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THE REALIZED EQUITY PREMIUM HAS BEEN HIGHER THAN EXPECTED: FURTHER EVIDENCE

Marco Taboga

The realized equity premium has been higher than expected: further evidence

Marco Taboga

(mtaboga@fastwebnet.it)*

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Abstract

We propose a new approach to the study of stock returns. We develop a simple model to show that, in the long run, the average rate of return on the market portfolio equals the average growth rate of income plus an average payout rate measuring the quantity of financial resources distributed or absorbed by quoted firms. We exploit this framework to calculate expected returns using U.S. stock market data.

The equity risk premium and the expected return on the market portfolio of stocks are of central importance in many financial models. They are the main input both in asset allocation decisions and in estimating the cost of capital. Furthermore, estimates of expected returns are becoming increasingly important in the debate about Social Security reform. As reported by Diamond (1999), many recent proposals to reform Social Security include a

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stock investment component and it is crucial to have reliable estimates of future expected returns in order to evaluate these proposals. Perhaps the most popular method to estimate future expected returns is to calculate averages of the historical returns on broad portfolios of stocks and extrapolate them to the future (for updated estimates see Mehra (2002)). This approach, although straightforward, has at least two drawbacks. First, historical averages yield poor estimates of expected returns with very large confidence intervals, due to the high volatility displayed by the time series of returns (see Welch (2000)). Second, over the last century the equity risk premium on the U.S. stock market has been considerably higher than predicted by standard equilibrium models. Mehra and Prescott (1985) were the first to dub the equity premium a "puzzle". Using a standard equilibrium model, with individuals maximizing an additively separable CRRA utility function, they calculated the coefficient of relative risk aversion needed to justify historical risk premia and concluded that it was unreasonably high. Since Mehra and Prescott (1985) brought the equity premium puzzle to the attention of financial economists, much research has been done to provide possible explanations to the puzzle: Cochrane (1997) and Siegel and Thaler (1997) comprehensively survey the literature about the equity premium puzzle; Cochrane (2001) devotes a whole chapter of his recent treatise on asset pricing to the equity premium puzzle, analysing it under the unifying framework of the stochastic discount factor methodology; Mehra (2002) summarizes the main directions taken by research in this field during the past two decades. Several modifications to the Mehra and Prescott (1985) model have been proposed: Epstein and Zin (1989) introduce a new class of preferences which allows a separate parametrization of risk aversion and intertemporal elasticity of substitution; Constantinides (1990) and Campbell and Cochrane (1999) take habits into account, relaxing the assumption of time separability; Constantinides and Duffie (1996) propose a model with heterogeneity and idiosyncratic income risk; Brown, Goetzmann and Ross (1995) argue that the equity premium estimated from U.S. market data is conditioned on market survival and the unconditional premium, including the possibility of a market failure, might be lower; however, Li and Xu (2002) have recently shown that the survival bias is unlikely to be significant.

Besides trying to provide satisfactory theoretical explanations to the equity premium puzzle, the most recent literature has also proposed new techniques of estimating the equity premium, based on ex-ante, rather then ex-post measures of stock returns. The idea, explained by Diamond (1999) and inspiring also this paper, is that there are two different equity premium concepts: a realized equity premium, measured by historical rates of return, and a required equity premium, which investors holding stocks expect to receive. The latter might have been considerably lower than the former in the past, due, for example (see Fama and French (2002)), to a steady decline of expected returns, generating unexpected capital gains. Diamond (1999) suggests a number of possible explanations to this alleged decline of expected returns: a reduction of the costs of investing in stocks, a broader ownership, greater possibilities of diversification and the expectation of slower economic growth in the future. Various techniques have been proposed to estimate ex-ante expected returns on stocks: Welch (2000) analyses the consensus estimate of academic financial economists and he finds that the consensus equity premium lies between six and seven percent, depending on time horizons. Claus and Thomas (2001) compute the discount rate which equates market prices to the present value of expected future cash flows: they find that, for the period 1985-1998 and for a panel of five countries, the equity premium is around three percent. Fama and French (2002) use dividends and earnings growth rates to measure the expected rate of capital gain. They estimate the ex-ante equity premium on the U.S. stock market for the period 1951-2000, using two different models: the dividend growth model yields an estimate of 2.55% and the earnings growth model yields an estimate of 4.32%; both estimates are well below the average realized equity premium during the same period, which amounts to 7.43%.

In this paper we propose a new technique to measure ex-ante expected stock returns. Taking a long-run view on the dynamics of aggregate income, market capitalization and corporate payout policies, we develop a new formula to calculate expected returns. Using U.S. market data for the period 1946-2001, we calculate an expected rate of return to stocks of 5.92%, which is slightly less than the 6.51% estimate obtained by Fama and French (2002) for the period 1951-2000 with their earnings growth model.

Adopting a discrete-time setting, we develop a simple model to study the long-run dynamics of stock market capitalization. We consider all stocks representing the outstanding capital of the economy and trading in regulated markets. Assuming boundedness of the price/earning ratio, we show that market capitalization grows in the long run at an average rate which equals the average growth rate of aggregate income. However, this is not the long run average rate of return obtained by individual investors, because of dividend payments and net issue of new stocks. Therefore, an investor replicating the market portfolio obtains in the long run an average rate of return equal to the sum of the average growth rate of income and the average payout rate measuring the quantity of financial resources distributed or absorbed by quoted firms. Consequently, we calculate the expected rate of return on the market portfolio using the growth rates of income and the payout rates.

The remainder of the paper is organized as follows. Section I analyses market capitalization dynamics. Section II analyses returns to the market portfolio of stocks from a theoretical standpoint. Section III presents the empirical results. Section IV concludes the paper.

I Market capitalization dynamics

We develop a simple model to study the long-run dynamics of stock market capitalization and to show that in the long run the average growth rate of market capitalization equals the average growth rate of aggregate income.

By stock market capitalization we mean the value of all shares trading in regulated markets and representing the outstanding capital of the economy. We consider a discrete-time setting with time periods indexed by $t = 0, 1, 2, \dots$

The relevant variables are total market capitalization, denoted by P_t, total income earned by quoted firms between $t-1$ and t, denoted by E_t, and aggregate income produced between $t-1$ and t, denoted by Y_t. All of these three quantities are assumed to remain strictly positive over time.

We can decompose P_t in the following way:

$$P_t = (P_t/E_t)\,(E_t/Y_t)\,Y_t \tag{1}$$

So, market capitalization can be thought of as the product of three factors, aggregate income Y_t, the price/earning ratio P_t/E_t and the share of aggregate income earned by quoted firms E_t/Y_t. The ratio E_t/Y_t can take values between 0 and 1 (we rule out the possibility that total income earned by quoted firms exceeds total aggregate income, generating a net transfer of wealth). As we have assumed strict positivity of Y_t and E_t, the ratio E_t/Y_t is strictly greater than 0. Also the price/earning ratio is strictly positive, but it is not naturally bounded from above, as long as prices may grow to infinity. However, historically, it has oscillated around equilibrium values and it has exhibited a mean-reverting behaviour, as documented, for example, by Campbell and Shiller (2001). So, it is not unreasonable to assume that the sequence of price/earning ratios is bounded from above by a positive constant.

Let π_t denote the growth rate of market capitalization between times $t-1$ and t and $\overline{\pi}_t$ denote the geometric average of the growth rates observed between 0 and t. Similarly, define g_t as the growth rate of income and $\overline{g}_t$ as its geometric average. We have:

$$\overline{\pi}_t = (P_t/P_0)^{1/t} - 1 = \left(\frac{P_t/E_t}{P_0/E_0} \frac{E_t/Y_t}{E_0/Y_0} \frac{Y_t}{Y_0} \right)^{1/t} - 1 \qquad (2)$$

Provided $(\overline{g}_t)$ forms a convergent sequence, we have, given boundedness of both the P_t/E_t and E_t/Y_t ratios:

$$\lim \overline{\pi}_t = \lim \left(Y_t/Y_0\right)^{1/t} - 1 = \lim \overline{g}_t \qquad (3)$$

So, in the long run (when t goes to infinity), market capitalization grows at an average rate which equals the average growth rate of aggregate income. This is consistent, in a sense, with the statement made by Diamond (1999) that in a steady state the growth rate of stock prices can be assumed to equal the growth rate of GDP.

II Returns to investors replicating the market portfolio

We now investigate long-run returns to a portfolio of stocks, held by an individual investor replicating the composition of the market portfolio. We argue that in the long run the average rate of return on the market portfolio equals the average growth rate of income plus an average payout rate measuring the quantity of financial resources distributed or absorbed by quoted firms.

By market portfolio we mean the set of all shares considered when calculating market capitalization.

The rate of return obtained by an investor replicating the market portfolio does not equal the growth rate of market capitalization. Between two successive periods $t-1$ and t, market capitalization changes for two reasons: prices of shares existing at time $t-1$ change and the number of existing shares changes too (because of initial public offerings, share repurchases, defaults, issues of new shares, exercises of employee stock options, acquisitions by cash, delistings, etc.). We can formalize this fact as follows:

$$P_t = P_{t-1} (1 + \mu_t) (1 + \nu_t) \tag{4}$$

where $(1 + \mu_t)$ is the growth factor attributable to price changes and $(1 + \nu_t)$ is the growth factor attributable to changes in the composition of the market portfolio (net issue of new shares).

An individual investor who holds a fraction w_{t-1} of the market portfolio at time $t-1$ and does not trade until time t, obtains a net relative capital gain which is exactly equal to μ_t. Furthermore, at time t an individual investor obtains dividends on the shares she owns. We assume that at every date t, dividends are distributed, then they are reinvested and, finally, the individual portfolio is rebalanced to reproduce exactly the market portfolio: this is necessary because the market portfolio has changed between $t-1$ and t (new shares have been issued and old shares have been delisted). As a result, the fraction held by the individual investor changes according to the following equation:

$$w_t = w_{t-1} (P_{t-1}/P_t) (1 + d_t) (1 + \mu_t) = w_{t-1} (1 + d_t) / (1 + \nu_t) \tag{5}$$

where d_t is the growth rate due to reinvestment of dividends. d_t might not be exactly equal to the dividend yield at time t, calculated as the ratio of total dividends distributed at time t to market capitalization P_{t-1} at time $t-1$, because, when dividends are distributed, the individual portfolio has not yet been rebalanced. However, we may well suppose that d_t is well approximated by the dividend yield at time t.

Let now r_t denote the rate of return to the individual portfolio between times $t-1$ and t and $\overline{r}_t$ denote the geometric average of the rates of return realized between 0 and t. We have:

$$\overline{r}_t = \left(\frac{w_t P_t}{w_0 P_0}\right)^{1/t} - 1 = \frac{(1+\overline{\pi}_t)\left(1+\overline{d}_t\right)}{1+\overline{\nu}_t} - 1 \tag{6}$$

Equation (6) shows that the average return is determined by three factors: the average growth rate of market capitalization and the average dividend yield contribute positively to overall return, while the average net issue of new shares contributes negatively. To provide a better insight into this relation, we can approximate linearly equation (6) in the following way:

$$\overline{r}_t = \overline{\pi}_t + \overline{d}_t - \overline{\nu}_t \tag{7}$$

Roughly speaking, the approximation is good when $\overline{\pi}_t$, $\overline{d}_t$ and $\overline{\nu}_t$ are small, because the approximation error is an infinitesimal of order greater than the euclidean norm of the vector $\begin{bmatrix} \overline{\pi}_t & \overline{d}_t & \overline{\nu}_t \end{bmatrix}$.

Taking limits, and using equation (3), we get:

$$\lim \overline{r}_t = \lim \overline{g}_t + \lim \left(\overline{d}_t - \overline{\nu}_t\right) \tag{8}$$

Of course, we can take limits only if the sequences $(\overline{g}_t)$ and $\left(\overline{d}_t - \overline{\nu}_t\right)$ converge; a sufficient condition for convergence is that the two processes be stationary and the requirement of stationarity may be weakened by asking that only a finite number of regime shifts take place.

The difference $\overline{d}_t - \overline{\nu}_t$ measures the average quantity of financial resources distributed or absorbed by quoted firms. In what follows, we will call it the average payout rate.

So, the long run average rate of return approximately equals the average growth rate of income (of market capitalization) plus the average payout rate. This is in the spirit of Diamond's (1999) statement that stock returns equal the adjusted dividend yield plus the growth rate of stock prices, which, in a steady state, can be assumed to equal the growth rate of GDP. But, although we agree to include the latter summand (GDP growth) in our long run relationship, we argue that the adjusted dividend yield is not an accurate measure of the cash flows received or faced by an investor holding a fraction of the market portfolio: the reason is that, when calculating the dividend yield at an aggregate level, i.e. considering all the quoted firms and all the dividends they pay, cash flows generated by initial public offerings, share repurchases, defaults, issues of new shares, exercises of employee stock options, acquisitions by cash, delistings, etc. are not taken into account. Furthermore, as pointed out by Fama and French (2002), dividends are a policy variable and changes in policy can raise problems for estimates of the expected stock return.

III Empirical results

In this section we exploit the long-run relation among returns, aggregate income and payout rates developed above to estimate expected returns on the U.S. stock market for the period 1946-2001.

In the preceding section we have shown that the geometric average $\overline{r}_t$ of the rates of return realized between 0 and t is approximated by the linear relation $\overline{r}_t = \overline{\pi}_t + \overline{d}_t - \overline{\nu}_t$. When the time interval under consideration becomes very large, i.e. t goes to infinity, a limiting argument allows us to replace the average growth rate of market capitalization $\overline{\pi}_t$ with the average growth rate of aggregate income $\overline{g}_t$, because the two rates are equal in the long run. However, the two rates can differ substantially over finite time periods: as equation (1) points out, short-run growth rates of market capitalization and hence short-run returns to individual investors can be highly affected by fluctuations in the price/earning ratio and in the share of aggregate income earned by quoted firms. We make a simple numerical example to illustrate this point. Suppose that both the price/earning ratio and the share of aggregate income earned by quoted firms double from their initial values over a period of 50 years: in such a case, the annualized average growth rate of market capitalization $\overline{\pi}_t$ would exceed the average growth rate of aggregate income $\overline{g}_t$ of 2.81 percentage points. The difference is remarkably large, but such deviations can not be systematic, given the assumptions of our model, and they are inevitably smoothed out as time elapses.

Although deviations can not be systematic, the average rate of return calculated with relatively short time series of historical returns is significantly influenced by fluctuations of the P_t/E_t and E_t/Y_t ratios. Furthermore, extrapolating past returns to the future and calculating expected returns by means of historical averages could lead to a contradiction: in the example above, where both the P_t/E_t and the E_t/Y_t ratio double over a period of 50 years, extrapolating past returns to the future would imply an assumption of infinite growth of the two ratios, which is clearly inconsistent with (3).

This is the reason why we propose to calculate an alternative estimate of the expected stock return in the following way:

$$\overline{r}_t = \overline{g}_t + \overline{d}_t - \overline{\nu}_t \tag{9}$$

where $\overline{\pi}_t$ has been substituted with $\overline{g}_t$. The procedure is the same proposed by Fama and French (2002) for their earnings and dividend growth models: the logic leading to (9) applies to any variable that is cointegrated with market capitalization.

Notice that if in equation (9) you use real values of income to calculate g_t, you obtain real expected rates (we will use real values in what follows) while, if you use nominal values, you obtain nominal expected rates.

We use U.S. annual production and stock market data from 1946 to 2001 to estimate the expected rate of return. For real income Y_t, we use the real GDP series from the U.S. Department of Commerce - Bureau of Economic Analysis. To calculate the net issue ν_t we exploit the following relation:

$$\nu_t = \frac{P_t/P_{t-1}}{1+\mu_t} - 1 \tag{10}$$

μ_t is approximated by the annual nominal rate of change of the S&P500 index and the series "corporate equities - issues at market value", from FED Flow of Funds Accounts, is used as a proxy of total market capitalization P_t. This is enough to obtain an estimate of the net issue ν_t. Dividend yields on the S&P500 index, calculated from the same sources as described in Shiller (2001), are used to approximate d_t.

As long as the validity of equation (9) depends on the stationarity of the ratio P_t/Y_t, we have calculated its sample autocorrelations for the period 1946-2001: the first three annual autocorrelations are 0.89, 0.75, 0.59; they are large, but their decay is roughly like that of a stationary first order autoregression.

A technical remark is in order: there is much debate among financial economists as to whether the geometric average or the arithmetic average should be used when computing mean returns; Welch (2000) briefly discusses this point. On the one hand, the appropriate Chisini (1929) average is the geometric average: it is the constant rate of return which would have yielded the same final result in a buy and hold investment strategy of the same duration. On the other hand, the arithmetic average is an unbiased and consistent estimator of the expected return, as opposed to the geometric average, which does not have any statistical meaning. It is a well-known fact that the geometric average is lower than the arithmetic average, unless the values to be averaged are all equal. In what follows, we calculate both arithmetic and geometric averages.

The estimates for the whole period 1946-2001 and for two subperiods of equal length are displayed in Table I. The average return $\overline{r}_t$ for the whole period, calculated with formula (9) is 5.92% (arithmetic) with a standard deviation of 6.09%. This is remarkably lower than the historical average, which is 8.72%, and is slightly less than the 6.51% estimate obtained by Fama and French (2002) for the period 1951-2000 with their earnings growth model. To ease the comparison with Fama and French's (2002) results, Table I also displays the estimates obtained for the shorter period going from 1951 to 2000. It is interesting to notice that the net issue of new shares is a relevant component of overall return and its average contribution is negative, amounting to 1.29 percentage points. However, it is is a very volatile component, with a standard deviation of 4.43%.

We decided to include the year 1946 in our sample, so as to span the whole post-war period, but this choice is not without consequences: the expected return for 1946 is an impressive -13.74%, mainly due to a decrease in real income of 11.09%. If 1946 were not included in the sample, the average return would rise from 5.92% to 6,27%.

IV Conclusions

Since Mehra and Prescott (1985) first brought the equity premium puzzle to the attention of financial economists, much research has been done, both to provide theoretical explanations to the puzzle and to devise new methods of estimating expected returns. Our contribution is in the latter direction. We have developed a theoretical model to shed some light on the long-run dynamics of market capitalization and returns to the market portfolio of stocks. We have shown that market capitalization and aggregate income must grow at the same pace, in the long run. We have analysed the components of the return to individual investors replicating the market portfolio: the growth of market capitalization is one of the components, and, obviously, dividends are another, but a third component, which is often neglected in the literature, is the net issue of new shares. A proper calculation of returns must take into account the cash flows generated by the adjustments needed to replicate the market portfolio: several events make these adjustments necessary; we cite, among others, initial public offerings, share repurchases, defaults, issues of new shares, exercises of employee stock options, acquisitions by cash and delistings. In addition, we suggest to use the growth rate of aggregate income, instead of the growth rate of market capitalization, to calculate average returns and estimate expected levels for the future. The rationale of this substitution is the fact that the short-run dynamics of market capitalization are highly affected by fluctuations of the price/earning ratio and of the share of aggregate income earned by quoted firms, but these fluctuations are bound to be directionless in the long run and, inevitably, the average growth rate of market capitalization converges to the average growth rate of aggregate income.

Using U.S. market data for the period 1946-2001, we have estimated an expected return of 5.92%, which is lower than the estimate obtained by averaging historical returns (8.72%). This is consistent with the recent findings of other researchers (e.g. Fama and French (2002), Claus and Thomas (2001)). We have found that the net issue of new shares is a relevant component of overall return, to whom has given a negative contribution throughout the period under consideration (-1.29%).

As a concluding remark, we stress the fact that we have modelled the long-run dynamics of stock returns isolating two main factors which determine the average return to the market portfolio of stocks: the first is the growth of aggregate income and the second is the quantity of financial resources distributed or absorbed by quoted firms (dividends plus net issue of new shares). This is important to the financial economist who wants to make forecasts on future expected returns, for example for Social Security planning purposes: the two factors can be forecast on the basis of historical data (which may be hazardous given the high standard errors of the estimated values) or their assessment can be left to the individual judgement or carried out separately with ad hoc models.

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Table I

Average returns

Period		Real GDP growth (in %)	Dividend yield (in %)	Net issue (in %)	Total expected return (in %)
1946-2001	Geom. avg.	3.09	4.06	1.39	5.76
	Arithm. avg.	3.14	4.07	1.29	5.92
	Std. dev.	3.13	1.53	4.43	6.09
1951-2000	Geom. avg.	3.46	3.88	1.42	5.92
	Arithm. avg.	3.48	3.89	1.31	6.06
	Std. dev.	2.34	1.26	4.60	5.54
1946-1973	Geom. avg.	3.22	4.38	1.59	6.02
	Arithm. avg.	3.31	4.40	1.50	6.21
	Std. dev.	3.93	1.60	4.58	6.97
1974-2001	Geom. avg.	2.96	3.74	1.20	5.73
	Arithm. avg.	2.98	3.75	1.10	5.63
	Std. dev.	2.14	1.42	4.37	5.18

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