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The Equity Premium: A Vanishing Puzzle†

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1. Introduction

The equity premium is the excess return for holding equities over short-term debt. A premium is paid to those bearing greater risk. Historically, this premium has been high in the United States. Estimated returns of Seigel (1998), when compounded, illustrate this well. Seigel's estimates imply that stocks have earned an average return of 8.4 percent over the last two centuries while short-term bonds have earned an average return of 4.3 percent. This means that one dollar invested in stocks in 1802 could be cashed in for more than 9 million dollars today, while one dollar invested in bonds in 1802 would yield only 4400 dollars today. Even if we take inflation into account, we still find a large historical equity premium. Stocks earned a real return of 7 percent and bonds earned a real return of only 2.9 percent. Thus, an investment in stocks in 1802 gave 2400 times the buying power of an investment in bonds.

These calculations are puzzling for economists. Mehra and Prescott (1985) showed that a standard asset pricing model could not account for the high premium paid to equities. With a real rate of return of 2.9 percent per year for short-term debt they estimate risk premia in the range of 0 to 0.25 percent. This translates into a meager 1.05-fold difference in payoffs between stocks and bonds for one dollar invested in 1802. This prediction falls far short of actual payoff differences. They fall short even under more general specifications than those used by Mehra and Prescott. Hansen and Jagannathan show that the conclusions are very robust. It is not surprising, therefore, that this work has led to a large literature that tries to account for the large equity premium. (See Kocherlakota 1996 for a nice survey of this literature.)

In this paper, we look at the current market data and make predictions for the equity premium in the near future. We argue that current data show that the equity premium is much closer to theoretical predictions than the past empirical averages. For this reason, we say that the equity premium puzzle is vanishing.

In making our projections, we start by analyzing U.S. corporate dividends and stock values. We use a simple asset-pricing formula to back out a theoretical prediction for the equity premium and use empirical counterparts for our estimation. We then show how our estimates change when we make alternative assumptions about our measure of dividends, the growth in future dividends, and the magnitude of the return on risk-free assets.

The result for reasonable assumptions on dividends and risk-free returns is an estimate for the future equity premium that is significantly below the historical average return on stocks over the last two centuries. Our estimate is roughly xx percent. This estimate is more in line with theoretical predictions, and it is more in line with the experiences of other developed countries. In our view, the main puzzle is the historical period in the United States.

2. Historical Returns

We begin with a brief look at historical returns on financial assets in the United States over the last 200 years. We will compare these returns to theoretical predictions.

Table 1 is a summary of average historical returns for stocks, long-term government debt, and short-term government debt. We classify financial assets this way because these categories match up well with the assets in our theory. The first panel has annualized compounded nominal returns for different historical time periods.[1] Returns for the period 1802-1997 are taken from Siegel (1998). Between 1871 and 1997, the stock returns are computed from capitalization-weighted indexes of all New York Stock Exchange (NYSE) stocks, and starting in 1962, all NYSE, American (AMEX) and NASDAQ stocks. Capitalization-weighted indexes use a firm's stock price times shares outstanding as weights for individual firms. Prior to 1871, the series is based primarily on stocks of financial institutions like banks and insurance companies. Siegel's returns on debt are returns on long-term government bonds and short-term government bills when available. When unavailable, comparable highly rated securities with low default premia are used. After 1926, the data on small- and large-firm stocks and U.S. Treasuries are taken from Ibbotson Associates (2000). The large-firm stocks are those in the S&P 500. The Treasury bond has a twenty-year maturity and the Treasury bill has a 1-month maturity. The value-weighted stock returns are taken from the database of the Center for Research in Security Prices (CRSP). As in the case of Siegel's stock returns, this return is a weighted return of all publicly traded firms on NYSE, AMEX, and NASDAQ. The weight for each firm in a particular month is its market value (i.e., stock price times shares outstanding) as of the previous month, divided by the total market value.

Consider the period 1802-1997. Stocks in the this period earned a premium of 4.1 percent over short-term debt. In the twentieth century, stocks earned an even higher premium. Take for example the period 1926-1999. The equity premium for the value-weighted portfolio over U.S. Treasury bills was 7.8 percent – despite the fact that the

[1] Given nominal returns r_t, $t = 1, \ldots, T$, we calculate the compounded annual return as follows:

$$100 \left([(1 + r_1)(1 + r_2) \cdots (1 + r_T)]^{\frac{12}{T}} - 1 \right).$$

For real returns we first subtract the monthly inflation rate, π_t, from r_t before doing the calculation.

United States experienced the Great Depression and World War II. Large and small firm stocks both did better, earning premia of 9.5 and 8.3, respectively. Even during the period of the Great Depression and World War II, we find a high return for stocks. The equity premia in this period are in the range of 6.4 to 8.3 for the different stock portfolios.

In the second panel of Table 1, we display standard deviations of annual returns. Historical stock returns are considerably more volatile than Treasury bills and bonds – especially when we consider small firms stocks. For example, the standard deviation for small firm stocks, which yielded the highest returns in each and every subperiod we consider, was 33.6 percent whereas the standard deviations for large-firm stocks in the S&P 500, for Treasury Bonds and Treasury Bills was 20.14%, 9.3%, and 3.2% respectively. There was a significant increase in the variability of Treasury bond returns after 1970 due to inflation uncertainty. Notice that investors in the 1970's and 1980's demanded a higher return on these bonds to compensate for the perceived higher risk.

In the last panel of Table 1, we report real returns. Since inflation affects both stock and bond returns similarly, we get the same estimates for equity premia using the nominal and real returns. However, we want to compare the magnitudes of these real returns to those in our theory. And the relevant number for investors is the real return. For the historical period, we see that the real return on the value-weighted portfolio was 7 percent while the real return on short-term debt was 2.9 percent. In the twentieth century, the return to short-term debt was even lower – falling below 1 percent in the period after 1926 – with real stock returns around 8 percent. These are the types of values that the asset-pricing literature tries to account for.

In Figure 1, we show graphically how various assets have performed by plotting the value of a dollar invested in 1926. The plot is intended to further illustrate the large differences in returns across the asset categories that we are analyzing. We use a logarithmic scale for this figure because the values of the investments are vastly different. We see from the figure that a \$1 investment in 1926 in small firm stocks could have been cashed in for \$6,639.70 in December 1999. A \$1 in a portfolio with larger firms, for example the S&P 500 or the value-weighted portfolio would have made on the order of \$2000 to \$3000. While not as good as the small-firm portfolio, these stock values dwarfed Treasury securities. A \$1 investment in 1926 in 20-year Treasury bonds could have been cashed in for only \$40.12, and the same investment in 1-month Treasury bills could have gotten only \$15.64. This is a small gain for such a long horizon.

The returns reported in Table 1 include reinvested dividends. For example, the return on stocks between period t and $t+1$ is given by

$$r^s_{t,t+1} = \frac{p_{s,t+1} + d_{t+1}}{p_{s,t}} - 1$$

where $p_{s,t}$ is the stock price in period t and d_t is the dividend paid in t. In Table 2, we decompose nominal returns on the value-weighted stock portfolio into two parts: the growth in price, $p_{s,t+1}/p_{s,t} - 1$, and the dividend yield, $d_{t+1}/p_{s,t}$. In our calculations later, we will rely on estimates of both. Notice that the dividend yield has been relatively smooth over time. In the latest period, we see decline in the dividend yield – primarily because stock prices have soared recently. On average, the stock prices grew 9.7 percent per year in the period 1972 to 1999.

In Figure 2, we show how large the increase in stock prices, and hence stock values, has been by plotting the total stock market value relative to GNP. We use two data sources for this. The first is CRSP which is the source of the returns in Table 2. The CRSP database includes publicly traded firms listed on the NYSE, AMEX, and NASDAQ. It does not include unlisted firms. Therefore, we also show data from the U.S. *Flow of Funds* which covers the larger universe of corporate equities. From the *Flow of Funds*, we take the total value of stocks held by U.S. residents.[2]

We see a similar pattern in the value of publicly traded equities and total equities. The value is high during the 1960's but really takes off after 1985. Notice that the stock value of firms traded on the major stock exchanges amount to roughly half of the total value in 1946. As of 1999, most U.S. corporate equities are publicly traded on the U.S. stock exchanges.

The dividend yield is displayed in Figure 3. With the large increase in stock prices, the dividend yield – for both sets of firms – fell after 1985. This is more pronounced for the stocks on the NYSE/AMEX/NASDAQ exchanges because dividends of these stocks show no upward trend relative to income. In Figure 4, we show the dividends relative to gross national income. Notice that the dividends for stocks traded on major exchanges are roughly a constant fraction of gross national income. Total dividends, on the other hand, did grow faster than gross national income between 1985 and 1999 rising from 0.023 GNI to 0.04 GNI. This growth was not enough though to offset the rise in prices so we do in fact see a significant decline in the dividend yield.

We next explore why historical asset returns are puzzling to economists. Economic theory says that there should be some premium to holding riskier assets like stocks. But the estimates based on theory are less than one percent, not greater than four percent.

[2] We subtract foreign holdings of domestic equities because we want to ultimately match this series up with dividends in the U.S. National Accounts.

3. The Puzzle for Historical Returns

With a standard asset-pricing model, Mehra and Prescott (1985) compared equilibrium returns predicted by their model with historical returns from U.S. data. In this section, we repeat their exercise and compare the predictions to the historical returns of Section 2. These calculations will be useful when we forecast future returns.

Let's start with a household that has preferences given by

$$E_0 \sum_{t=0}^{\infty} \beta^t U(c_t)$$

where $E_0\cdot$ is an expectation operator conditioned on information at time 0, β is a parameter determining how the household discounts future utility, $0 < \beta < 1$, $U(\cdot)$ is a concave utility function, and c_t is consumption in period t.

Each period, the household decides how to split its income into purchases of consumption and into further saving. The budget in t looks like

$$c_t + p_{s,t}(s_{t+1} - s_t) + p_{f,t} b_{t+1} = y_t + d_t s_t + b_t$$

where y_t is nonfinancial income in period t, s_t are shares in stocks that yield a dividend payment of d_t in period t, $p_{s,t}$ is the price of additional shares, and b_t is the quantity of risk-free one-period bonds that cost $p_{f,t}$ in period t.

Maximization of household utility leads to the following conditions on asset prices:

$$p_{s,t} = \beta E_t \left[\frac{U'(c_{t+1})}{U'(c_t)} (p_{s,t+1} + d_{t+1}) \right] \tag{3.1}$$

$$p_{f,t} = \beta E_t \left[\frac{U'(c_{t+1})}{U'(c_t)} \right] \tag{3.2}$$

We can use these prices to construct asset returns from t to $t+1$ as follows:

$$r^s_{t,t+1} = \frac{p_{s,t+1} + d_{t+1}}{p_{s,t}} - 1 \tag{3.3}$$

$$r_t^f = \frac{1}{p_{f,t}} - 1 \tag{3.4}$$

given a process for dividends. Note that the return on bonds does not depend on any realization of information in $t+1$ since we have assumed that bonds earn a sure return.

Mehra and Prescott (1985) assumed that total output produced in the economy was equal to d_t. Thus, in their economy, $c_t = d_t$ and $y_t = 0$. They further assumed that

$$c_{t+1} = x_{t+1} c_t$$

where x_{t+1} is the growth rate in consumption and was assumed to be stochastic. The stochastic process chosen for x was parameterized to match certain features of U.S. consumption growth over the period 1889-1978, namely the average growth rate of per capita consumption (.018), the standard deviation of this growth rate (.036), and the first-order serial correlation of this growth rate (-.14).

In Figure 5, we plot results for the Mehra-Prescott economy for various values of α and β where $U(c) = c^{1-\alpha}/(1-\alpha)$. (This figure replicates Figure 4 of Mehra and Prescott but includes more points.) We show results for α in the range of 0 to 50 and β in the range of 0.8 to 1. We also include a point marking the empirical analogues. This picture highlights the puzzle with historical asset returns. Despite the wide range of values for the preference parameters, no theoretical returns come close to the actual returns. We have marked the regions corresponding to various parameterizations to show that increasing α beyond 50 and decreasing β below 0.8 (to its feasible minimum of 0) will not help.

We should point out that our goal in this article is not to rationalize the large empirical equity premium paid to equity holders over the past two centuries. These returns are indeed puzzling. Instead, we would like to make estimates for the future. We turn to that next.

4. Estimates for the Future

We start with a simple calculation using formulas derived earlier and data on dividends and stock values. With these data, we predict a low equity premium. We then consider alternative assumptions to check the robustness of our finding.

4.1. The Benchmark Calculation

Let's start with the stock return in (3.3). Assume for now that expectation of this return, conditional on information at time t, is a constant,

$$E_t r^s_{t,t+1} = r^s.$$

Then we can take expectations of both sides of (3.3) and rewrite the equation as

$$p_{s,t} = E_t \left[\frac{p_{s,t+1} + d_{t+1}}{1 + r^s} \right]$$

or, if we substitute prices recursively, we can write prices as the expected present value of the stream of future dividends:

$$p_{s,t} = E_t \left[\sum_{i=1}^{\infty} \frac{d_{t+i}}{(1 + r^s)^i} \right]$$

assuming that in the limit the expected price does not get too large. If dividends are expected to grow at a constant rate g, which is lower than r^s, then we can further simplify this expression for the price as a simple linear function of next period's dividend:

$$p_{s,t} = d_{t+1}/(r^s - g)$$

This is an expression for the stock price derived originally by Gordon (1962).

We can get an estimate for the equity premium by noting that the equity premium is $r^{ep} = r^s - r^f$ and therefore,

$$r^{ep} = d_{t+1}/p_{s,t} + g - r^f.$$

If we have values for the current dividend yield, the growth rate of dividends, and the risk-free return, then we can make an estimate of the equity premium.

Consider, for example, the value-weighted stock portfolio that we discussed in Section 2. The annual dividend yield of this portfolio is plotted in Figure 3. In 1999, the value was 0.014. For g, we want an estimate of the growth rate of real per-capita dividends. Figure 4 shows nominal dividends as a fraction of nominal gross national income but both series would be deflated by the same series to convert them to real per-capita units. Thus, we can use the recent growth experience of real per-capita GNP as an estimate for g. During the 1990's, real GNP grew 3.0 percent per year while population growth averaged 1.0 percent. Thus, we use $g = 0.02$.

The remaining term in our equation is r^f, the risk-free return. In 1997, the U.S. Treasury introduced inflation-protected securities (TIPS) that are virtually risk-free bonds indexed to inflation. Thus, they are a good measure of the real risk-free rate. The TIPS rate on a 5-year bond on December 31, 1999 was 4.0 percent. Using this value, along with our estimate for the current dividend yield and growth rate, we find an equity premium of

$$r^{ep} = 0.014 + 0.02 - 0.04 = -0.006 = -0.6\%.$$

Not only is this estimated premium smaller than historical averages, it is actually negative. Does this make sense?

What if we use total dividends for the U.S. economy? In this case, we have a dividend yield for 1999 equal to 0.026. Assuming that the growth in this series is only temporarily higher than the growth in GNP, we have a new estimate for the equity risk premium,

$$r^{ep} = 0.026 + 0.02 - 0.04 = 0.006 = 0.6\%.$$

Now we have a positive estimate that is only slightly larger than the theoretical predictions of Mehra and Prescott (1985) and McGrattan and Prescott (this issue). We will take this to be our benchmark estimate. We view this estimate to be in line with theory.

4.2. Alternative Assumptions

Welch (2000) surveyed 226 professors of finance and asked for their forecast of the equity premium over different horizons. At the one-year horizon, the mean forecast was 4.7 percent, with a standard deviation of 4.2 percent. At the ten-year horizon, the mean forecast was 7.2 percent, with a standard deviation of 1.8 percent. There are a number of possible reasons for the large discrepancy between the professors' estimates and ours. It may be that the actual dividend yield is higher than the figure we used from CRSP or the Flow of Funds. Another possibility is that our estimate of the growth of dividends is too low. We may in fact be in a "new economy" with higher real growth. Or, we are overestimating the risk-free rate, say because there are in fact costs to holding TIPS securities that we are not including.

In this section, we try to consider alternative assumptions that could lead us to higher estimates for the risk premium. We consider adjusted dividend yields that take into account new share issues and share repurchases. We consider different forecasts for future earnings growth. And, we consider costs that may lower the riskfree rate.

4.2.1. Adjusted Dividend Yield

During the 1980's, firms increased the amount of their share repurchases, possibly as a way of providing a tax advantage for shareholders. We now incorporate net share repurchases in our notion of payouts to shareholders and construct an adjusted dividend yield. In Figure 6, we plot the adjusted and unadjusted dividend yields using data from the Flow of Funds.[3] The unadjusted series is total dividends divided by the stock market value of the prior year (as shown in Figure 3). The adjusted series is total dividends less net new equity issues for both domestic nonfinancial corporations and financial corporations, all divided by the stock market value in the prior year. Net new equity issues are equal to new share issues less share repurchases. Figure 6 shows that the net new equity issues can add significantly to the volatility of payouts.

Note that the Gordon growth model still works even if we include new equity issues and share repurchases. Consider the following simple example of Wadhwani (1999). Suppose that firms make a steady annual profit of \$1000 and pay the entire profit as dividends. Suppose also that the number of shares outstanding is 1000 (which implies dividends per share are equal to \$1). If the discount rate on equity is 10 percent, then, price of the stock is \$10, (i.e., $p_{s,0} = d_1/(r^s - g)$ =\$1/.1).

Consider a second scenario which involves repurchasing shares. Suppose that the firm instead pays half of its \$1000 profits in dividends and half to repurchase shares. Let N_t equal the number of shares outstanding in year t. Dividends per share in t are therefore \$500/N_t with a growth rate given by

$$g_t = \frac{d_t}{d_{t-1}} - 1 = \frac{500/N_t}{500/N_{t-1}} - 1 = \frac{N_{t-1}}{N_t} - 1.$$

[3] We get a similar pattern when we use data from the merged Compustat/CRSP database. There is a significant increase after 1985.

In words, the growth rate of dividends per share is equal to the rate of decrease in the number of shares outstanding. Let $p_{s,t}$ be the share price in year t. Because shareholders stand to get the whole profit stream regardless of the corporate dividend policy, it should be the case that

$$N_t p_{s,t} = \$1000/.1.$$

If \$500 is used to repurchase shares at price $p_{s,t}$ then,

$$p_{s,t}(N_{t-1} - N_t) = 500.$$

Putting this all together, we get N_t/N_{t-1}=1/1.05 and a growth rate for dividends of 5 percent per year.

Without share repurchases, we compute a dividend yield of 0.1 and a dividend growth rate of 0. With share repurchases, we compute a dividend yield of 0.05 and a dividend growth rate of 5 percent. In either case, the initial share price is \$10. For the second scenario, we simply treat the share repurchases as if they were a one-to-one substitute for dividends. But we should get the same result whether we use the cash dividends and the cash dividend growth rate or the adjusted dividends and the adjusted dividend growth rate.

Consider the series in Figure 6. In 1999, the adjusted dividend yield was 0.037. Suppose that the dividend yield will remain at this level. Repeating the earlier calculation with 0.037 replacing 0.026, we obtain an estimate for the equity premium of 1.7 percent, that is

$$r^{ep} = 0.037 + 0.02 - 0.04 = 0.017 = 1.7\%.$$

Here, we did not adjust the growth rate g but would have to estimate the growth rate of adjusted dividends. As is clear from Figure 6, it will be more difficult to make estimates for the growth in adjusted dividends since they are far more volatile than ordinary cash dividends. Since it does not affect the long-run estimate, we are better off using on cash dividends.

4.2.2. Higher Dividend Growth

There is a view that information technology has led to sustainable higher productivity growth. (See for example Jovanovic and Rousseau 2000). This "new economy" view assumes that the 1990s are much like the post-industrial revolution period that enjoyed the fruits of the technological advances. Then, higher productivity translates into higher growth in output, earnings, and dividends.

But ultimately real growth is determined by growth in factors of production like labor and increases in output per worker. In the 1990's, growth in the U.S. labor force has been roughly one percent – which is lower than in earlier years when more women and babyboomers entered the workforce. Similarly, productivity has grown only about 1 percent per year. (See Krugman 1997.)

Suppose that we experienced a temporary increase in growth with the rate eventually returning to 2 percent. We see at least for the dividends for corporate equities held by U.S. residents that the recent growth rate has accelerated vis a vis GNP. (See Figure 4.) Other evidence on a temporary increase is the recent IBES consensus forecasts for earnings. With earnings projected to be higher, we expect higher dividends.

Suppose that we assume that the growth in dividends will continue to be high, say for the next 5 years and then revert back to the 2 percent trend. Between 1985 and 1999, total dividends grew roughly 6 percent per year faster than GNP. If we expect that to continue, the formula for the price in 1998 is

$$\begin{aligned} p_{s,98} &= \frac{d_{99}}{1+r^s} + \frac{d_{00}}{(1+r^s)^2} + \frac{d_{01}}{(1+r^s)^3} + \dots \\ &= \frac{d_{99}}{1+r^s}\left[1 + \frac{1.06}{1+r^s} + \frac{1.06^2}{(1+r^s)^2} + \frac{1.06^3}{(1+r^s)^3} + \right. \\ &\left. \quad \frac{1.06^4}{(1+r^s)^4} + \frac{1.06^5}{(1+r^s)^5} + \frac{1.06^5 1.02}{(1+r^s)^6} + \frac{1.06^5 1.02^2}{(1+r^s)^7} + ...\right] \end{aligned} \tag{4.1}$$

We can use the dividend yield and back out a value for r^s. Doing this calculation, we find $r^s = 5.1\%$. If $r^f = 4\%$, the equity risk premium is 1.1 percent. This is certainly higher than our benchmark estimate but well below the average historical premium.

4.2.3. Lower Risk-Free Rate

Thus far, we have assumed that the risk-free rate was equal to the rate on inflation-protected securities issued by the U.S. Treasury. However, costs incurred in shifting out of these securities can be as much as 50 basis points. If we subtracted 50 basis points from the risk-free rate for illiquidity concerns, we would then have

$$r^{ep} = 0.026 + 0.02 - 0.035 = 0.011 = 1.1\%.$$

which is slightly higher than our benchmark estimate of 0.6% for the equity premium. Note that to get equity premia above 4 percent, the risk-free rate would have to drop below 0.6%. There are episodes in U.S. history when the interest rates fell this low, but few expect that to happen in the near future.

4.2.4. The Bottom Line

In our view, it is reasonable to allow for temporarily higher growth in dividends relative to GNP and a risk-free rate that is a bit lower than the TIPS rate due to illiquidity. If we use the pricing formula in (4.1), we have a stock return of 5.1 percent. If we subtract 3.5 percent for the risk-free rate, we get an estimate of 1.6 percent. We view this as an upper bound. To get this we have to assume a phenomenal rise in dividends and a conservative risk-free rate. Without these assumptions, we are back to estimates near to zero as Mehra and Prescott found. These calculations suggest that the puzzle is vanishing – it is hard to justify equity premia over 4.1 percent, the average over the past 200 years. It is even harder to justify equity premia on the order of 7 or 8 percent found in the last 100 years.

4.3. Discussion

The stock market has received a lot of attention of late because of remarks by policymakers such as Alan Greenspan and academics such as Robert Shiller (2000) who view the stock market as overvalued. The calculations of this paper show that the current stock prices are warranted. The open question, therefore, is not why is the stock market value is equal to 1.8 GNP, but rather why was the stock market value so low in the past?

It also leaves open the question, why models are being developed that rationalize very high equity premia if, in fact, the U.S. historical period is an aberration. (See, for example, Boldrin et al. 1995 and Jermann 1998). If we look at the experiences of other countries, we find that the historical U.S. returns are the highest in the world – by a significant margin in many cases. In Figure 7, we reproduce a figure from Jorion and Goetzmann (1999) who compute long-run compounded real returns, excluding dividends, for 39 countries over the period 1921 to 1996. (Note Romania is the one country not shown on the figure. The return for Romania was -28.1 percent.) The U.S. had the highest real return over all countries, all periods. Sweden is close but most other countries with developed stock markets have significantly lower returns. This evidence suggests that the U.S. is the exception rather than the rule.

5. Conclusions

Historical asset returns in the United States pose a serious challenge to applied economists. Current asset returns, on the other hand, seem to be exactly in line with what our theories predict. Our best guess for the equity premium in the current and near future is in the range of 0 to xx percent, far lower than that seen by U.S. stockholders over the last 200 years.

A naive investor who looks only at the past when planning for his retirement may be sadly disappointed if he simply extrapolates historical returns. Unfortunately, this form of planning, whether for individuals or firms investing in projects, is common and even taught to MBA students.

References

Boldrin, Michele, Lawrence J. Christiano, and Jonas D.M. Fisher, 1995, "Asset Pricing Lessons for Modeling Business Cycles," Working Paper 560, Federal Reserve Bank of Minneapolis.

Jermann, Urban, 1998, "Asset Pricing in Production Economies," *Journal of Monetary Economics*, Vol. 41, pp. 257-76.

Jorion, Philipe and William Goetzmann "Global Stock Markets in the Twentieth Century," *Journal of Finance*, Vol. LIV, pp. 953-980.

Jovanovic, Boyan and Peter L. Rousseau, 2000, "Accounting for Stock Market Growth – 1885-1998," mimeo, New York University.

Kocherlakota, Narayana, 1996, "The Equity Premium: It's Still a Puzzle," *Journal of Economic Literature*, Vol. XXXIV, pp. 42-71.

Krugman, Paul, 1997, "How Fast Can the U.S. Economy Grow?" *Harvard Business Review*, July-August, 123-129.

Mehra, Rajnish and Edward C. Prescott, "The Equity Premium: A Puzzle," *Journal of Monetary Economics*, Vol. 15, pp. 145-61.

Shiller, Robert J., 2000, *Irrational Exuberance*, City: Publisher.

Siegel, Jeremy, 1998, *Stocks for the Long Run*, New York: McGraw-Hill.

Wadhwani, Sushil B., 1999, "The U.S. Stock Market and the Global Economic Crisis," *National Institute Economic Review*, January, pp. 86-105.

Welch, Ivo, 2000, "Views of Financial Economists on the Equity Premium and on Professional Controversies," mimeo UCLA.

Table 1

Financial Asset Returns, 1802-1999

	Stocks			U.S. Treasury	
	Small-Firm	S&P 500	Value-Weighted	Bonds	Bills
			Annual Nominal Returns		
Compounded Average					
1802-1997	NA	NA	8.4	4.8	4.3
1926-1999	12.6	11.3	10.9	5.1	3.8
1945-1999	14.7	13.3	12.9	5.4	4.7
1926-1945	9.4	7.1	6.5	4.7	1.1
1945-1972	13.7	12.8	12.4	2.2	2.7
1972-1999	15.4	14.1	13.6	8.7	6.8
Standard Deviation					
1802-1997	NA	NA	17.5	6.1	NA
1926-1999	33.6	20.1	20.2	9.3	3.2
1945-1999	25.7	16.5	16.6	10.4	3.1
1926-1945	51.1	28.3	28.3	4.8	1.5
1945-1972	28.5	16.6	16.5	6.0	1.8
1972-1999	22.6	16.4	16.7	12.5	2.7
			Annual Real Returns		
Compounded Average					
1802-1997	NA	NA	7.0	3.5	2.9
1926-1999	9.3	8.0	7.5	1.9	0.7
1945-1999	10.1	8.8	8.4	1.1	0.5
1926-1945	9.4	7.1	6.4	4.6	0.9
1945-1972	10.2	9.3	9.0	-1.0	-0.5
1972-1999	9.7	8.4	8.0	3.3	1.5

NOTE: NA indicates not available.

TABLE 2

Nominal Annual Returns and Dividend Yields for the Value-Weighted Stock Portfolio, 1802-1999

Time Period	Total Return	Capital Appreciation	Dividend Yield
1802-1997	8.4	3.0	5.4
1926-1999	10.9	6.4	4.3
1945-1999	12.9	8.7	4.0
1926-1945	6.5	1.3	5.1
1945-1972	12.4	7.9	4.3
1972-1999	13.6	9.7	3.7

FIGURE 1

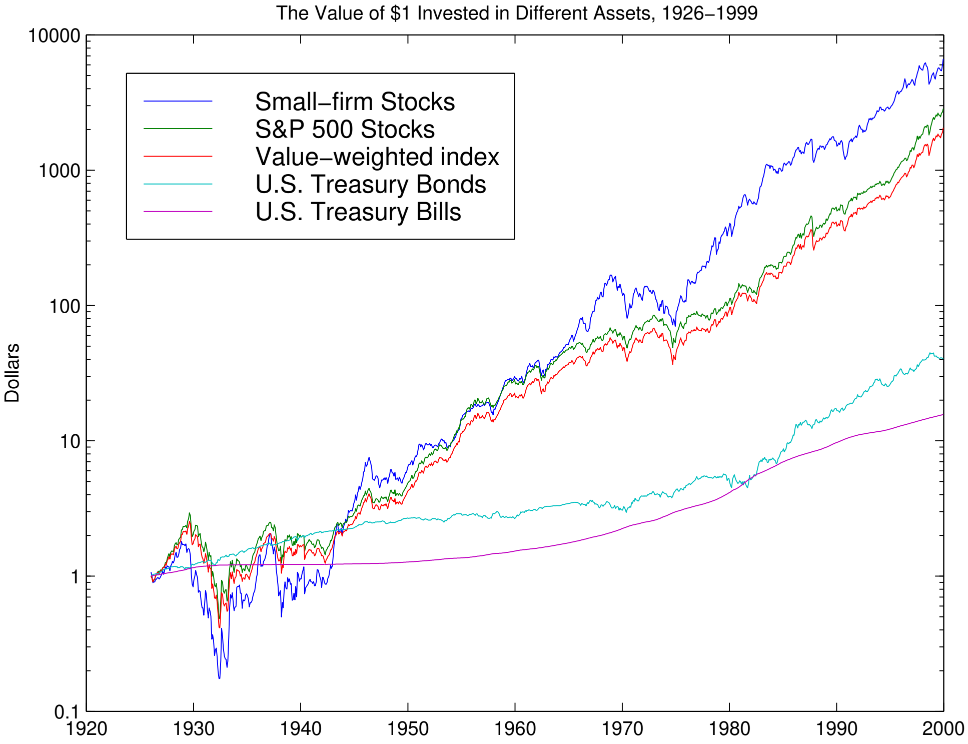

The Value of $1 Invested in Different Assets, 1926−1999
Small−firm Stocks
S&P 500 Stocks
Value−weighted index
U.S. Treasury Bonds
U.S. Treasury Bills
Dollars
10000
1000
100
10
1
0.1
1920
1930
1940
1950
1960
1970
1980
1990
2000

FIGURE 2

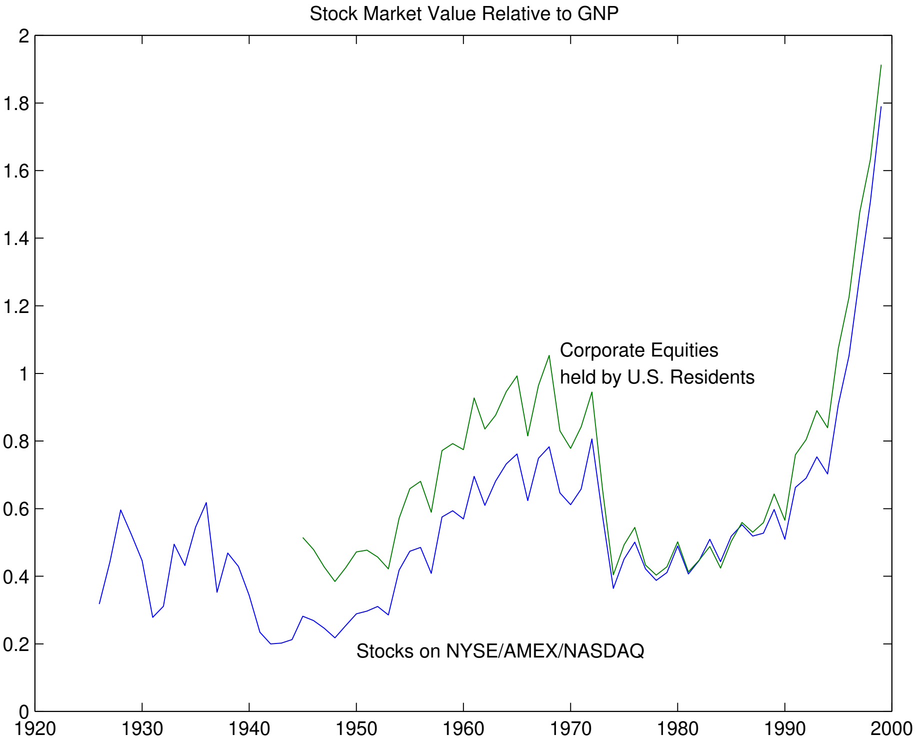

Stock Market Value Relative to GNP
Corporate Equities
held by U.S. Residents
Stocks on NYSE/AMEX/NASDAQ
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1920
1930
1940
1950
1960
1970
1980
1990
2000

Figure 3

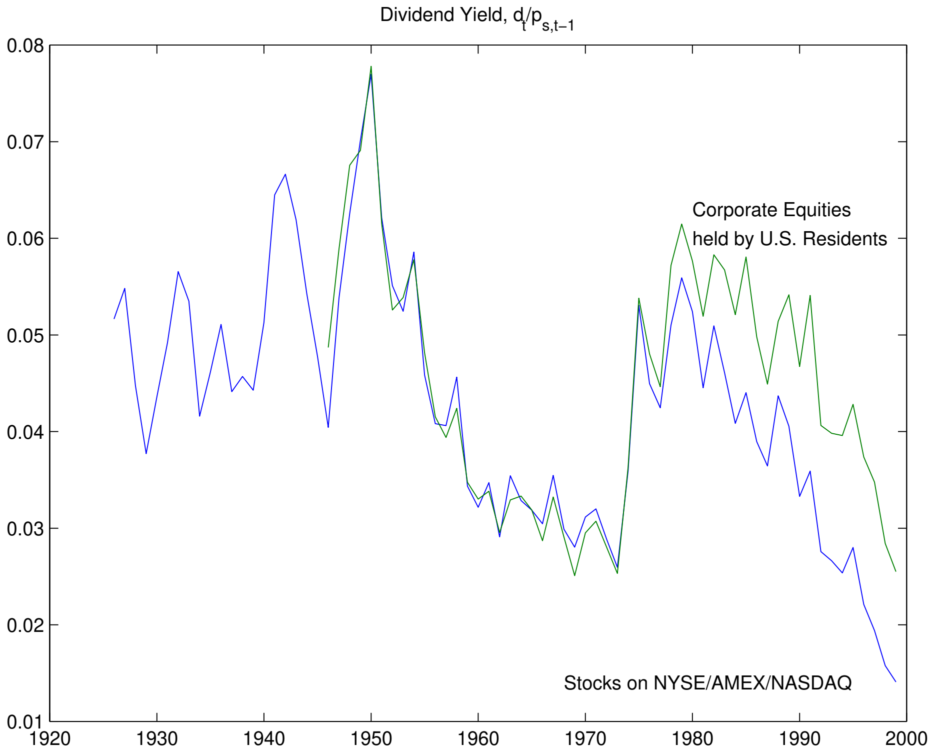
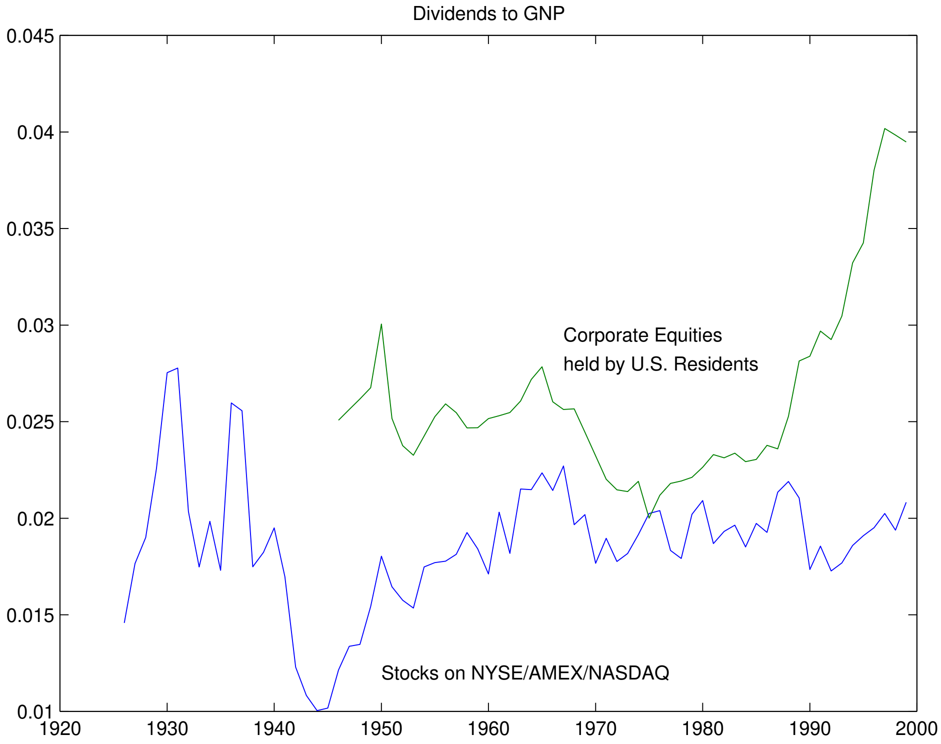

Dividend Yield, $d_t/p_{s,t-1}$
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
1920
1930
1940
1950
1960
1970
1980
1990
2000
Corporate Equities
held by U.S. Residents
Stocks on NYSE/AMEX/NASDAQ

Figure 4



Dividends to GNP
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
1920
1930
1940
1950
1960
1970
1980
1990
2000
Corporate Equities
held by U.S. Residents
Stocks on NYSE/AMEX/NASDAQ

Figure 5

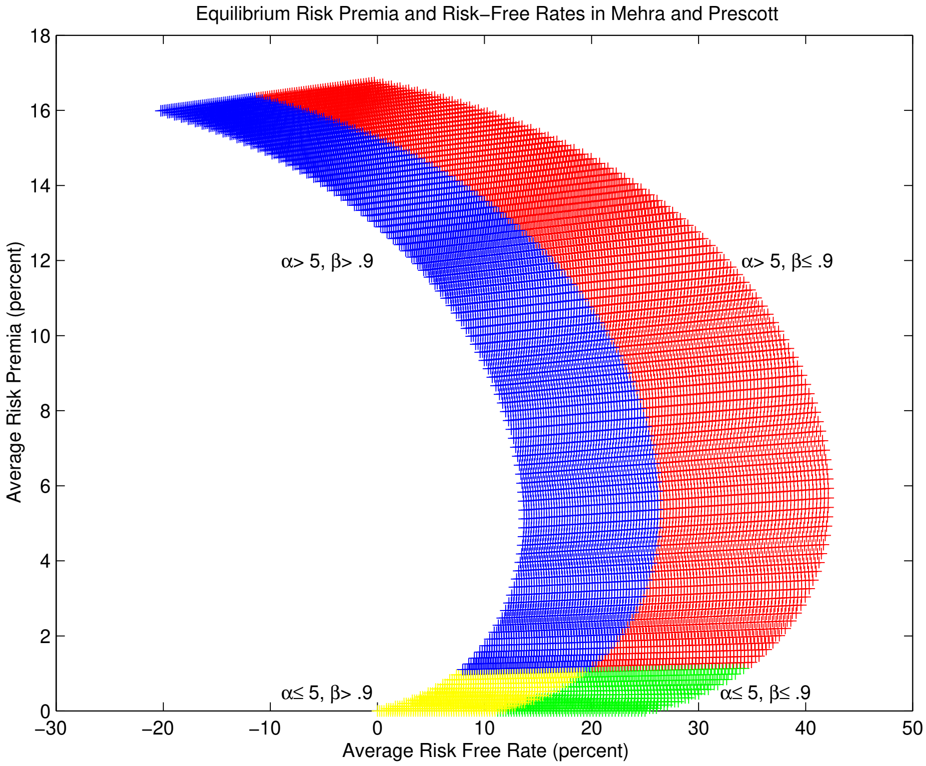

Equilibrium Risk Premia and Risk−Free Rates in Mehra and Prescott
Average Risk Premia (percent)
Average Risk Free Rate (percent)
α> 5, β> .9
α> 5, β≤ .9
α≤ 5, β> .9
α≤ 5, β≤ .9
18
16
14
12
10
8
6
4
2
0
−30
−20
−10
0
10
20
30
40
50

FIGURE 6

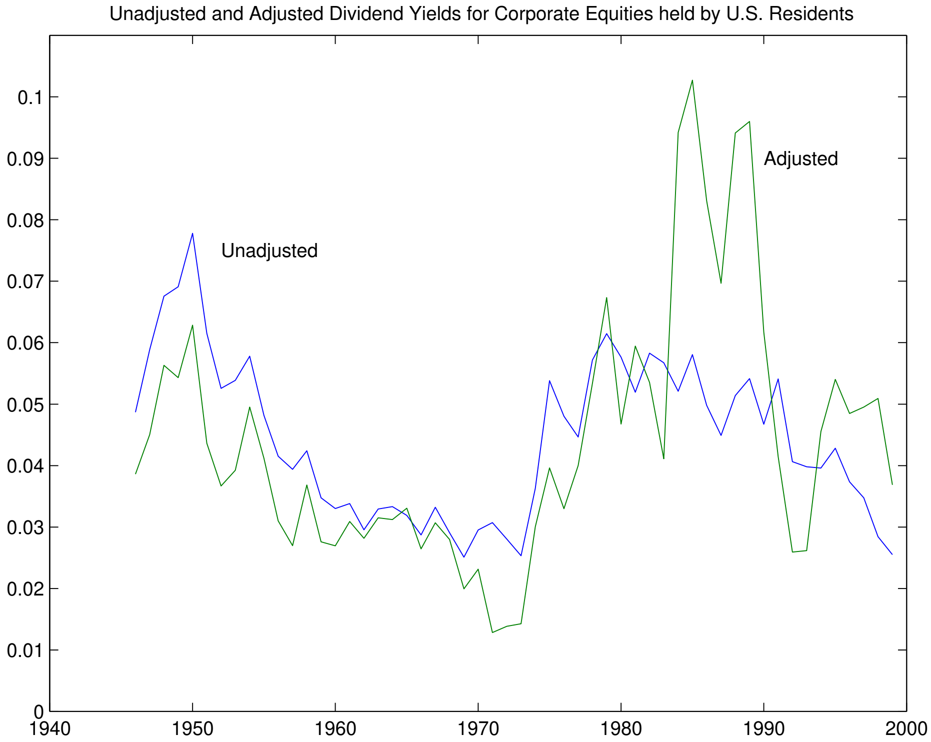
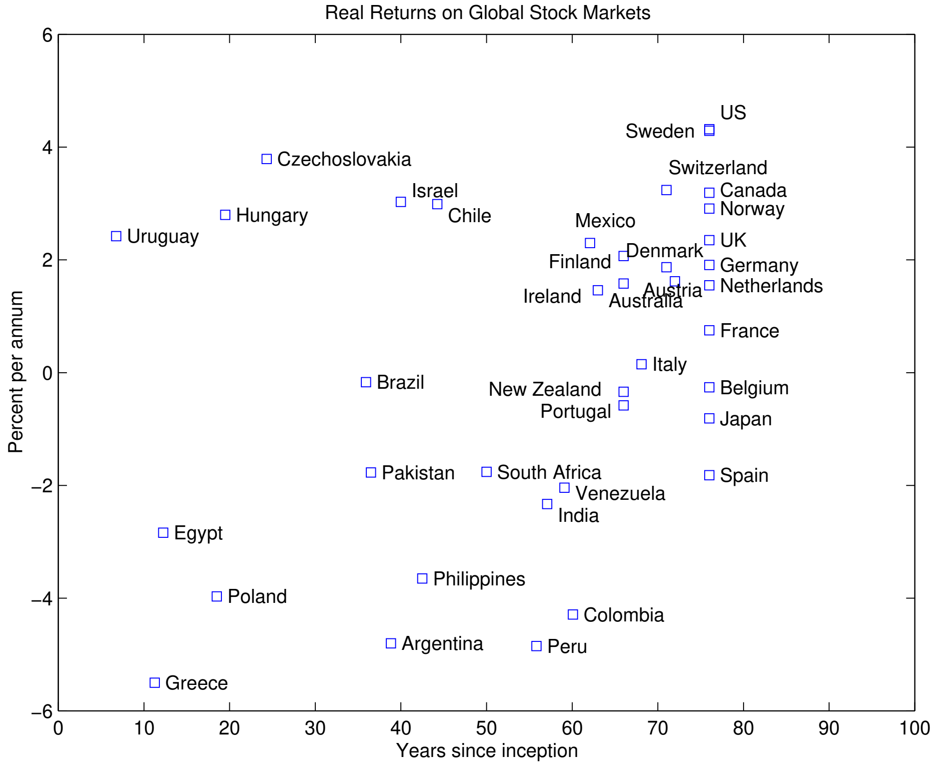

Unadjusted and Adjusted Dividend Yields for Corporate Equities held by U.S. Residents
Adjusted
Unadjusted
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1940
1950
1960
1970
1980
1990
2000

Figure 7



Real Returns on Global Stock Markets
Percent per annum
Years since inception
6
4
2
0
−2
−4
−6
0
10
20
30
40
50
60
70
80
90
100
US
Sweden
Czechoslovakia
Switzerland
Israel
Canada
Hungary
Chile
Norway
Uruguay
Mexico
UK
Denmark
Finland
Germany
Austria
Netherlands
Ireland
Australia
France
Italy
Brazil
New Zealand
Belgium
Portugal
Japan
Pakistan
South Africa
Spain
Venezuela
India
Egypt
Philippines
Poland
Colombia
Argentina
Peru
Greece