annual Statistical appendixes to the Annual Report to the Shareholders of the Bank of Italy.

[4]The reader interested in how the Bank of Italy - Rosania (BIR) index was constructed can find thorough explanations in (Rosania, 1954).

[5]Since 1937 the research department of the Bank of Italy has computed several industry indexes which have been spliced with the equivalent ones computed by BNL. For reasons which will become clearer below our study dealt only with the general index.

[6]Among the yearbooks consulted we mention *Il Taccuino dell'Azionista*, Colombi- Sasip - Databank - Radiocor 1936-2001, *Il Calepino dell'azionista*, Mediobanca, 1957-, *Il Repertorio delle notizie statistiche sulle societá anonime in Italia* del Credito Italiano poi dell'Assonime, 1910-1984.

Price earnings and price to book ratios have been reconstructed indirectly, see equations (1) and (2). Multiplying the dividend yield time series for the median of the payout ratio computed on the yearbooks, see left hand side of figure 1, we have obtained the earnings price ratio, see equation (1). Then multiplying the latter ratio times a return on equity ratio, see left hand side of figure 1, we have obtained the price to book ratio, see equation (2). The time series of $\frac{E_{t-1}}{P_t}$ and of $\frac{P_t}{B_{t-1}}$ are represented in figure 2.

$$\frac{E_{t-1}}{P_t} = \frac{D_{t-1}}{P_t} \times \frac{E_{t-1}}{D_{t-1}} \tag{1}$$

$$\frac{P_t}{B_{t-1}} = \frac{P_t}{E_{t-1}} \times \frac{E_{t-1}}{B_{t-1}} \tag{2}$$

where:

$\frac{E_{t-1}}{D_{t-1}}$:= median value of the payout ratios;
$\frac{P_t}{E_{t-1}}$:= multiplicative inverse of the time series of earnings price ratios computed in equation (1);
$\frac{E_{t-1}}{B_{t-1}}$:= median value of ROE.

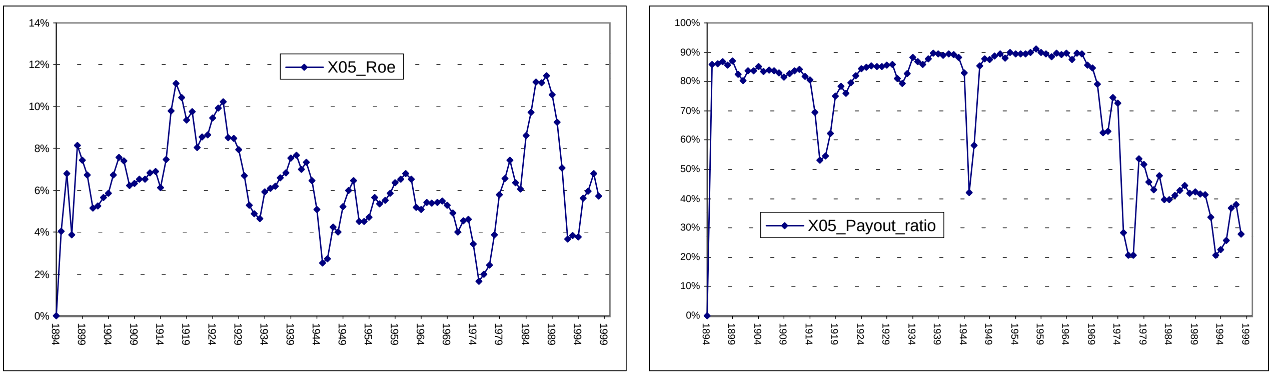

Figure 1: Time Series of ROE and of payout ratio, 1894-1998

It is worth noting that accounting data have been collected on the month of July of each year. As a matter of fact in that month balance sheets are approved by the shareholders' meetings. Hence it is reasonable to consider this one as the date in which the fundamentals data set is updated. The alternative date, the end of the year, would have implied a sort of perfect foresight by the representative investor. On the other hand, the solution proposed may imply some staleness in the data set being too much conservative. Procedures similar to those followed in equations (1) and (2) have been adopted in the literature. See for instance (Campbell and Shiller, 1988b) who compute earnings in a similar way [7], or (Goetzmann and Jorion, 1993) who gets dividends computing the difference between a total return and a capital gain only index.

[7] As underlined by (Lee, 1996).

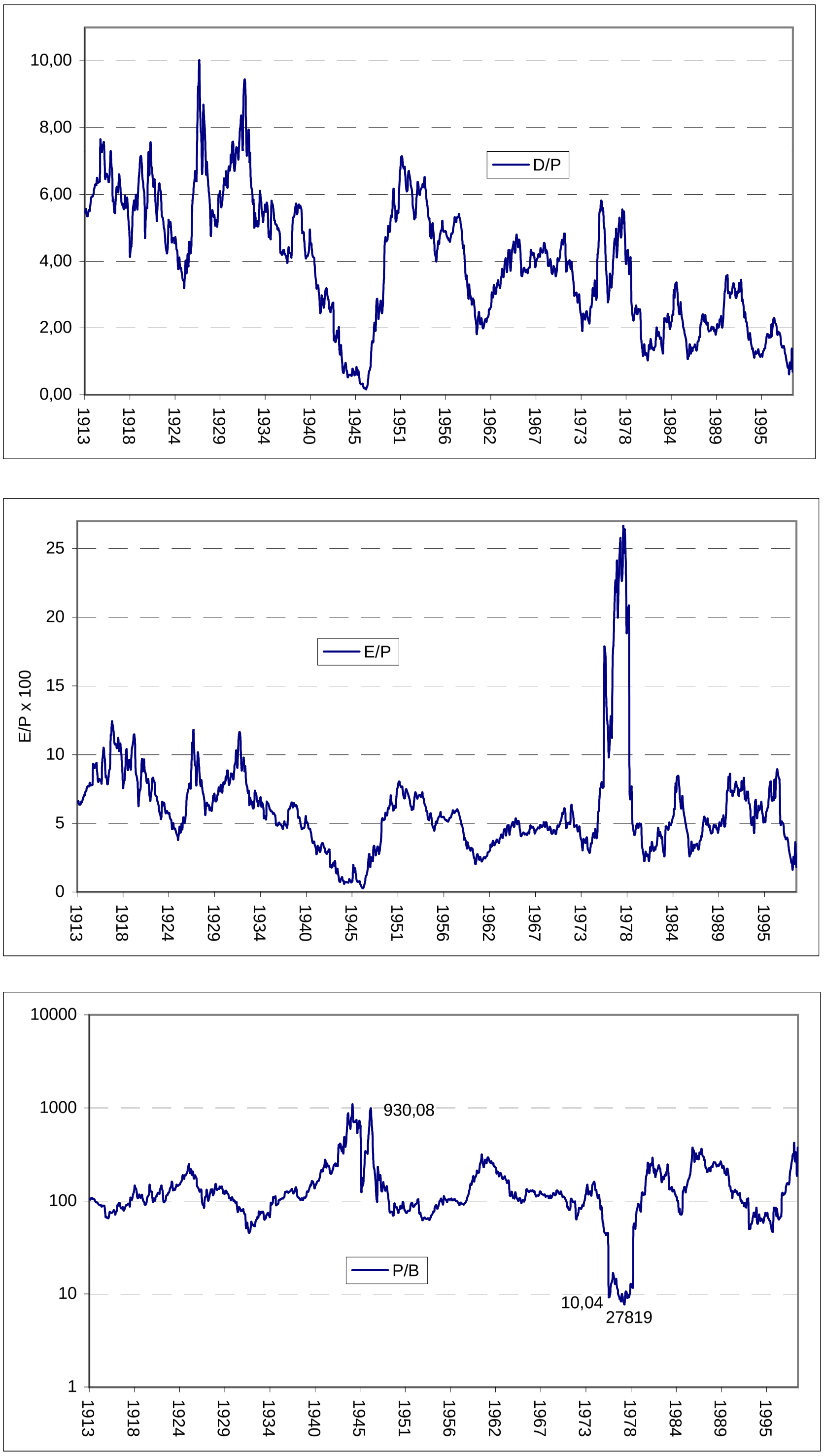

Figure 2: Time series of D/P, E/P and P/B, 1913-1998

Long and short term interest rates together with inflation complete the data set of the representative investor in our model. As a proxy for the short term interest rates we have chosen the nominal discount rate of the Bank of Italy, see figure 3. This series has been reconstructed since 1894, year in which the Bank of Italy began operating. Long term interest rates have been taken from (Bianchi, 1979) in (Vicarelli, 1979) for the period 1913-1946 and they have been updated with the Statistical Bulletins of the Bank of Italy. These series consist of long term Treasury bonds yields to maturity.

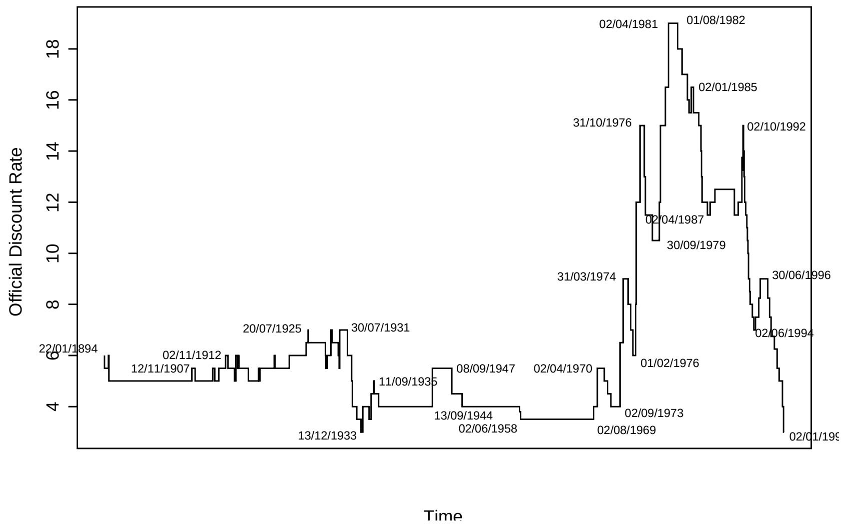

Figure 3: Nominal discount rate Bank of Italy, 1894 - 1999

Inflation time series has been reconstructed on a monthly basis since 1870 splicing together the series reconstructed ex post by Cianci, see (Cianci, 1933) when the Italian bureau of Census, ISTAT, was constituted as a separate entity, and the ISTAT consumer inflation time series computed over the period 1928-1999. It is worth noting that in the period 1942-1948, ISTAT did not publish inflation indexes. To fill up that gap we have used the indexes reconstructed by the Research Department of the Bank of Italy published in the Annual Report to the Shareholders of the Bank of Italy in the years 1946-1948. These quarterly series were the only evidence of the worst hyperinflation which ever plagued Italy.

2.2 Descriptive Statistics of the Fundamentals Time Series

The time series studied in this paper have never been used previously in finance literature nor the Italian neither, a fortiori, the international one. Hence, we have considered it convenient to report some descriptive statistics aimed not only at exploring a new data set but also at justifying the choice of the econometric methods adopted in the following paragraph.

The time series 1913-1999 is the result of the splicing of two indexes computed by two different institutions. Hence, we computed the same statistics not only for the whole period, see table 1, but also for two subperiods corresponding to the original time series, namely BIR for the period 1913-1937, see table 2 and BNL for the period 1953-1999, see table 3.

To begin with, in the tables just mentioned dimensionality and dispersion indexes have been reported in order to single out periods with higher market volatility. Blatantly enough in the first period 1913-1953 stock market returns and corresponding fundamentals have been extremely volatile due to the two World Wars and the big depression of 1929. Moreover, it is worth noting that volatility has been much higher for real than for nominal time series due to ensuing periods of deflation, the 1930s and hyperinflation, the 1940s.

In the second world war hyperinflation period, 1946-1947, we observe the outliers of many time series both for fundamentals, see graphs reported in figure 2 and in stock market returns. Highs and lows in the following period, 1953-1999 are definetly much closer.

Finally, since the gist of this paper is the additional informative content of fundamental ratios other than dividend yields, we have reported the correlation matrices of simultaneous levels of fundamentals and interest rates. With the exception of D/P and E/P ratios in the period 1913-1953, other fundamentals correlations are not very high. Moreover, the condition number of the regressors matrix, see page 269 in (Greene, 1994) is always less than 20, indicating no collinearity between the three fundamentals ratios despite the procedure followed for their construction.

A) Mean Values, Std Dev, Min - Max and date of occurrence

	D/P	E/P	P/B	LDN	LDR	DRR	DRN	Ret_n	Ret_r
Mean Values	4.00%	6.10%	146.70%	7.80%	-0.90%	-1.90%	6.80%	15.50%	4.00%
Standard Deviations	1.90%	3.40%	150.80%	3.70%	15.10%	15.10%	3.90%	51.80%	39.30%
Minimum Value	0.00%	0.20%	8.00%	3.60%	-69.90%	-70.20%	3.00%	-60.70%	-74.70%
Minimum Value Date	05/31/1945	03/31/1947	09/30/1975	01/31/1913	02/29/1944	02/29/1944	12/31/1933	03/31/1947	12/31/1944
Median Value	4.10%	5.50%	113.10%	6.20%	2.40%	0.70%	5.00%	7.80%	-1.60%
Maximum Value	10.00%	25.50%	2265.20%	21.40%	43.20%	44.00%	19.00%	843.50%	529.40%
Maximum Value Date	12/31/1926	12/31/1977	03/31/1947	11/30/1981	08/31/1927	08/31/1927	03/31/1981	04/30/1946	04/30/1946

B) Correlation Matrix

	D/P	E/P	P/B	LDN	LDR	DRR	DRN	Ret_n	Ret_r
D/P	1.000	0.547	-0.461	-0.436	0.301	0.306	-0.374	-0.159	-0.026
E/P	0.547	1.000	-0.480	0.148	0.167	0.171	0.165	-0.117	-0.047
P/B	-0.461	-0.480	1.000	-0.034	-0.321	-0.313	-0.018	-0.002	-0.145
LDN	-0.436	0.148	-0.034	1.000	0.143	0.142	0.942	0.041	0.073
LDR	0.301	0.167	-0.321	0.143	1.000	0.997	0.153	-0.100	0.178
DRR	0.306	0.171	-0.313	0.142	0.997	1.000	0.180	-0.096	0.181
DRN	-0.374	0.165	-0.018	0.942	0.153	0.180	1.000	0.050	0.089
Ret_n	-0.159	-0.117	-0.002	0.041	-0.100	-0.096	0.050	1.000	0.866
Ret_r	-0.026	-0.047	-0.145	0.073	0.178	0.181	0.089	0.866	1.000

C) Collinearity tests

Regressors					γ
D/P	E/P	P/B			4.836
D/P	E/P	P/B	LDR	R_ttpT_r	4.920
D/P	E/P	P/B	LDN	R_ttpT_n	6.640
D/P	E/P	P/B	DRR	R_ttpT_r	4.933
D/P	E/P	P/B	DRN	R_ttpT_n	6.550

Table 1: Data Description: Years 1913-1998; Observations 1020

Legend: D/P: *dividend yield*; E/P: *earnings price ratio*; P/B: *price to book ratio*; LDN: nominal long term rate; LDR: real long term rate; DRR: real short term; DRN: nominal short term rate; Ret_n: nominal stock market return over a 12 months period; Ret_r: real stock market return over a 12 months period. γ: condition number for the matrix of regressors. Levels greater than 20 indicate collinearity.

A) Mean Values, Std Dev, Min - Max and date of occurrence

	D/P	E/P	P/B	LDN	LDR	DRR	DRN	Ret_n	Ret_r
Mean Values	4.90%	6.20%	164.70%	5.70%	-4.60%	-5.10%	5.10%	18.00%	1.80%
Standard Deviations	2.00%	2.80%	202.00%	0.80%	21.10%	21.10%	1.00%	64.80%	43.80%
Minimum Value	0.00%	0.20%	40.90%	3.60%	-69.90%	-70.20%	3.00%	-60.70%	-74.70%
Minimum Value Date	05/31/1945	03/31/1947	06/30/1932	01/31/1913	02/29/1944	02/29/1944	12/31/1933	03/31/1947	12/31/1944
Median Value	5.40%	6.30%	115.30%	5.60%	0.40%	-0.60%	5.00%	10.90%	-1.70%
Maximum Value	10.00%	13.80%	2265.20%	8.60%	43.20%	44.00%	7.00%	843.50%	529.40%
Maximum Value Date	12/31/1926	03/31/1916	03/31/1947	10/31/1943	08/31/1927	08/31/1927	07/31/1925	04/30/1946	04/30/1946

B) Correlation Matrix

	D/P	E/P	P/B	LDN	LDR	DRR	DRN	Ret_n	Ret_r
D/P	1.000	0.930	-0.594	0.025	0.601	0.609	0.416	-0.286	-0.024
E/P	0.930	1.000	-0.553	-0.075	0.390	0.402	0.397	-0.252	-0.068
P/B	-0.594	-0.553	1.000	0.106	-0.354	-0.360	-0.200	0.008	-0.179
LDN	0.025	-0.075	0.106	1.000	0.116	0.092	0.148	-0.006	0.093
LDR	0.601	0.390	-0.354	0.116	1.000	0.999	0.335	-0.130	0.182
DRR	0.609	0.402	-0.360	0.092	0.999	1.000	0.372	-0.138	0.173
DRN	0.416	0.397	-0.200	0.148	0.335	0.372	1.000	-0.225	-0.069
Ret_n	-0.286	-0.252	0.008	-0.006	-0.130	-0.138	-0.225	1.000	0.830
Ret_r	-0.024	-0.068	-0.179	0.093	0.182	0.173	-0.069	0.830	1.000

C) Collinearity tests

Regressors					γ
D/P	E/P	P/B			13.964
D/P	E/P	P/B	LDR	$R_t tpT_r$	16.363
D/P	E/P	P/B	LDN	$R_t tpT_n$	18.488
D/P	E/P	P/B	DRR	$R_t tpT_r$	16.261
D/P	E/P	P/B	DRN	$R_t tpT_n$	17.481

Table 2: Data Description: Years 1913-1953; Observations 480

Legend: D/P: *dividend yield*; E/P: *earnings price ratio*; P/B: *price to book ratio*; LDN: nominal long term rate; LDR: real long term rate; DRR: real short term; DRN: nominal short term rate; Ret_n: nominal stock market return over a 12 months period; Ret_r: real stock market return over a 12 months period. γ: condition number for the matrix of regressors. Levels greater than 20 indicate collinearity.

A) Mean Values, Std Dev, Min - Max and date of occurrence

	D/P	E/P	P/B	LDN	LDR	DRR	DRN	Ret_n	Ret_r
Mean Values	3.10%	6.00%	132.10%	9.80%	2.30%	0.90%	8.40%	13.40%	6.00%
Standard Deviations	1.30%	4.00%	78.90%	4.30%	3.90%	4.20%	4.90%	36.70%	35.10%
Minimum Value	1.00%	2.00%	8.00%	4.80%	-11.50%	-13.80%	3.50%	-34.90%	-45.90%
Minimum Value Date	05/31/1981	08/31/1960	09/30/1975	04/30/1962	11/30/1974	12/31/1974	05/31/1958	07/31/1976	07/31/1976
Median Value	3.00%	5.00%	113.00%	8.90%	3.00%	1.00%	7.00%	6.10%	-1.60%
Maximum Value	6.50%	25.50%	446.90%	21.40%	9.70%	9.30%	19.00%	206.90%	188.40%
Maximum Value Date	04/30/1954	12/31/1977	03/31/1986	11/30/1981	09/30/1992	09/30/1992	03/31/1981	05/31/1985	05/31/1985

B) Correlation Matrix

	D/P	E/P	P/B	LDN	LDR	DRR	DRN	Ret_n	Ret_r
D/P	1.000	0.390	-0.576	-0.445	-0.203	-0.337	-0.520	0.009	0.037
E/P	0.390	1.000	-0.635	0.242	-0.240	-0.245	0.185	0.007	-0.032
P/B	-0.576	-0.635	1.000	0.028	0.228	0.359	0.159	-0.071	-0.054
LDN	-0.445	0.242	0.028	1.000	0.025	0.135	0.965	0.156	0.064
LDR	-0.203	-0.240	0.228	0.025	1.000	0.953	0.046	0.188	0.277
DRR	-0.337	-0.245	0.359	0.135	0.953	1.000	0.224	0.266	0.339
DRN	-0.520	0.185	0.159	0.965	0.046	0.224	1.000	0.220	0.132
Ret_n	0.009	0.007	-0.071	0.156	0.188	0.266	0.220	1.000	0.986
Ret_r	0.037	-0.032	-0.054	0.064	0.277	0.339	0.132	0.986	1.000

C) Collinearity tests

		Regressors			γ
D/P	E/P	P/B			4.435
D/P	E/P	P/B	LDR	$R_t tpT_r$	4.786
D/P	E/P	P/B	LDN	$R_t tpT_n$	7.280
D/P	E/P	P/B	DRR	$R_t tpT_r$	4.707
D/P	E/P	P/B	DRN	$R_t tpT_n$	7.637

Table 3: Data Description: Years 1953-1999; Observations 528

Legend: D/P: *dividend yield*; E/P: *earnings price ratio*; P/B: *price to book ratio*; LDN: nominal long term rate; LDR: real long term rate; DRR: real short term; DRN: nominal short term rate; Ret_n: nominal stock market return over a 12 months period; Ret_r: real stock market return over a 12 months period. γ: condition number for the matrix of regressors. Levels greater than 20 indicate collinearity.

3 Econometric Methods and Results

3.1 Individual Fundamentals Regressions

Any study of the fundamental efficiency of stock markets is based on a very simple intuition. Basically, high (low) levels of D/P and E/P or low (high) levels of P/B should be followed by high (low) returns of the stock market. This intuition is actually justified by a simple heuristic analysis of the time series reconstructed for this paper, see figure 2. For instance, in the bull markets ended in speculative bubbles, such as those of 1925, 1946, 1961, 1974, 1981, 1986, 1998, the peak of the bubble was reached with a very low levels of dividend yield and earning price ratios or a very high level of P/B. These levels of fundamentals ratios were followed by crashes. By the same token, in bear markets, for instance 1930-33, 1949-52, 1975-77, the troughs of the negative bubble has been reached with very high levels of D/P and E/P and low levels of P/B. These levels of fundamental ratios were harbinger of very high returns in the following years. In conclusion, in the first case fundamental ratios indicate market overvaluation while in the second undervaluation with respect to a fair or fundamental value of the listed companies.

We have formalized this heuristic reasoning adopting the Myron Gordon (Gordon, 1962) dividend discount model. This has helped us to tackle how variables involved in valuation influence expected returns. In a nutshell, Gordon's dividend growth model values a share of stock as the present value of an annuity growing at the rate $g < \rho$ being ρ the expected return on the stock, see equation (3).

$$P_t = \frac{D_t}{\rho - g} \tag{3}$$

The three fundamental ratios considered in this paper can be expressed as a function of Gordon's model variables, see equations (4)-(6).

$$\frac{D_t}{P_t} = \rho - g \tag{4}$$

$$\frac{E_t}{P_t} = \frac{\rho - g}{1 - pb} \tag{5}$$

$$\frac{P_t}{B_{t-1}} = \frac{Roe - g}{\rho - g} \tag{6}$$

where:

D_t	:=	dividend at epoch t;
E_t	:=	earning per share at epoch t;
ρ	:=	expected return on the stock;
g	:=	dividends growth $g < \rho$, it is the same for all the accounting variables of the firm;
pb	:=	plowback ratio $pb = \frac{E_t - D_t}{E_t}$, $0 \leq pb < 1$;
Roe	:=	return on equity $Roe = \frac{E_t}{B_{t-1}}$ or earnings over book value.

From equation (4) it is evident how greater levels of D/P correspond to higher expected returns ρ, for the same levels of growth rates g. By the same token, for the same level of ρ, an higher growth justifies a lower level of the dividend yield. The same kind of reasoning can be followed for the influences of ρ and g on the E/P ratio, see equation (5). On top of that, it is possible to single out the influence of dividend policy, *pb*. The higher it is the plowback ratio the higher it is the E/P ratio. Finally, from equation (6) we can conclude that a higher level of the P/B ratio results from, ceteris paribus, a lower expected return. The influence on P/B ratio of g depends on how *Roe* and ρ are related. If $\rho < Roe$ then growth is economically viable and it increases P/B else it simply destroys value and decreases the price to book ratio. If $\rho = Roe$ then $P/B = 1$ and growth has no influence on valuation. From this reinterpretation of Gordon's model, we draw the following conclusions:

- fundamentals ratios are sufficient statistics of a number of variables simultaneously:
  - dividend yield ratio: both expected return ρ and dividend growth g influence simultaneously D/P. Hence, we conclude that any linear relationship between D/P and returns computed at various horizons is affected by expected dividend growth.
  - earnings price ratio: on top of the same line of reasoning already mentioned for D/P, it is worth noting that the predictive ability of E/P is higher since it entails the influence of dividend policy too or of the management expectations of future earnings.
  - price to book ratio: on top of the influence of the variables already included in the computation of the previous two ratios, accounting return is explicitly considered. Hence it is possible to compare the accounting return on equity with the market expected return. Over or under valuation have then a clear intuitive meaning. High levels of P/B are justified only by a level of *Roe* higher than ρ. When actual observed levels are higher (lower) the stock is over (under) valued. The expectations about g lever this $Roe - \rho$ effect.
- expected signs of regressions like the one reported in equation (7) of the three fundamentals on stock returns computed at various horizons:

$$R_{t,t+h} = \alpha_h + \beta_h \left(X\right)_t + \epsilon_{t,t+h} \tag{7}$$

where:

$R_{t,t+h}$:= return between month t and month $t+h$ $\forall h = 12, \ldots, 48$;
X := fundamental ratio D_{t-1}/P_t, E_{t-1}/P_t e P_t/B_{t-1} at epoch t.

– for D_{t-1}/P_t and for E_{t-1}/P_t ratio we expect $\beta_h > 0$;

– for P_t/B_{t-1} we expect $\beta_h < 0$.

Regressions like those reported in equation (7) are quite common in literature, see for instance (Fama and French, 1988a) and those of (Goetzmann and Jorion, 1993) e (Goetzmann and Jorion, 1995). In those articles OLS regressions are computed on different horizons in order to study the predictive ability of D/P with respect to stock returns on the following 12,24,...,48 months. The original contribution of this paper is to perform the same exercise for the first time to out knowledge on E/P and P/B.

The estimation of regressions like those reported in equation (7) involves several econometric problems. The first one is due to the fact that overlapping returns induce autocorrelations in the residuals which inflates classic OLS statistics. The second one is owed to the intrinsic nature of fundamental ratios and their endogeneity with respect to the regressor. As a matter of fact the same level of price used to compute the fundamental ratio is used to compute return on the following time horizon.[8]

Among the solutions suggested in the literature for the first kind of problems, we have adopted White standard errors, see (White, 1980), to correct s.e. for heteroscedasticity of residuals and Newey - West standard errors, see (Newey and West, 1987), to take into due account autocorrelation in residuals induced by the use of overlapping returns. Instead, about the second kind of problems we have used bootstrapping simulation methods, see chapter 21 in (Davidson and MacKinnok, 1993), as they were applied to dividend yield regressions by (Fama and French, 1988a) and by (Goetzmann and Jorion, 1993), (Goetzmann and Jorion, 1995). These methods derive the distribution of the estimate of β_h under the null $H_0 : \beta_h = 0$. Then, comparing the actual parameter estimate with this distribution we get an estimate of type I error.

The first bootstrap method is called fixed dividend yield. In this method we resample actual, in our case monthly, returns. This resampling may take place with replacement or without. When resampled this time series of return is re-integrated into a new time series of price levels.[9] These prices are then used to compute returns on various horizons. These returns are the regressands in equations like (7) in which dividend yields, or any other fundamental ratio, are those of the original time series.

We have repeated this procedure 2.000 times in order to create a distribution of β_h estimates under the null of no predictability of stock returns at various horizons. Then we have computed relative

[8]These variables are defined as predetermined, see (Campbell et al., 1997).

[9]It is worth noting that re-integrated series that produce negative levels are simply discarded. This important detail of the simulation process should remind that all the estimation takes place under the hypothesis of survival of the stock exchange. To a certain extent this assumption is not realistic. For instance, both in 1916 and in 1976 not many investors would be so sure that the Italian stock market would survive the war and the political turmoil respectively. For the influence of survival on the estimates of dividend yields regressions see (Goetzmann and Jorion, 1995) and references listed therein.

frequencies of estimates higher than the actual for the first two fundamentals and lower for the last one, being the coefficient positive for D/P and E/P and negative for P/B. These frequencies are probabilities to commit type I error or the size of the test, level of significance. The lower this percentage the lower is the probability to reject the null when this is true.

Although very much used in the literature, see for instance (Fama and French, 1988a), this first simulation method has a main shortcoming. That is it does not consider the relationship between the accounting variable, e.g. dividend, earnings, book value, and the price level. As a consequence, these time series statistical properties are completely neglected since the previous variables are considered only in ratios and not for themselves, i.e. for their levels. Moreover, regressor endogeneity is no longer a problem when the price level for computing the ratio and the one for computing returns are different. For these reasons, (Goetzmann and Jorion, 1993) e (Goetzmann and Jorion, 1995) propose a bootstrapping method called fixed dividend.

In this second approach to simulation the fundamental ratio is computed dividing the actual dividend, or other fundamental, time series for index levels computed integrating bootstrapped monthly returns, resampled with or without replacement. In this way, for every bootstrapping experiment we get a series of returns, regressands, and a series of fundamentals ratios computed from the same returns simply dividing the accounting variable for the time series of the re integrated index levels. In this case too the procedure is replicated for 2.000 times. On these parameters estimates we have computed relative frequencies to gauge the level of significance of actual parameters estimates under the null hypothesis of no predictability of returns.

The econometric methods just depicted have been extensively applied to the time series described in paragraph 2. Equation (7) has been estimated on both real and nominal returns. Moreover, considering that the index reconstructed is the result of a splicing operation of two indexes computed by two different institutions we have also estimated equation (7) for both periods 1913-1953 and 1953-1999 for just to single out differences in results due to different construction criteria of the two indexes.

In general, equation estimates on nominal returns have not the expected signs and they are not significant when compared to empirical quantiles computed through the bootstrap methods described above.[10] Although that is true, equation estimates on real returns are quite significant both for the period 1913-1999 and for the two subperiods, namely 1913-1953 and 1953-1999.

Some of the most significant results have been reported in table 4. Signs of $\hat{\beta}_h$ are generally those

[10]These results are due to the influence of the speculative bubble of 1946-'47 which was particularly humongous expecially in nominal terms. Even in the second period, 1953-1999 we had a speculative bubble in a hyperinflation environment, namely 1978-1981. Because of these nominal returns estimates of equation (7) are not significant.

expected, i.e. positive for dividend yield and price earning and negative for price to book ratio, although significance levels varies with the fundamental ratio. In general the fixed dividend procedure is more conservative than the fixed dividend yield one, as it is well known in the literature, see (Goetzmann and Jorion, 1993).

Regressions on E/P are the least significant with a low level of R^2 and generally low significance levels mostly on shorter horizons. Instead, dividend yield regressions have an higher level of significance.

The fundamental ratio which seems to be the most reliable in predicting stock returns is, instead, P/B. This is confirmed by all the statistic we have computed. Student's t show extremely high values which already in the classical OLS theory allow to reject the null hypothesis of no correlation between returns and P/B. These results are confirmed by extremely high values of R^2 not only is compared with the other fundamentals regressions in this paper but also if collated to similar estimates on the US or the UK evidence, see for instance (Goetzmann and Jorion, 1993) and (Goetzmann and Jorion, 1995). Finally, both bootstrapping methods are consistent with a few exceptions in suggesting high levels of significance, between 15% and 1%.

It is worth noting that the most part of parameters estimates with non expected signs or with low levels of significance are for short horizons regressions. This evidence confirms how the predictive ability of fundamentals is effective only for medium long horizons.

Table 4: Fundamentals Univariate Regressions

		t-statistics				Bootstrap Betas		
Horizon	$\hat{\beta}_h$	OLS	W	NW	R^2	Prob $(b_{boot1} > b_t)$	Prob $(b_{boot2} > b_t)$	Prob $(b_{boot3} > b_t)$
Dividend Yield Regressions								
Real Returns General Series 1913-1998								
1	0,123	0,991	0,777	0,424	0,001	0,423	0,164	0,171
6	0,653	1,886	1,414	0,586	0,003	0,422	0,205	0,186
12	1,438	2,724	2,153	0,853	0,007	0,418	0,161	0,168
24	3,342	4,471	4,311	1,689	0,019	0,352	0,111	0,121
36	4,836	5,242	5,185	2,015	0,027	0,363	0,142	0,134
48	4,974	4,675	4,588	1,767	0,022	0,412	0,183	0,196
Real Returns General Series 1913-1953								
1	0,356	1,842	1,113	0,609	0,007	0,148	0,029	0,036
6	1,680	3,180	1,817	0,755	0,020	0,218	0,064	0,068
12	3,132	4,074	2,447	0,975	0,034	0,235	0,071	0,073
24	5,707	5,711	4,485	1,776	0,065	0,264	0,103	0,090
36	7,275	5,879	5,370	2,118	0,071	0,276	0,130	0,139
48	7,731	5,576	5,439	2,115	0,066	0,325	0,182	0,171
Earnings Price Regressions								
Real Returns General Series 1913-1953								
1	0,140	0,992	0,655	0,359	0,002	0,346	0,174	0,161
6	0,640	1,651	1,040	0,433	0,006	0,423	0,229	0,235
12	1,214	2,142	1,419	0,564	0,010	0,410	0,233	0,226
24	2,426	3,273	2,682	1,056	0,022	0,440	0,216	0,234
36	2,819	3,081	2,732	1,070	0,020	0,486	0,270	0,283
48	2,673	2,611	2,308	0,892	0,015	0,552	0,339	0,312
Nominal Returns General Series 1954-1998								
1	-0,056	-0,781	-0,677	-0,414	0,001	0,981	0,787	0,801
6	-0,166	-0,840	-1,085	-0,466	0,001	0,952	0,663	0,645
12	0,082	0,263	0,305	0,121	0,000	0,847	0,447	0,489
24	0,837	1,786	1,806	0,704	0,006	0,693	0,283	0,283
36	2,008	3,554	3,735	1,462	0,025	0,583	0,174	0,145
48	3,210	5,008	5,143	2,006	0,049	0,505	0,106	0,111
Price to Book Ratio Regressions								
Real Returns General Series 1913-1998								
1	0,002	1,288	0,469	0,262	0,002	0,000	0,109	0,102
6	-0,023	-5,388	-2,331	-1,113	0,028	0,963	0,997	0,989
12	-0,061	-9,585	-7,813	-3,566	0,083	0,978	0,999	0,999
24	-0,075	-8,256	-4,545	-2,079	0,063	0,944	0,996	0,994
36	-0,080	-7,092	-4,699	-2,120	0,048	0,939	0,979	0,982
48	-0,088	-6,796	-4,499	-2,008	0,045	0,925	0,973	0,970
Real Returns General Series 1913-1953								
1	0,002	1,144	0,448	0,250	0,003	0,015	0,128	0,138
6	-0,027	-5,119	-2,277	-1,100	0,051	0,872	0,990	0,993
12	-0,065	-8,949	-6,901	-3,220	0,143	0,898	0,999	0,999
24	-0,066	-6,611	-3,875	-1,794	0,086	0,836	0,979	0,979
36	-0,061	-4,874	-4,060	-1,869	0,050	0,758	0,935	0,931
48	-0,064	-4,612	-3,816	-1,725	0,046	0,573	0,869	0,881

Legend: values reported in column $\hat{\beta}_h$ refer to the estimate of the slope of the following expression:

$$R_{t,t+h} = \alpha_h + \beta_h (X)_t + \epsilon_{t,t+h}$$

where $R_{t,t+h}$ is the returns from month t to month $t+h$ and $X = D_t/P_t$, E_t/P_t and P_t/B_t respectively dividend yield, earnings price and price to book ratio at epoch t. t-stats are: t(OLS) computed using classical s.e., t(W) with s.e. adjusted for heteroscedasticity using (White, 1980), t(NW) with s.e. adjusted for autocorrelation and heteroscedasticity using (Newey and West, 1987). In the last three columns we report the size estimates for the following three bootstrap procedures:

- fixed dividend,earnings and book value;
- fixed dividend yield, earnings price and price to book with replacement;
- fixed dividend yield, earnings price and price to book without replacement.

3.2 Regressions with all the Fundamentals

Besides univariate regressions reported in table 4, we have computed multivariate regressions too in which we included all three fundamentals utilized individually in section 3.1. Theoretical motivations which led us to perform such an estimation exercise follow the same line of reasoning of the reinterpretation of the Gordon's model reported in section 3.1. In other words, even though P/B ratio summarizes the influence of variables already contained in E/P and the latter in turn adds the influence of another variable to D/P, the three fundamentals are more complements than substitutes. On the other hand, from an empirical point of view, condition number γ in the matrix of regressors computed for the whole sample and for the two subperiods, as reported in panel C of tables 1-3, shows that fundamentals are not collinear and regressors matrices are full rank. Although that is true, it is worth noting that in the period 1913-1953 fundamentals are actually nearly collinear, while this is not true for the second subperiod and for the whole sample.

Coefficients in a multivariate regression need not be the same as those of the univariate ones. This basic observation is based on the Frisch, Waugh (1933), Lovell (1963) theorem.[11] This lead us to interpret regressions like (8) in a much different way than univariate ones. To begin with, we were not able to formulate a priori hypotheses about the sign of the coefficients. Instead, by comparing results of the univariate regressions with multivariate ones we were able to detect, in cases estimates sign changes w.r.t. univariate regressions, the different influence of each fundamental when considered concurrently with the others and the increased predictive ability when R^2 is higher.

Equation (8) has been estimated extensively both on nominal and real data

$$R_{t,t+h} = \alpha_h + \beta_{h,1}\,(D/P)_t + \beta_{h,2}\,(E/P)_t + \beta_{h,3}\,(P/B)_t + \epsilon_{t,t+h} \tag{8}$$

where:

$R_{t,t+h}$	:=	stock returns from month t to month $t+h$ $\forall h = 12,\ldots,48$;
D_t/P_t	:=	dividend yield at epoch t;
E_t/P_t	:=	earnings price ratio at epoch t;
P_t/B_t	:=	price to book ratio at epoch t.

As in the univariate regressions, the estimates of equation (8) on nominal data are not very significant. In table 5 we have reported only those with real, deflated, data. Among the results reported in table 5, the most significant estimates are those for the subperiod 1913-1953. The overall sample estimates are definetly less significant. A possible explanation of this difference stays in the lower significance of the last subperiod both in terms of R^2 and t-stats.

[11] See (Davidson and MacKinnok, 1993) page19-24 for a textbook version of the theorem mentioned in the text.

Results for the period 1913-1953, mainly for the 12-48 months horizons show the most interesting results. Not only t-stats are highly significant after being corrected for autocorrelation with (Newey and West, 1987) s.e. but also the R^2 is considerably increased w.r.t. corresponding individual fundamental regression, compare for instance those on P/B reported in the third panel of table 4. Moreover, another empirical regularity which deserves further study is the negative sign of the coefficient of E/P ratio. While for the other two fundamentals coefficients have, in all cases but one, the same sign of the univariate regressions, for the earnings price ratio the sign is always negative and significant in many horizons. This lead us to conclude that concurrently fundamentals have a different predictive ability than taken individually.

In conclusion, predictive ability of fundamentals when taken together is increased considerably with respect to individual fundamental ratio regressions. As a matter of fact, R^2 increases a lot. Although that is true, the real interaction among fundamentals in predicting stock returns is quite counterintuitive being the sign of the E/P ratio coefficient just the opposite of that computed in univariate regressions. This empirical regularity would deserve further theoretical study.

	Real Returns 1913-1998				Real Returns 1913-1953				Real Returns 1954-1998			
Horizon	$\hat{\beta}_{D/P}$ t(OLS) t(W) t(NW)	$\hat{\beta}_{E/P}$ t(OLS) t(W) t(NW)	$\hat{\beta}_{P/B}$ t(OLS) t(W) t(NW)	R^2	$\hat{\beta}_{D/P}$ t(OLS) t(W) t(NW)	$\hat{\beta}_{E/P}$ t(OLS) t(W) t(NW)	$\hat{\beta}_{P/B}$ t(OLS) t(W) t(NW)	R^2	$\hat{\beta}_{D/P}$ t(OLS) t(W) t(NW)	$\hat{\beta}_{E/P}$ t(OLS) t(W) t(NW)	$\hat{\beta}_{P/B}$ t(OLS) t(W) t(NW)	R^2
1	0,276	-0,038	0,003	0,005	1,704	-0,744	0,007	0,030	0,120	-0,111	0,000	0,004
	1,797	-0,439	1,730		3,171	-1,967	2,827		0,451	-1,189	-0,072	
	1,705	-0,375	0,637		3,347	-3,174	1,253		0,497	-1,013	-0,055	
	0,946	-0,221	0,360		1,828	-1,646	0,725		0,276	-0,615	-0,032	
6	0,363	-0,810	-0,030	0,039	4,824	-3,662	-0,026	0,076	0,979	-0,605	-0,009	0,012
	0,860	-3,396	-5,899		3,334	-3,601	-4,017		1,280	-2,290	-0,605	
	0,827	-3,832	-2,470		2,999	-4,743	-1,850		1,425	-3,000	-0,600	
	0,357	-1,810	-1,244		1,315	-2,100	-0,965		0,594	-1,287	-0,253	
12	0,116	-1,519	-0,077	0,102	7,521	-6,753	-0,072	0,186	1,167	-1,165	-0,055	0,022
	0,186	-4,346	-10,300		3,769	-4,814	-8,120		0,945	-2,776	-2,321	
	0,173	-4,678	-6,671		3,401	-8,317	-5,318		1,109	-3,123	-2,651	
	0,070	-1,946	-3,206		1,410	-3,581	-2,561		0,439	-1,252	-1,065	
24	1,771	-1,438	-0,081	0,072	16,614	-10,744	-0,049	0,155	1,430	-2,056	-0,151	0,051
	1,961	-2,867	-7,493		6,159	-5,679	-4,138		0,762	-3,272	-4,238	
	1,923	-2,741	-3,652		6,902	-10,514	-2,673		0,855	-3,506	-5,480	
	0,764	-1,111	-1,687		2,818	-4,389	-1,252		0,335	-1,371	-2,177	
36	3,039	-0,976	-0,073	0,055	26,054	-15,776	-0,028	0,161	2,003	-1,700	-0,172	0,050
	2,683	-1,566	-5,456		7,739	-6,728	-1,909		0,849	-2,193	-3,877	
	2,739	-1,728	-3,626		10,517	-12,408	-2,116		0,835	-2,424	-4,372	
	1,074	-0,698	-1,649		4,303	-5,239	-0,986		0,324	-0,959	-1,724	
48	2,364	-0,469	-0,079	0,048	31,287	-19,510	-0,030	0,176	-2,158	-0,799	-0,188	0,035
	1,796	-0,660	-5,124		8,346	-7,470	-1,850		-0,749	-0,884	-3,553	
	1,849	-0,710	-3,418		11,167	-12,645	-1,951		-0,722	-0,962	-4,008	
	0,722	-0,283	-1,535		4,500	-5,234	-0,877		-0,279	-0,375	-1,569	

Table 5: Fundamentals Multivariate Regressions

Legend: values reported under the columns labeled $\hat{\beta}_{D/P}$, $\hat{\beta}_{E/P}$ and $\hat{\beta}_{P/B}$ refer to the estimates of the following multivariate regression:

$$R_{t,t+h} = \alpha_h + \beta_{h,1}\left(D/P\right)_t + \beta_{h,2}\left(E/P\right)_t + \beta_{h,3}\left(P/B\right)_t + \epsilon_{t,t+h}$$

where $R_{t,t+h}$ is the return from month t to month $t+h$ and D_t/P_t, E_t/P_t e P_t/B_t are respectively dividend yield, earnings price and price to book ratio at epoch t. t-stats are: t(OLS) computed using classical s.e., t(W) with s.e. adjusted for heteroscedasticity using (White, 1980), t(NW) with s.e. adjusted for autocorrelation and heteroscedasticity using (Newey and West, 1987).

3.3 VAR approach with Individual Fundamentals

In order to test the *additional* predictive ability of individual fundamental ratios when included in the information set of any investor, we have adopted the vector autoregression (VAR) approach. Hence, the predictive ability of individual fundamentals has been tested together with past stock returns and current interest rates.

Past stock returns and current interest rates have been chosen according to the following motivations. To begin with, in a quite recent literature, stock returns are not white noise and stock prices do not follow a random walk, as it was commonly accepted in the 1960s literature á la Cootner.[12] Instead, over the medium long run stock returns can be easily predicted. For instance, according to (Fama and French, 1988b) stock returns are negatively autocorrelated over the medium long run while they are non correlated over the short and the long run. This is the result of the mixture of two components one in the long, the other in the short run, the former predictable the latter not.

Moreover, we have included the short or long term interest rate, see (Campbell, 1991).[13] In the US or the UK markets the sign of the coefficient of this regressor on stock returns is negative for both real and nominal rates, see (Modigliani and Cohn, 1979). It is worth noting though that this negative relationship is normal only in those financial markets in which real interest rates have been normally positive or zero and negative only for very short periods. This is not the case of the Italian financial market in which real returns on both short and long term fixed income have been deeply negative for very long periods of time, for instance, in the years 1915-'25, 1939-'48, and 1973-'81. In these periods shares of stock were perceived as any other financial investment with their value not keeping pace with inflation. Hence, after a few years of sagging prices, reducing the real and sometimes even the nominal value of the share of stock investment, see for instance the periods 1915-'25, 1942-'44 o 1973-1978, domestic investors, unable to convert liras into a foreign currency due to capital exporting restrictions, suddenly discovered shares of stock as an safe shore for their capitals against hyperinflationary storms. This sudden change of attitude with respect to stocks investment lead to steep price increases which ended in speculative bubbles leading from an undervaluation to an overvaluation of the listed companies.

Because of these peculiar features of the Italian financial system the negative relationship between stock and fixed income returns, usually observed in the US and UK evidence, cannot be expected in the Italian stock markets. And, as matter of fact, it is not actually observed as shown below.[14]

[12] See for instance the review reported in chapters 1-3 and 6 of (Lo and MacKinlay, 1999).

[13] Another estimate of the VAR model by John Y. Campbell can be found in chapter 7 of (Campbell et al., 1997) page 285.

[14] Monetary policy pursued by the Bank of Italy had a crucial influence in shaping this attitude of savers toward investment

In conclusion, estimated VAR has been as reported in equation (9).

$$\begin{bmatrix} R_{t,t+12} \\ D_t/P_t \\ r_{f,t} \end{bmatrix} = \begin{pmatrix} a_{10} \\ a_{20} \\ a_{30} \end{pmatrix} + \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \begin{bmatrix} R_{(t,t+12)-1} \\ (D_t/P_t)_{-1} \\ (r_{f,t})_{-1} \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix} \tag{9}$$

where:

$R_{t,t+h}$	:=	stock return from month t to month $t+h$;
D_t/P_t	:=	dividend yield at epoch t or other fundamental ratio;
$(r_{f,t})$	:=	short run interest rate;

The disadvantage of the VAR approach stays in the difficulty in reconciling estimated parameters to structural models.[15] Hence, although it is easy to specify a null hypothesis of no predictive ability of stock returns, all the coefficients are not significantly different from zero, it is difficult to specify an alternative, see for instance (Hodrick, 1992) and (Goetzmann and Jorion, 1993).

On the other hand, the main advantage of the VAR approach stays in the flexibility in specifying the data generating process (DGP) for deriving through simulation power and size of the parameters estimates tests. For instance, in case of no stationarity of one or more regressors, it is possible to set up a Montecarlo simulation, see (Hodrick, 1992), and derive empirical size and power of diagnostic tests under the assumptions of a DGP as much as possible closer to the multivariate process observed and estimated in the VAR.

In estimating system (9) we have followed mostly (Hodrick, 1992) in which fundamentals are used as collected without any further transformation. This approach leads to a more immediate and intuitive interpretation of VAR parameters. Equations in system (9) have been estimated using OLS with (White, 1980) s.e. to cope with heteroscedasticity in residuals. For every equation we have computed a Wald stat, see page 131 (Greene, 1994), to test the null that all three coefficients are zero. The Wald test is distributed as a χ^2 with three degrees of freedom, one for each restriction imposed.

The econometric methods reported above have been extensively applied to the time series described in section 2 on returns computed over a 12 months horizon, the most significant in the univariate fundamentals regressions. Moreover, as in the previous evidences, results derived on nominal returns are not very significant hence we report in table 6 only VAR estimated on real, deflated, time series of both returns and interest rates.

in stocks. Till 1981 the Treasury budget deficit was actually financed printing money since the Bank of Italy purchased all the issued bond which were not purchased by retail savers and other institutional investors. Moreover, due to portfolio regulations, banks were forced to keep among their assets long term bonds which otherways would have never invested in. As a matter of fact long term interest rates did not reflect expectations nor of future inflation neither of future interest rates.

[15]See for instance (Campbell and Shiller, 1988a) for a specification in which a VAR is reconciled with the parameters of a dynamic version of a Gordon's dividend growth model. (Campbell et al., 1997) page 261 report a textbook version of the Gordon's dynamic loglinear model.

VAR estimates reported in table 6 are comparable to those reported in (Hodrick, 1992). First equation estimates are definetly significant considering the Wald test, the t-stats and the R^2 even more than the results reported by (Hodrick, 1992) table 1 for the US evidence. This is true even more for the second sub period in which coefficient of determination reaches a staggering level of $R^2 = 18.8\%$. Instead, the inflated levels of R^2s and of the Wald tests in the second and in the third equation are due to unit roots in the second and in the third regressor, the fundamental ratio and the short term interest rate. It is worth noting that this does not happen when a VAR is estimated for the P/B ratio over the whole 1913-1999 period and in the first subsample.

Parameters estimates are those expected: positive for dividend yields and earning price ratios and negative for price to book ratio. Instead, as expected above, coefficients for interest rates are always positive due to specific peculiarities of the Italian financial system. As a matter of fact, negative real interest rates have been observed together with negative stock market returns during inflationary periods. On the other hand, positive real interest rates in the '50-'60s and in the '80-90s have been observed with positive stocks returns. Finally, stock returns autocorrelation is always negative and often significant as expected by (Fama and French, 1988b).

It is interesting to note that real interest rate influences negatively fundamentals ratios in all VAR estimated with P/B and in the second subsample for D/P and E/P. This evidence can be explained using the reinterpretation of the three fundamentals as functions of the Gordon's dividend discount model remembering that ρ, expected return on the stock, includes the price for time in addition to the price for risk, following the former the short term interest rate.

In conclusion, VAR estimates suggest a high predictability of stock returns through linear relations with fundamentals. Although that is true, the presence of unit roots mostly in the dividend yield and in the earnings price ratios warn us in being wary in interpreting results reported in table 6. Hence following (Hodrick, 1992) it is necessary to test asymptotic properties of tests used in a sample rather small as the one used for the previous estimates.

3.4 Small Sample Properties Tests

In this section we test the small sample properties of Wald tests used in the previous paragraph. For the sake of brevity results are reported for dividend yield VAR only, see table 7.

In the previous paragraph we have used a Wald stat, henceforth Test 4, distributed as a $\chi^2(3)$ in order to test the null hypothesis $H_0 : \beta_j = 0 \ \forall j = 1, \ldots, 3$. In addition to this, similar Wald statistics can be devised, henceforth Tests 1,2,3, in order to test similar nulls but for individual regressors, hence

	Dividend Yield VAR						Earnings Price VAR						Price to book VAR					
	Intercept	ln(Rt) (se)	Dt/Pt (se)	rbt (se)	$\chi^2(3)$ (conf)	R^2	Intercept	ln(Rt) (se)	Et/Pt (se)	rbt (se)	$\chi^2(3)$ (conf)	R^2	Intercept	ln(Rt) (se)	Pt/Bt (se)	rbt (se)	$\chi^2(3)$ (conf)	R^2
	Real returns, Dividend Yield and Short Run Real Rates						Real returns, Earnings Price and Short Run Real Rates						Real returns, Price to Book and Short Run Real Rates					
Period 1913-1998																		
$ln(Rt)_{-1}$	-0,032	-0,069	0,639	0,41	12,772	0,039	-0,023	-0,068	0,275	0,423	12,823	0,038	0,001	-0,074	-0,005	0,422	13,147	0,038
(se)	0,025	0,049	0,491	0,127	0,995		0,02	0,049	0,265	0,127	0,995		0,018	0,052	0,011	0,135	0,996	
$(X)_{-1}$	0,006	-0,017	0,834	0,013	3182,122	0,765	0,02	-0,037	0,66	0,03	514,463	0,559	0,97	2,72	0,33	-3,547	51,039	0,397
(se)	0,001	0,001	0,015	0,002	1		0,003	0,003	0,047	0,005	1		0,097	0,462	0,075	0,625	1	
$(rbt)_{-1}$	-0,017	0,074	0,208	0,527	226,747	0,367	-0,02	0,075	0,191	0,528	232,776	0,368	-0,001	0,069	-0,005	0,523	227,744	0,369
(se)	0,011	0,019	0,255	0,043	1		0,008	0,019	0,105	0,043	1		0,006	0,02	0,004	0,043	1	
Period 1913-1953																		
$ln(Rt)_{-1}$	-0,09	-0,245	1,109	0,368	25,249	0,087	-0,051	-0,247	0,29	0,418	24,594	0,084	-0,031	-0,25	-0,001	0,431	24,216	0,084
(se)	0,049	0,067	0,837	0,12	1		0,038	0,068	0,504	0,115	1		0,02	0,074	0,011	0,134	1	
$(X)_{-1}$	0,015	-0,014	0,714	0,021	1412,746	0,71	0,013	-0,022	0,789	0,022	1383,936	0,756	1,188	3,643	0,257	-4,303	62,679	0,42
(se)	0,002	0,002	0,031	0,003	1		0,002	0,002	0,027	0,004	1		0,082	0,775	0,062	0,667	1	
$(rbt)_{-1}$	-0,134	0,119	2,127	0,364	184,176	0,371	-0,075	0,117	0,813	0,446	191,397	0,354	-0,015	0,104	-0,006	0,477	195,059	0,347
(se)	0,034	0,033	0,621	0,056	1		0,027	0,035	0,376	0,049	1		0,01	0,038	0,005	0,047	1	
Period 1954-1998																		
$ln(Rt)_{-1}$	-0,156	0,024	4,432	2,552	106,836	0,128	-0,063	0,067	0,824	2,206	66,946	0,11	0,142	-0,007	-0,123	3,032	137,983	0,188
(se)	0,035	0,047	0,96	0,287	1		0,021	0,047	0,275	0,311	1		0,022	0,047	0,014	0,318	1	
$(X)_{-1}$	0,008	-0,019	0,729	-0,012	911,3	0,736	0,027	-0,048	0,56	-0,132	221,672	0,536	0,285	1,689	0,81	-2,363	2438,048	0,853
(se)	0,001	0,001	0,028	0,011	1		0,004	0,004	0,061	0,059	1		0,028	0,073	0,019	0,446	1	
$(rbt)_{-1}$	0,014	0,023	-0,326	0,681	628,123	0,603	0	0,019	0,042	0,732	446,64	0,596	-0,003	0,022	0,005	0,683	477,888	0,601
(se)	0,004	0,005	0,094	0,041	1		0,003	0,005	0,03	0,039	1		0,002	0,005	0,001	0,04	1	

Table 6: Individual Fundamentals in a VAR Approach

Legend: results refer to a VAR approach in the period 1913-1999 and in the two subsample 1913-1953 and 1953-1999. As an example, the dividend yield VAR has been estimated as follows:

$$\begin{bmatrix} R_{t,t+12} \\ D_t/P_t \\ r_{f,t} \end{bmatrix} = \begin{pmatrix} a_{10} \\ a_{20} \\ a_{30} \end{pmatrix} + \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \begin{bmatrix} R_{(t,t+12)_{-1}} \\ (X)_{-1} \\ (r_{f,t})_{-1} \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix}$$

where $R_{(t,t+12)_{-1}}$ is the return lagged for one period and $X_{-1} = D_t/P_t$, E_t/P_t e P_t/B_t is the fundamental ratio lagged one period. Parameters estimate has been performed with OLS while s.e. are those of (White, 1980). The null hypothesis that is tested using a Wald test distributed as a χ^2 with three degrees of freedom is that all three coefficients are zero.

distributed as $\chi^2(1)$. The asymptotic properties of these test have been derived using a Montecarlo simulation of VAR reported in equation (9). To be specific, we have derived the size and the probability of type II errors (complement to one of the power of the test). In this version of the paper these results were derived under the assumptions of a homoscedastic DGP for the residuals.[16]

We have performed five different Montecarlo simulations:

1. **emp1**: VAR simulated under the null hypothesis that all three coefficients of the first equation in system (9) are all zero $H_0 : \beta_j = 0 \ \forall j = 1, \ldots, 3$; in other words under the assumption of not predictability of stock returns. Expected stock returns is set equal to the value of the intercept summed with the shock taken from a trivariate normal with a variance covariance matrix estimated from the OLS residuals of the three equations, under the hypothesis of homoscedasticity. In the other two equation VAR is considered stationary or without unit roots both in the fundamental ratio and in the interest rate. The other VAR parameters are set equal to OLS estimates;

2. **emp2**: VAR simulated under the null hypothesis already specified under **emp1** but imposing a unit root in the second equation or in the time series of the fundamental ratio;

3. **emp3**: the same as in the previous one but imposing a unit root in the second and third equation that is in both the fundamental ratio and in the interest rate time series;

4. **emp4**: similar to the previous two but imposing a unit root only in the third equation that is only in the time series of interest rates;

5. **emp5**: VAR simulated under the alternative $H_1 : \beta_j = \hat{\beta}_j \ \forall j = 1, \ldots, 3$, or predictability of stock returns with significant additional contribution of all three regressors.

We have performed 2.000 Montecarlo simulations on dividend yield VAR over the period 1954-1999, with a sample of 528 observations. Results of the five different simulations are reported in table 7. In panel A of the table, for Test 4 we tabulate quantiles of a $\chi^2(3)$ together with the four empirical distributions derived from the Montecarlo simulations. Blatantly enough, quantiles computed on empirical distributions are close to those tabulated on the actual $\chi^2(3)$. They are even closer for the empirical distributions derived with unit roots in the fundamental ratio and in the interest rate, **emp3**.

This is confirmed also by empirical size of the four tests[17] reported in panel B of the same table. For test 4 these are much closer with tabulated values, mostly for **emp3**. The other three tests look quite

[16]We leave a multivariate GARCH specification of the DGP for the next draft.

[17]Relative frequency on 2.000 experiments of cases in which the $\chi^2(3)$ for test 4 or $\chi^2(1)$ for the other three test is greater than tabulated critical values tabulated corresponding to 10%, 5% e 1% sizes.

reliable when considering **emp1** and **emp2**. On the other hand unit roots have a very bad influence on sizes for tests 1 and 2 but not for tests 3 and 4.

In panel C of table 7 we report errors of type II[18] computed with respect to empirical critical values derived under the null in a stationary VAR.[19] The power of three tests over 4 is very high. Only the Wald test on the predictive ability of interest rate has a very low power, less than 20%.

In conclusion, the small sample properties of Wald tests used to test significance of VAR estimates confirms the predictive ability of fundamentals with respect to stock market returns. These results are generally good with the exception of the predictive ability of interest rates.

Table 7: Small Sample Properties of Wald Tests Applied to VAR Estimates

Panel A: Quantiles of the chi-squared(3) test statistic under the null

quantile	5%	10%	50%	90%	95%
chi(3)	0,350	0,590	2,370	6,250	7,820
emp1	0,273	0,513	2,202	5,222	7,568
emp2	0,482	0,738	2,213	5,070	6,723
emp3	0,350	0,556	2,591	6,161	7,260
emp4	0,303	0,569	2,084	5,024	5,549

Panel B: percent of observations greater than nominal critical values under the null hypothesis

	Test 1			Test 2			Test 3			Test 4		
Nominal Size	0,100	0,050	0,010	0,100	0,050	0,010	0,100	0,050	0,010	0,100	0,050	0,010
emp1	0,114	0,034	0,000	0,086	0,034	0,000	0,084	0,047	0,015	0,083	0,049	0,015
emp2	0,080	0,064	0,016	0,096	0,064	0,016	0,080	0,048	0,017	0,083	0,048	0,000
emp3	0,178	0,086	0,000	0,178	0,086	0,000	0,083	0,032	0,000	0,097	0,050	0,017
emp4	0,065	0,016	0,000	0,115	0,019	0,000	0,086	0,037	0,019	0,037	0,019	0,019

Panel C: Simulated type II error rates for tests of the 5% size and new critical values

	Test 1			Test 2			Test 3			Test 4		
	err. rate	crit. val.1	crit. val.2	err. rate	crit. val.1	crit. val.2	err. rate	crit. val.1	crit. val.2	err. rate	crit. val.1	crit. val.2
Emp5 & Emp1	0,000	3,534	4,932	0,000	3,589	4,927	0,846	3,386	3,379	0,000	7,568	6,723

Legend: results refer to 2.000 Montecarlo simulations on a first order VAR, see equation (9), with the vector made up of annual returns, dividend yield e short term interest rate. Number of observations is 528 over the period 1954-1998. Panel A reports tabulated quantiles of a $\chi^2(3)$ distributions and compares them with the same quantile derived under the null hypothesis of no predictability and four different specifications of the VAR, namely empirical distribution of $\chi^2(3)$ under the assumption of a:

- Emp1: stationary VAR;
- Emp2: non stationary VAR and unit root in dividend yield time series;
- Emp3: non stationary VAR and unit root in dividend yield and interest rate;
- Emp4: non stationary VAR and unit root in interest rate;
- Emp5: alternative hypothesis.

Panel B reports that part of the experiments under the null in which computed Wald tests are higher than nominal critical values for nominal sizes of 10%, 5% e 1% of a $\chi^2(3)$ for test 4 and of a $\chi^2(1)$ for the other three. Panel C reports quantiles of a $\chi^2(3)$ derived empirically under Emp1 and the fraction of experiments derived under the alternative hypothesis, Emp5.

[18] Relative frequency on 2.000 experiments of case in which the value of $\chi^2(3)$ for Test 4 or of $\chi^2(1)$ for the remaining three is not greater than the critical empirical value corresponding to a size of 5%.

[19] These are the same values which can be found tabulated in panel A for Test 4 under the column 95%. The other critical values are not provided in any other part of the table.

4 Conclusions

In this paper we have reconstructed for the Italian stock market over a long period, 1913-1999, both the stock returns and three of the most used fundamental ratios, namely dividend yield D/P, earnings price E/P and price to book P/B. We have then tested the predictive ability of these three fundamentals using them individually in dividend yield like regressions á la (Fama and French, 1988a) and concurrently in multivariate regressions. Moreover, we have tested the additional predictive ability of fundamentals when considered together with lagged stock returns and interest rates in a VAR approach á la (Hodrick, 1992). Both the former and the latter approach have been verified using bootstrap and Montecarlo methods respectively.

Results of these econometric methods show a certain predictability of stock market returns using fundamentals. Among the three used in this paper P/B ratio seem to be the one with the best predictive ability. Tests which support univariate regressions and VAR estimates have a comparable or higher significance than those reported in other literature on US and UK evidence, see for instance the already mentioned (Hodrick, 1992) or (Goetzmann and Jorion, 1993).

The original contribution of this paper stays in the construction of a unique original data set with fundamentals other than dividend yield derived for the first time for Italian stocks. Moreover, differently from the literature just mentioned which dealt only with the D/P ratio and only in one case with E/P, see (Campbell and Shiller, 1988b), in this paper we apply well established econometric methods to all three fundamentals commonly used in security analysis deriving also some evidence of their concurrent predictive ability.

Further drafts or extensions of this paper should test the predictive ability of fundamentals out of sample, as in (Rozeff, 1984), (Bulkley and Tonks, 1989), (Fuller and Kling, 1990) and (Bulkley and Tonks, 1992) in order to devise a convenient trading rule based on the fundamental inefficiency of the Italian stock market.

References

Barone, E. (1990). The italian stock market: Efficiency and calendar anomalies. *Journal of Banking & Finance*, 14:483–510.

Bianchi, B. (1979). *Appendice Statistica: Il Rendimento del Consolidato dal 1862 al 1946*, chapter 2, pages 139–150. Volume 1 of (Vicarelli, 1979).

Bulkley, G. and Tonks, I. (1989). Are uk stock prices excessively volatile? : Trading rules and variance bound tests. *Economic Journal*, 99(398):1083–1098.

Bulkley, G. and Tonks, I. (1992). Trading rules and excess volatility. *Journal of Financial and Quantitative Analysis*, 27(3):365–382.

Campbell, J. (1991). A variance decomposition for stock returns. *Economic Journal*, 101:157–179.

Campbell, J. Y., Lo, A. W., and MacKinlay, C. A. (1997). *The Econometrics of Financial Markets.* Princeton University Press.

Campbell, J. Y. and Shiller, R. (1988a). The dividend-price ratio and expectations of future dividends and discount factors. *Review of Financial Studies*, 1(3):195–228.

Campbell, J. Y. and Shiller, R. J. (1988b). Stock prices, earnings, and expected dividends. *Journal of Finance*, 53(3):661–676.

Cianci, E. (1933). Dinamica dei prezzi in italia dal 1870 al 1929. Annali di Statistica Serie VI XX, ISTAT, Roma.

Davidson, R. and MacKinnok, J. G. (1993). *Estimation and Inference in Econometrics.* Advanced Texts in Econometrics. Oxford University Press, New York, Oxford, first edition.

Fama, E. F. and French, K. R. (1988a). Dividend yields and expected stock returns. *Journal of Financial economics*, 22:3–25.

Fama, E. F. and French, K. R. (1988b). Permanent and temporary components in stock prices. *Journal of Political Economy*, 96(2):246–273.

Fuller, R. and Kling, J. (1990). Is the stock market predictable? *Journal of Portfolio Management*, 16:28–36.

Goetzmann, W. and Jorion, P. (1993). Testing the predictive power of dividend yields. *Journal of Finance*, XLVIII(2):663–679. NA.

Goetzmann, W. and Jorion, P. (1995). A longer look at dividend yields. *Journal of Business*, 68(4):483–507.

Gordon, M. (1962). *The Investment, Financing, and Valuation of the Corporation.* Irwin, Homewood, Illinois.

Greene, W. H. (1994). *Econometric Analysis.* MacMillan, New York, second edition.

Hodrick, R. J. (1992). Dividend yields and expected stock returns: Alternative procedures for inference and measurement. *Review of Financial Studies*, 5(3):357–386.

Lee, B.-S. (1996). Time series implications of aggregate dividend behavior. *Review of Financial Studies*, 9(2):589–618.

Lo, A. W. and MacKinlay, C. A. (1999). *A Non Random Walk Down Wall Street.* Princeton University Press, Princeton, New Jersey, first edition.

Modigliani, F. and Cohn, R. A. (1979). Inflation, rational valuation and the market. *Financial Analysts Journal*, pages 24–44.

Newey, W. K. and West, K. D. (1987). A simple, positive definite, heteroscedasticity and consistent covariance matrix. *Econometrica*, 55:703–708.

Panetta, F. and Violi, R. (1995). Premi per il rischio, consumi e struttura finanziaria dalla formazione del regno d'italia ad oggi. Lavori preparatori a relazione '94, Servizio Studi della Banca d'Italia, Direzione Monetaria e Finanziaria.

Rosania, L. (1954). Indice del corso secco e rendimento dei titoli quotat in borsa. Bollettino servizio studi, Banca d'Italia.

Rozeff, M. (1984). Dividend yields are equity risk premiums. *Journal of Portfolio Management*, 11:68–75.

Siciliano, G. (2000). *Cento anni di Borsa in Italia: mercato, imprese e rendimenti azionari nel ventesimo secolo.* Il Mulino, Bologna. Forthcoming,.

Vicarelli, F. (1979). *Capitale Industriale e Capitale Finanziario.* Il Mulino, Bologna.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and direct test for heteroskedasticity. *Econometrica*, 48:817–838.