Stock Prices and Fundamentals*

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1 Introduction

While stock returns in the U.S. this past century have exceeded Treasury returns by an average of about 6 percent annually, returns in the last few years have exceeded the return on Treasury bills by more than 12 percent annually. Commentators have suggested a variety of explanations for the dramatic stock market run-up that accompanied these high returns. The baby boom is entering peak savings years, productivity has escalated worldwide due to technological improvements and political change, and stock market participation rates are on the rise. The growth of mutual funds has lowered transactions costs and made diversification feasible. Public awareness of the benefits of stock market investing is high. On the other hand, "irrational exuberance" could be fueling the price rise, with inexperienced investors expecting double-digit returns to continue indefinitely or at least long enough to reap a substantial gain.

Whether the price rise is due primarily to fundamentals or whether it is the result of a bubble is important to policy makers concerned with avoiding the real disruption a sharp stock market decline could precipitate. It is also important to the academic debate over the determinants of stock valuations. Because this paper is about the relation between stock prices and fundamentals, we emphasize three broad categories of explanations for the recent price rise: changes in corporate earnings growth, changes in consumer preferences, and changes in stock market participation patterns. The goal in quantifying the potential impact of fundamental effects is to better understand whether a combination of fundamentals and statistical fluctuation can plausibly explain the observed magnitudes, or whether a bubble is the likely cause of the price rise.

Although the paper touches on a variety of issues, its main contribution is to look more closely at how participation patterns have changed, and at how they are expected to affect required returns in a stochastic equilibrium model. We interpret participation broadly to include both the fraction of the population that holds any stocks, and the degree of diversification of a typical stockholder. To review the evidence, we use data from the Survey of Consumer Finances (SCF) to document changes in stock holding patterns and reported attitudes toward risk over the 1989 to 1995 period. Consistent with previous studies (e.g., Poterba (1993), Vissing-Jørgensen (1997)), we see an increasing rate of stock market participation over time. Participation rates among the wealthy, who own the majority of stock, however, have increased only slightly. Foreign participation changes may also influence required returns. Using data from the U.S. Treasury, we find that net purchases of stocks by foreigners have been relatively high in recent years, but small in comparison to total trading volume. Finally, Flow of Funds data shows that diversification has increased markedly, with large outflows of individual stocks from household portfolios moving into mutual funds and other institutional accounts.

To quantify the potential impact of these changes, we calibrate an overlapping generations model that allows for considerable heterogeneity in the cross-section of nonmarketable income risk, preferences, diversification and participation. This extends the analyses of Basak and Cuoco (1998), Saito (1995), and Vissing-Jorgensen (1997), all of who consider the effect of participation when traded securities span income realizations. We use this framework to experiment with changes in stock market participation rates, changes in background risk, changes in preferences, and changes in the expected dividend process reflecting changes in diversification. We find that for realistic changes in raw participation rates, expected stock returns change very little. Within the range of risk aversion parameters normally considered, preferences changes also have little affect on expected return differentials. Changing the rate of time preference has a significant impact on the level of all returns, but not on the differential between stock and bond returns. One factor that appears to have a significant affect on required returns is the degree of assumed diversification. This suggests that one fundamental reason for the stock price run-up may be the rapid growth of mutual funds and the accompanying large increase in diversification.

The remainder of the paper is organized as follows. In section 2 we review the statistical evidence on whether the current stock price level is anomalous. In section 3, we discuss some possible explanations for the stock price increase in the context of a simple discounted cash flow model, and present some evidence from the SCF and other sources on changes in stock market participation patterns. The impact of participation rates, extent of diversification, background income risk, and preferences on stock prices is examined in section 4 in an overlapping generations model. By considering a variety of scenarios reflecting simultaneous changes in several of these factors, we show that changes in fundamentals can account for perhaps half of the observed increase in price- dividend ratios in the model. Section 5 concludes.

2 Empirical Facts

Historically stocks have returned a substantial premium over bonds. For example, over the period 1871 to 1998, the average annual (log) real return on a broad-based index of U.S. stocks was 7.3% compared to an average (log) real return on comercial paper of about

3%.[1] The return on stocks over the last few years has exceeded this historical average. For example, since 1991 the average real return on stocks was 17% per year. This has led many observers to question whether expected returns looking forward are lower than they have been in the past.

A related issue is the composition of recent returns, which have been mostly the result of capital gains rather than increased dividend payments. To illustrate this, figure 1 plots the ratio of prices to dividends and prices to earnings for aggregate U.S. stocks. (For the years since 1926 this is based on the S&P500 index.) Notice that the price-dividend ratio for this index has increased to an unprecedented level since about 1995. The increase in this ratio is significant because in a discounted cash flow model of stock valuation, it indicates a reduction in the expected rate of return or an increase in the dividend growth rate (see Section 3). Because dividends are discretionary and only one of the ways in which corporations distribute cash to share holders, it may be more informative to look at price to earnings ratios. Figure 1 also shows the ratio of prices to earnings. This ratio is also at a relatively high level, but the change has not been as dramatic as for dividends.

A notable aspect of the rise in the price-dividend ratio is that there is substantial evidence that a large value of the price-dividend ratio predicts lower stock returns in the future. For example, Table 1 reports the results of regressing annual (log) stock returns on a constant and the log of the price-dividend ratio lagged one year for the period 1887 to 1998. Notice that the coefficient on the dividend-price ratio is negative. This is consistent with a large body of evidence (e.g., Campbell and Shiller (1988), Hodrick (1992), and Lamont (1996)). At the current high level of the dividend price ratio, this regression predicts a substantial decline

[1] Source: Robert Shiller's Data. Available at http://www.econ.yale.edu/ shiller/chapt26.html.

in the stock market over the next year. In fact, since 1995 this regression has consistently predicted a decline in the stock market.

On the other hand, due to the substantial variability in stock returns, it is possible that the recent returns are within the bounds of normal statistical fluctuations, without any change in the underlying driving processes. For example, the standard deviation of the annual premium of stock returns over bond returns over the period 1871 to 1998 was 18%. Therefore, it is not improbable that one would observe several years of premiums in excess of 20% per year, even with no change in the underlying statistical process. Since there is not a statistically definitive answer to the question of whether returns have been abnormally high, we focus below on whether recent changes in various aspects of the economy are large enough to suggest a fundamental change in expected returns.

3 Possible explanations

In this section, we discuss some of the potential explanations that have been offered for the stock price run-up, and begin to evaluate their likely quantitative importance in the context of a simple discounted cash flow model. We also present some evidence on changes in market participation patterns that may be influencing required returns.

3.1 Gordon Growth Model

The "Gordon growth model" is perhaps the simplest fundamentals-based approach to predicting stock prices.[2] In this model, stock prices are based on the discounted present value of future expected dividend payments. It is assumed that dividends grow, on average, at a

[2]This valuation model, a staple of market analysts, is described, for instance, in Brealey and Myers, 1996.

constant rate, g, and investors discount dividends at a constant rate, r. Dividends, earnings and growth are connected by two equations: $DIV = (1 - p)E$, and $g = p(ROE)$, where DIV is dividends, E is earnings, p is the proportion of earnings reinvested, and ROE is the marginal physical product of capital. If the marginal physical product of capital is constant, and if the fraction of reinvested earnings is constant, all else equal dividend growth is constant. Then the price-dividend ratio equals $(1/(r - g))$.

The model highlights two of the fundamental reasons that the price-dividend ratio can change. The first is due to changes in dividend growth, reflected in the choice of g. The second is due to changes in preferences that affect the subjective rate of time preference or the premium demanded for risk, reflected in the choice of r.

Expectations of g may be higher than in the past for several reasons. A major determinant of dividend growth is the availability of profitable investment projects. The potential for sustained economic growth in excess of historical precedent has been attributed to the opening and integration of world markets, continuing technological advances, and an increasingly educated labor force. In fact, U.S. per capita GDP growth has been slightly higher than average in recent years, averaging 2.3% over the 1995 to 1998 period, compared to 2.0% percent from 1947 to 1998.

Other considerations suggest that r may be lower than in the past. One possibility is that aggregate preferences have changed. Either a decrease in risk aversion or an increase in patience could contribute to the run-up in stock prices. Risk aversion could vary across generations due to their varying experiences and circumstances. For example, baby boomers do not share their parents' first-hand experience with the Great Depression. Some have argued that the economy is more stable, reducing the exposure to background risk, and possibly reducing the risk of dividends. Davis and Willen (1998) show, for example, that the income risk for households with various educational attainments has changed over time. Reduced transactions costs in financial markets make diversification easier, which, as discussed below, can reduce effective aversion to the risk of holding stocks as people hold more diversified portfolios.

It should be noted that these types of changes impact the risk free rate as well as the expected return on stocks. Since the risk free rate has been relatively stable over the period of the recent stock price run-up, in much of what follows we focus on factors that impact the equity premium, rather than the absolute level of rates.[3]

The Survey of Consumer Finances (SCF) is one of the few data sources that provides some direct survey evidence on peoples attitude towards financial risk, and how it has changed over time. Respondents to the SCF answer detailed questions, both quantitative and qualitative, about their financial situation. The survey is conducted by the Federal Reserve Board every three years, with different households in each survey year. Here we focus on the question: "Which of the statements on this page comes closest to the amount of financial risk that you (and your husband/wife) are willing to take when you save or make investments? If more than one box checked, code smallest category #."

1. take substantial financial risks expected to earn substantial returns

2. take above average financial risks expecting to earn above average returns

3. take average financial risks expecting to earn average returns

[3]See Blanchard (1993) for an analysis of historical trends in the equity premium and risk-free rate.

4. not willing to take any financial risks

Table 2 reports the average response by age and survey year. The implied population standard deviation across responses is reported in parentheses. Since the population represented by the survey totals approximately 90 million households, the standard errors of the estimates of the means are quite small. Consistent with the idea that risk tolerance has increased, the average reported aversion to risk has decreased slightly for each age category over time. Older households own significantly more stock than younger households, and reported risk aversion increases with age in each survey year. When a similar tabulation (not reported here) is done conditional on households that own at least $500 in stocks, the same patterns emerge with respect to age and time. The average reported level of risk tolerance, however, is higher when we condition on stockholders. For instance, in 1995 the average risk attitude for stockholders over age 65 was 3.17, as compared to 3.58 for all households over 65. This suggests that those who already own stocks are more risk tolerant as a group than non-participants. Hence, the entry of new stockholders may slightly decrease the average level of risk tolerance. One would expect this to mitigate the effect of wider participation on reducing the equity premium.

There are objective reasons why the underlying subjective rate of time-preference also may be changing. Increases in life expectancy beyond retirement would likely increase the incentive to save, and thereby reduce required returns. Mortality, for example, has declined at an average annual rate of 3.3 percent, over the period 1900 to 1988 (Social Security Administration). Past improvements in health and life expectancy might understate expected improvements in these factors that are premised on continued medical progress.[4] As with the other explanations considered for the stock price run-up, however, it is hard to point to events that would trigger a large change in aggregate preferences over the course of only a few years.

Calibrating the Gordon Growth Model gives a rough sense of how far earnings growth rates or stock returns would have to deviate from their historical averages to justify current price levels. This approach has the advantage that it allows one to avoid taking a definitive stand on the magnitude of technology or preference parameter changes. In the tabulations presented here, we focus on earnings-adjusted price-dividend ratios rather than actual price-dividend ratios because earnings are likely to be a more stable proxy for long-run payments to shareholders. Consistent with the average ratio of dividends to earnings over the period 1947 to 1997, we assume an average reinvestment rate of 50 percent. Hence, the adjusted price-dividend ratio is defined as twice the price to earnings ratio.[5]

Over the past century, real earnings growth has averaged about 1.4 percent annually, with a standard deviation of about 25 percent. Table 3 shows the required growth rate in the future to match current and historical adjusted price-dividend ratios, for various levels of required returns. For r ranging from 5 to 15 percent, Column 2 reports the growth rate, g, that is consistent with the adjusted price-dividend ratio of 28 for the period 1872 to 1998. Column 3 reports the growth rate necessary to match the adjusted price- dividend ratio

[4] In fact, there is a lively debate in the demographic literature on these questions, with some authors claiming that a life expectancy at birth of 100 years will be realized early in the next century.

[5] While stock prices depend on the long-run behavior of dividends, properly measured, in the short-run dividends can vary due to temporary changes in payout policy (for instance, in response to changes in the tax law). Therefore, it is common to focus on the price to earnings ratio, adjusted for reinvestment rates, to approximate long-run dividend to price ratios.

of 48 in January 1998 (the ratio in January 1999 is even higher at 58). For instance, to realize a real stock return of 7 percent (consistent with a 6 percent equity premium and a 1 percent real risk-free rate) and to match the average historical adjusted price-dividend ratio of 28, requires growth of 3.4 percent. To match the 1998 adjusted price-dividend ratio of 48, assuming a real risk-free rate of 3 percent and an equity premium of 6 percent, requires perpetual growth of 6.9 percent. This is a high number by historical standards, suggesting that, at least in this simple model, a plausible increase in the expected long-run growth rate is unlikely to be the sole explanation for the increase in stock prices.

The growth rate and required return enter symmetrically in these calculations. Therefore, another interpretation of the results in Table 3 is that if growth rates are expected to be similar to historical averages, the expected real return on the stock market is now less than 5 percent. Again assuming a risk-free return of 3 percent, this implies an equity premium below 2 percent. This large a change in expected returns also seems unlikely to have taken place over the period of only a few years.

One shortcoming of this model is the restriction that the expected growth rate is constant. This assumption, however, can be relaxed quite easily. A minor variation on the model is to assume a higher growth rate for some number of years, followed by a return to a lower long-run growth rate. Column 4 of Table 3 reports, for each value of r in Column 1, the growth rate over 10 years necessary to explain the adjusted price-dividend ratio in January 1998. The calculation assumes that the growth rate returns to the long-run average of 2 percent from year 10 onward. In this case achieving a 9 percent average rate of return requires a growth rate of 18.9 percent for ten years!

Although these calculations are admittedly primitive, more detailed analyses along similar lines produce qualitatively similar conclusions. For instance, Lee and Swaminathan (1999) estimate the value of individual stocks in the Dow Jones Industrial Average, projecting cash flows using accounting data and analysts' forecasts, and discounting using the CAPM. They conclude that the index is about 1.6 times the fundamental values predicted by their analysis.

Despite the apparently large changes in parameters necessary to explain current price levels, these results do not preclude a fundamentals-based explanation. It is possible that there has been a simultaneous increase in expected growth rates and reduction in required returns. For instance, if the long-run growth rate is realistically expected to be about 2.4 percent, and if expected returns fall to about 6.6 percent, current prices are in line with fundamentals. Our focus in the rest of the paper is on whether such a change in expected returns can be attributed to measurable changes in the economy, in the context of an equilibrium model. One factor of particular interest is the change in stock market participation patterns, which is the topic of the next subsection.

3.2 Stock Market Participation Patterns

It is well-documented that a large fraction of the U.S. population holds little or no stocks (Bertaut and Haliassos (1995), Blume and Zeldes (1993), and that participation varies systematically with factors such as wealth and age (Gentry and Hubbard (1998), King and Leape (1987)). As noted in several recent studies, (e.g., Basak and Cuocco (1998), Constantinides, Donaldson and Mehra (1998), Saito (1995), Polkovnichencko (1998), and Vissing-Jørgensen (1997)) an increase in the stock market participation rate has, in theory, the potential to decrease the required risk premium on stocks because it spreads market risk over a broader population.[6] Not only have the number of participants been rising, but the nature of participation has changed. A typical stockholder today has a more diversified portfolio than in the past, presumably due to the lower cost of diversification. Thus, the effective risk of the typical portfolio may have declined. In this subsection, we review some of the evidence on these changes.

The best source of data on market participation rates in the U.S. is perhaps the SCF, which reports detailed information about household wealth composition every three years. Using this data, Poterba (1998) reports that in 1995 there were approximately 69.3 million shareholders in the U.S.. This is compared to 61.4 million in 1992, and 52.3 million in 1989. There is also evidence that people are entering the market at a younger age. Poterba and Samwick (1997) show that baby boomers are participating more heavily in the market than previous generations at a similar age. Baby boomers are entering peak savings years, and directing some of their savings into stocks. More generally, the aging of the population should result in a greater demand for stocks, since older people hold proportionally more of their wealth in the market than do younger people, (see, e.g., Heaton and Lucas (1998)). Finally, foreign participation in U.S. markets has increased, further spreading the risk across a broader population.

Market participants also are holding more diversified portfolios, which reduces their exposure to risk from their stock holdings. This is potentially important, since holders of diversified portfolios may demand a lower average return. Historical evidence on this phenomenon of improving diversification is summarized in Allen and Gale (1994). Blume and

[6] Bakshi and Chen (1994) note that to the extent that demographic changes have an affect on the demand for stocks, they will have a predictable affect on asset prices. Bodie, Merton and Samuelson (1992) provide a theoretical justification for why the demand for stocks may vary with age.

Friend (1978) found that a large proportion of investors had only one or two stocks in their portfolios and very few had more than ten. At the time, this lack of diversification in individual stock holdings could not be justified by the claim that these investors achieved diversification through unreported mutual fund holdings. In fact, King and Leape (1984) found that only one percent of investors' wealth was in mutual funds at around that time. In contrast, Poterba (1998) reports a sharp increase in the proportion of stock held in mutual funds over time and a reduction in directly held stocks. For instance, while the total number of individuals holding stock increased from 61.4 to 69.3 million from 1992 to 1995, the number of individuals holding stock directly fell from 29.2 million to 27.4 million over the same period. In the calibrations presented below, we will look at whether this diversification effect is significant by comparing stock prices with different underlying assumptions about dividend volatility, where high assumed dividend volatility proxies for less diversification.

Although these statistics point to an increase in participation and a reduction in risk exposure, it is questionable how quantitatively significant these effects are. The change from 52 to 69 million participants is a 33 percent increase, but when the numbers are wealth-weighted, the increase is much smaller. Now as in the past, the vast majority of stocks are held by wealthy individuals. For instance, Poterba (1998) finds that in the 1995 SCF, 82 percent of stock is held by households with a stock portfolio exceeding \$100,000. Similarly, 54 percent of stock is held by households with annual income over \$100,000. This suggests that stock holdings remain extremely concentrated. Figures 2 and 3 present a more complete picture of how the distribution of stock holdings versus wealth and income has changed over the period 1989 to 1995. Using data from the SCF, we plot the share of stocks held against the share of income or wealth. Stock holding looks more democratic when measured relative to income than relative to wealth, since as noted in Vissing-Jørgensen (1997), lower labor income households own a larger share of the market than in the past. When the metric is wealth, however, there has been very little change – holdings were and are extremely concentrated.

Ideally, one would like to measure the net investment in the stock market in recent years on behalf of households. If net inflows were large, one could perhaps conclude that the demand for stocks had significantly increased. The fact that aggregate savings rates are low is indirect evidence that these net inflows cannot be large. Still, there could be substitution out of money and bonds into stocks, increasing the net flow into stocks. Looking at the Flow of Funds Accounts, U.S. Treasury securities is the only category of fixed income investment that had a large net outflow from the household sector in recent years. Calculating flows into stocks directly is tricky because there have been large changes in the institutional structure of the investment industry. Table 4, using data from the Investment Company Institute, shows net purchases of stocks, purchases made through mutual funds, and purchases made outside mutual funds, by households, from 1995 to 1997. While purchases made through mutual funds increased significantly over the period, net purchases of equities by households were actually negative in each year. This is due to the fact that households were net sellers of equities to institutions.

Changes in foreign participation in the U.S. market may also affect expected returns. Assuming that foreign participants are similar to U.S. stockholders in terms of their attitude towards risk and their ex ante risk exposure, an increase in foreign participation should lower expected returns by increasing opportunities for diversification. Net foreign purchases of stock have spiked sharply in recent years (see Figure 4), and these inflows, over the period January 1988 to February 1999, have a correlation of .13 with monthly returns on the S&P 500. The average monthly net inflow between January, 1996 and February, 1999 is \$3.8 billion, compared to only \$349 million from the period January, 1988 to December, 1995. Although the inflows have increased significantly, they still represent a small fraction of total market transactions, which totaled approximately \$479 billion per month in 1997 on the New York Stock Exchange alone.[7]

4 An Overlapping Generations Model

In this section, we ask whether changing stock market participation patterns and increased diversification can have a quantitatively important effect on stock prices in an equilibrium model. We calibrate an overlapping generations (OLG) model in which agents face both aggregate and idiosyncratic income risk, and a variable subset of agents has limited access to financial markets.

The effects of limited participation in financial markets has been considered by a number of authors including Basak and Cuocco (1998), Saito (1995) and Vissing-Jørgensen (1997). In these papers, aggregate consumption is completely traded in financial markets in the form of dividends. Only a limited number of agents can trade claims on this dividend flow directly. The other agents participate in financial markets only by trading claims to risk-free bonds. The result is incomplete sharing of aggregate risk, with stockholders often taking

[7]Data on foreign purchases and sales of U.S. stocks are from the U.S. Dept. of Treasury from the table "TIC Capital Movements, U.S. Transactions with Foreigners in Long Term Securities". S&P500 monthly returns data are from Robert Shiller. Total trading volume is from the NYSE 1997 Fact Book.

leveraged positions to accommodate the demand for bonds by non-participants. Because of this, a larger risk premium is necessary to induce those in the stock market to hold all of the aggregate risk. It is difficult to justify the magnitude of the observed equity premium in these models, however, unless one assumes very high risk aversion or very low participation rates.

One way to increase the impact of limited participation is to include other sources of uninsurable income risk. For instance, income from wages and/or privately held businesses constitutes the majority of income for most households (Heaton and Lucas (1998)). These income flows are difficult to contract upon, and a large component of this income risk is specific to each individual or household. We refer to the sum of labor income and privately held business income as "nonmarketed income." Potential differences in the properties of this income for participants versus non-participants are likely to influence the effects of limited participation on asset returns. This is consistent with the empirical observation that the consumption of stockholders is more volatile than that of non-stockholders (Mankiw and Zeldes (1991)). Polkovnichencko (1998) demonstrates how differential income risk and risk aversion can affect asset prices in a model with infinitely lived heterogeneous agents. He shows that a small fixed transaction cost that endogenously limits stock market participation can interact with idiosyncratic risk to result in a bigger equity premium than in a representative agent model, although matching the observed premium is still elusive.

The model presented here allows us to examine the effect of participation and diversification while considering a greater degree of cross-sectional heterogeneity than in the previous literature, due to the simplifying assumption of two-period lives. Unlike the papers discussed above, which focus on whether limited participation can explain the historical equity premium, we focus on the question of to what extent observed *changes* in participation rates can explain the recent run-up in stock market prices. We also emphasize the effect of changes in the degree of portfolio diversification.

4.1 Structure of the Model

At each time period, t, a generation of J "young" agents are born and live for two periods.[8] Let $C(j,t)$ be the consumption of agent j when young and $C^o(j,t+1)$ be the consumption of agent j when old, $(j = 1, 2, \ldots, J)$. The utility specification for agent j distinguishes between risk aversion and the elasticity of intertemporal substitution. We use the parametric form proposed by Epstein and Zin (1989) and Weil (1990):

$$U(j,t) \equiv \log(C(j,t)) + \frac{\beta_j}{1-\alpha_j} \log \left\{ E\left[C^o(j,t+1)^{1-\alpha_j} \mid \mathcal{F}(t) \right] \right\} \tag{1}$$

where $\beta_j > 0$ and $\alpha_j > 0$. $\mathcal{F}(t)$ is the information available at time t, and is assumed to be common across agents. As discussed by Epstein and Zin (1989), the parameter α_j is the coefficient of relative risk aversion. The elasticity of intertemporal substitution equals one. In the experiments considered below, changes in participation affect the equilibrium volatility of individual consumption in the second period. In general, this affects both the level of interest rates and the equity premium. By distinguishing between risk aversion and the elasticity of intertemporal substitution, the effect of the income process on the equity premium is to some extent separated from its effect on the risk-free rate.

[8] Storesletten, Telmer and Yaron (1998) consider an OLG model in which the agents face nontradeable idiosyncratic risk and live for a large number of periods. We limit ourselves to a smaller number of periods to make numerical solution of the model easier.

Each agent j ($j = 1, 2, \ldots, J$) is endowed with random nonmarketed income $Y(j,t)$ at time t and random nonmarketed income $Y^o(j, t+1)$ when old at time $t+1$. The details of the individual income processes are described below. The agents trade in financial markets in an attempt to smooth consumption over time. There are two securities that can be traded: a stock and a risk-free bond. At time t the stock represents a claim to future dividends $\{D(t+\tau) : \tau = 1, 2, \ldots\}$. The total supply of stock is normalized to one. The bond is assumed to be in zero net supply.

Each agent is exposed to nonmarketed income risk that has both an aggregate component and an idiosyncratic component. Aggregate nonmarketed income at time t is denoted by $Y^a(t)$ where

$$Y^a(t) = \sum_{j=1}^{J} Y(j,t) + \sum_{j=1}^{J} Y^o(j,t) \ . \tag{2}$$

In equilibrium, this endowment plus dividends equals aggregate consumption at time t. The properties of individual nonmarketed income $Y(j,t)$ and $Y^o(j,t)$ will be potentially important in assessing the effects of changing participation and background income risk on equilibrium returns.

At time t each young agent maximizes utility (1) subject to a constraint that depends on the agent's access to financial markets. Let $P^s(t)$ be the price of the stock at time t and $P^b(t)$ be the price of a bond that pays one unit of consumption at time $t+1$ for sure. If agent j has access to both financial markets, then the agent's flow wealth constraints are:

$$C(j,t) = Y(j,t) - S(j,t)P^s(t) - B(j,t)P^b(t) \ , \text{ and} \tag{3a}$$

$$C^o(j,t+1) = Y^o(j,t+1) + S(j,t+1)[P^s(t+1) + D(t+1)] + B(j,t)\ , \tag{3b}$$

where $S(j,t)$ gives the stock holdings of agent j and $B(j,t)$ gives the bond holdings of agent j. A subset of the agents is assumed to have only limited access to financial markets and can trade only in bonds. In this case the constraints (3) are replaced by:

$$C(j,t) = Y(j,t) - B(j,t)P^b(t)\ ,\ \text{and} \tag{4a}$$

$$C^o(j,t+1) = Y^o(j,t+1) + B(j,t)\ . \tag{4b}$$

An equilibrium is given by processes for stock and bond prices $\{P^s(t) : t = 0,1,\ldots\}$ and $\{P^b(t) : t = 0,1,\ldots\}$ such that:

$$\sum_{j=1}^{J} S^*(j,t) = 1\ ,\ \text{and} \tag{5a}$$

$$\sum_{j=1}^{J} B^*(j,t) = 0 \tag{5b}$$

where $\{S^*(j,t), B^*(j,t)\}$ maximizes (1) subject to (3) if the agent can trade in both markets or subject to (4) if the agent can trade only in the bond market.

We assume that nonmarketed income $\{Y^a(t) : t = 0,1,\ldots\}$ and dividend income grow over time in such a way that the growth rate of aggregate income is a stationary process. Consistent with this, we assume that at time t, $Y(j,t) = y(j,t)Y^a(t)$ and $D(t) = d(t)Y^a(t)$, where $y(j,t)$ denotes the share of individual j's income in aggregate income and $d(t)$ gives the dividend relative to aggregate nonmarketed income. Similarly we assume that $Y^o(j,t) = y^o(j,t)Y^a(t)$. This implies that one can look for an equilibrium in which the stock price also scales with aggregate income, so that $P^s(t) = p^s(t)Y^a(t)$. Finally, we assume that the face value of a bond purchased at time t is given by $Y^a(t)$ so that $B(j,t) = b(j,t)Y^a(t)$ where $b(j,t)$ gives the quantity of these "rescaled" bonds purchased by agent j.

4.2 Calibration

In this subsection, we calibrate the model in order to quantitatively revisit some of the questions discussed in section 3. How much do assumed changes in participation rates impact the predicted equity premium and expected returns (and hence prices)? How does the degree of portfolio diversification affect required returns? Can small changes in preference parameters, reflecting changes in patience or risk aversion, result in large changes in required returns? How important is heterogeneity in income risk? To answer these questions, the model is solved numerically using standard techniques. Although we assume considerable heterogeneity in the cross section, the fact that agents only live for two periods makes the problem numerically tractable.[9]

We begin by describing the parameterization of the income processes and preferences. Parameters are chosen to reflect limited stock market participation, and to try to match gross features of the data with respect to stock returns, the risk-free rate, and the driving processes for nonmarketed income and dividends.

As in most exercises of this type, the equity premium puzzle remains a serious problem. For income and dividend processes and participation rates based on historical data, the model predicts an unrealistically small equity premium. We have increased the assumed income volatility of aggregate income to increase the predicted premium, but want to emphasize that this may not be a neutral adjustment with respect to the other quantities of interest.

[9]The Matlab code is available upon request.

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4.2.1 Income and preferences

Let $\gamma(t) \equiv \log[Y^a(t)/Y^a(t-1)]$ be the growth rate of aggregate nonmarketed income at time t. Then the aggregate state of the economy is given by the $z(t) \equiv [\gamma(t)\ d(t)]'$, which is assumed to be generated by a Markov chain. To calibrate a process for $z(t)$ we assume that a period corresponds to 25 years. The first period roughly corresponds to the working years between age 40 to retirement, and the second period is the time in retirement. Over the period 1889 to 1985, the average annual (log) growth rate in real aggregate consumption was 1.7% with a standard deviation of 3.5%. So that the model produces a nonnegligible equity premium, we assume that the standard deviation of the aggregate growth rate in the model is 1.5 times the historical standard deviation of aggregate consumption. For the same reason, we assume that annual income growth is independently and identically distributed over time, although in fact it is slightly negatively correlated. This implies a 25-year average (log) growth rate of 42.5% with a standard deviation of 17.5%. This distribution is discretized by assuming that γ takes on the values 0.16 and 0.69 with equal conditional probability.

Capital share in total income averages approximately 30%. Consistent with the aggregate statistics reported in Heaton and Lucas (1998), we assume that only half of this capital income is actually tradable. The nontradable portion, generated by private business holdings, is accounted for in nonmarketed income. Since dividends in the model are scaled relative to nonmarketed income this means that we require $d(t)$ to average 18%. In most of the

[10] Recently Campbell and Cochrane (1998) suggest that time-varying habit provides a higher estimate of the equity premium in a model based on aggregate consumption. However, Cochrane (1997) claims that this preference specification cannot account for the recent run-up in stock prices.

calculations $d(t)$ is fixed at 18%. In other experiments described below, we assume a more volatile dividend process to proxy for a lack of diversification.[11]

The relative nonmarketed income of young agent j and of old agent k at time t is given by:

$$y(j,t) = \epsilon(j,t)(1-\eta(t)) \quad \text{and} \tag{6}$$

$$y^o(k,t) = \epsilon^o(k,t)\eta(t) \ , \tag{7}$$

where

$$\sum_{j=1}^{J} \epsilon(j,t) = 1 \text{ and } \sum_{k=1}^{J} \epsilon^o(k,t) = 1 \ . \tag{8}$$

Under this normalization, $\eta(t)$ gives the share of old individuals' nonmarketed income in total nonmarketed income. The analysis is sensitive to this parameter because the amount of nonmarketed income influences agents' attitude towards the risk of investment income. For the basic analysis we assume that $\eta = 0.2$ for all t, reflecting the observation that non-investment wealth is relatively small for retirees. In the sensitivity analysis, this parameter is varied to a maximum of 0.3.

The process for $\epsilon(j,t)$ and $\epsilon^o(k,t)$ captures idiosyncratic income risk across agents. We know from earlier work (e.g., Constantinides and Duffie (1996)) that asset returns are potentially sensitive to the persistence of idiosyncratic income shocks, and to the correlation

[11] In constructing the total dividend series, we always normalize the level of dividends so that they average 15% of GDP.

and conditional covariance of idiosyncratic and aggregate shocks. We assume a process for individual income risk based in part on the estimations reported in Deaton (1992), and adjusted for the assumed 25 year period length. Deaton reports a standard deviation of shocks for an MA(1) specification of individual income growth of 15%, and an MA coefficient of -.4. Based on this, the idiosyncratic income shock for both the young and the old are assumed to have a standard deviation of 45% over each 25 year period. The shock when young is assumed to be completely persistent, so that:

$$\epsilon^o(j, t+1) = \epsilon(j, t)\omega(j, t+1) \tag{9}$$

where $\omega(j, t+1)$ is the further 45% shock to relative nonmarketed income that agent j faces when old. In experiments below, we also consider the situation in which the idiosyncratic shocks of a subset of the population are correlated with dividends. This captures the possibility that certain classes of agents, such as business owners or executives who own large shares of stock in their own corporation, face risks that are more correlated with the market than a typical individual. Because preferences are homothetic, when agents are assumed to be homogeneous only the ω shock affects prices and portfolio choice. When the wealth and income of participants and non-participants differ, however, the income distribution of the young can affect predicted returns.

For most of the analysis, preferences are parameterized with $\beta_j = 0.95^{25}$ and $\alpha_j = 5$ for all j. These parameters are also varied in the sensitivity analysis.

4.2.2 Varying participation rates

Table 6 shows what happens when the assumed participation rate in the stock market is varied between 30 percent and 100 percent of the population, assuming the preference specification and processes for individual and aggregate income described above. As one would expect, increased participation lowers the equity premium. Notice, however, that the effect is small in the region of participation rates that correspond to the data. For example, when participation increases from 50% of the population to 80% of the population the equity premium, and the absolute level of equity returns, is reduced by less than a tenth of a percent. Changing participation also has a small affect on the level of the risk free rate, with an increase in participation increasing the average rate of return. This can be attributed to a precautionary effect that decreases when risk is spread more evenly over the population. Although small, this is in keeping with the observation that the risk-free rate has risen in recent years.

Consistent with the literature on the equity premium puzzle, aggregate income and dividend risk alone are not sufficient to generate a sizable equity premium. This is true even under the assumption of extremely limited participation, inflated aggregate risk, and non-marketed income risk. Still, the premium predicted here is higher than in Mehra and Prescott (1985) by about 1 percent. Experiments not reported here indicate that this is due primarily to the assumption that aggregate risk is higher than observed in the data, rather than to limited participation or exposure to idiosyncratic income risk.

In the experiments that follow, we examine other stochastic steady states based on different degrees of diversification, risk aversion, etc. Although looking across steady states does not allow one to watch returns gradually changing over time as parameters gradually change, it does provide an upper bound on the size of these effects. Thus, one can give a temporal interpretation to some of the experiments. For instance, we will compare the stylized historical past, with low diversification and low participation rates, to the stylized present, with greater diversification, more complete participation and greater patience.

4.2.3 Increasing diversification

As a proxy for the increased diversification of a typical market participant over time, we vary the assumed volatility of the dividend process. It is an empirical fact that the variability of returns falls dramatically as diversification increases. Based on CRSP monthly data from 1962 to 1997, Table 7 shows the effect of diversification on a typical portfolio's annual standard deviation. In monthly data, we find an average individual stock standard deviation of 16 percent, and an average pairwise covariance of .01. The portfolio standard deviations reported in the table assume equal value weights on each stock. Monthly returns are annualized under the assumption that they are independent. These calculations show that holding a one-stock portfolio results in an annual standard deviation of 55 percent, while increasing holdings to 5 stocks decreases the standard deviation to 28 percent. Holding 500 stocks brings the portfolio standard deviation down to 14 percent annually.

The above statistics on portfolio returns do not translate directly into parameter values, since the inputs into the model are income and dividend processes, whereas returns are endogenous. One assumption about dividends that produces returns consistent with those observed in CRSP data is that $d(t)$ is variable over time, taking on the value 0.11 and 0.25 with equal probability. This level of variation essentially brackets the variation in dividend's share in total income based on the S&P 500 dividend flow and U.S. Gross Domestic Product since 1947. We call this the "high dividend volatility" case. It implies variation that is approximately consistent with a three-stock portfolio under the parameterizations we focus on.

Second, we consider a situation referred to as the "correlated high dividend volatility case." Here the aggregate dividend is assumed to be correlated with nonmarketed income, taking on the value 0.11 in the low nonmarketed income state, and .25 in the high nonmarketed income state. These first two cases bracket two views of the relation between dividend growth and income growth. The first is that there is very little correlation between income growth and dividend growth on an annual basis. The second is that over longer time periods, such as the 25 year periods considered here, there is a positive correlation between dividends and income.[12]

Finally, we represent the increased volatility in a poorly diversified portfolio by assuming a skewed distribution of dividends. The dividend share, δ, is fixed at .1865 95 percent of the time, but δ falls to .06 five percent of the time, independent of the aggregate state. This "skewed dividend case" represents bankruptcy of a poorly diversified portfolio. It is further assumed that zero is an absorbing state for the value of a bankrupt portfolio after this small dividend is paid. To maintain stationarity, bankrupt shares are replaced by new shares in the next generation. These new shares are held in the portfolios of the young, but cannot be sold until the following period. The reason to consider a more skewed distribution of payoffs is

[12] As one would expect, predicted returns are sensitive to the assumed degree of correlation between dividends and nonmarketed income. It is not obvious, however, whether the dividends from a poorly diversified portfolio are likely to be more or less highly correlated with nonmarketed income than for a well-diversified portfolio. If, for instance, households own stock primarily in the companies for which they work, a common phenomenon, the correlation may be relatively high.

twofold. First, although catastrophic outcomes are rare for the U.S. stock market as a whole, individual firms fail quite frequently. Secondly, the properties of the utility function suggest that skewed outcomes will have a much different impact on asset prices than a symmetric distribution with the same variance. In fact, the implied volatility of returns in this case is set to be similar to that in the "high dividend volatility case".

Table 8 is similar to Table 6, but reports results under the assumptions of high dividend volatility, correlated high dividend volatility, and skewed dividends. Panel A reproduces the predicted returns under the base case set of assumptions for participation rates of 50 percent and 100 percent. Relative to panel A, assuming high dividend volatility (panel B) has the effect of decreasing the risk free rate by 0.61 percent and 0.82 percent, for participation levels of 100 percent and 50 percent respectively. It increases the equity premium by 0.71 percent and 0.97 percent respectively, for the same participation rates. These results are consistent with the view that increased diversification has significantly reduced the required equity premium, although for these parameters it suggests only a slight decrease in the level of the required return on equities. For the case of correlated high dividend volatility (panel C), the effect on the equity premium of an increase in dividend volatility is even larger.

Notice that in the "high dividend volatility case", an increase in participation results in a larger decline in the equity premium than in the "low dividend volatility case". This occurs in part because in the "high dividend volatility case", there is more risk to be shared, and hence a greater benefit from spreading this risk to new participants with no initial exposure to market risk. In the "correlated high dividend volatility case", however, changes in participation have a smaller effect on the equity premium than in the "uncorrelated high dividend volatility case". This is because the new entrants are less willing to bear stock market risk when it is correlated with their nonmarketed risk.

Finally, the much more dramatic results of the "skewed dividend case" are shown in Panel D. The small risk of a catastrophic outcome reduces the risk-free rate to .47 percent, and increases the equity premium to 6.46 percent with 50 percent participation. With 100 percent participation, the risk-free rate equals 1.54 percent, and the equity premium is 4.63 percent. This assumption therefore allows one to match the historical equity premium. It also suggests that in this region of parameter space the premium is more sensitive to changes in participation rates. This points to changes in diversification as a potentially large factor in explaining changes in expected returns.

4.2.4 Preference parameter changes

The potential effects of changing risk attitudes are explored by changing the coefficient of relative risk aversion, α_j. Recall that in all the results reported above α_j is set to 5. If α_j is increased to 10, with all else as in the "high dividend volatility case" and at a 50% participation rate, the equity premium rises by only 0.16 percent. The risk free rate falls by 0.3 percent. It is clear that over the range of risk aversion coefficients usually considered, a change in risk aversion does not account for large changes in stock prices in this model.

As discussed in Section 3, increases in life expectancy may affect the subjective rate of discount. Varying β_j is a proxy for these changes. Unlike in an infinite horizon model, where β generally does not have a first order impact on the equity premium, varying β_j here influences the equity premium as well as the general level of returns. The reason for this is that when β_j increases, the value of future dividends and nonmarketable income increases relative to the value of first period income. This changes the share of capital in wealth, and increases the importance of second-period income risk. For the parameters we consider, this results in a lower equity premium in levels, but a higher premium relative to the risk-free rate. For instance, increasing β from 0.95^{25} to 0.96^{25}, with 50 percent participation, high dividend volatility, α equal to 5, and η equal to 0.2, moves the equity premium from 2.16 percent to 2.02 percent, and the risk-free rate from 3.51 percent to 3.05 percent. We interpret the increase in the relative premium as a response to the increased exposure to market risk. The reduction in the absolute premium reflects the increased precautionary demand for savings with the increase in risk, which lowers all required rates of return.

Varying η, the share of nonmarketed income accruing to the elderly, similarly affects risk and hence returns. For instance, increasing η from .2 to .3, with β_j equal to 0.95^{25}, and all else as in the case above moves the equity premium from 2.16 percent to 2.49 percent, and the risk-free rate from 3.51 percent to 4.14.

4.2.5 Heterogeneity in idiosyncratic income shocks

An interesting question is whether background income risk (i.e., nonmarketable risk) is different for stockholders and non-stockholders, and whether this difference interacts with the effect of participation changes on asset returns. In Heaton and Lucas (1998) we present evidence that many large stockholders depend more heavily on income from privately held businesses than on labor income. Business income is more volatile and more highly correlated with stock returns than is labor income. Hence, the equity premium is likely to fall more sharply if new entrants who are otherwise similar to stockholders depend predominantly on labor income. As discussed in 3.2, in recent years there has been an increase in participation by middle income households who are likely to be wage-earners. We investigate the potential quantitative impact of this change by assuming a different idiosyncratic income process for a subset of the stockholders and for non-stockholders.[13]

To implement this, we assume that a fixed number of participants have nonmarketed income that is correlated with the dividend flow from stocks. New entrants to the stock market and non-participants have a less correlated income process. More precisely, we assume that 25 percent of the population receive idiosyncratic income when old with a standard deviation of 67.5 percent and a correlation with dividends share in aggregate income of 0.2. This group is always assumed to hold stocks.[14] The balance of the population receives idiosyncratic shocks that have a standard deviation of 45 percent as before, and a correlation with dividends of -0.1. This negative correlation is necessary to produce an average correlation that is consistent with data. In annual data, one does in fact see a slight negative correlation between labor income and stock returns.

Table 9 reports results under these assumptions for the "high dividend volatility case" (panel A), the "correlated high dividend volatility case" (panel B), and the "skewed dividend case" (panel C). In each case, the experiment is to move from a situation in which 50 percent of the stockholding population is exposed to high background risk, to one in which 25 percent of the stockholding population has this exposure. Changes in participation now have only slightly more impact than in table 8 for the "high dividend volatility case". The impact of a change in participation is slightly smaller in the "skewed dividend case." The effect of an

[13]Ideally we would make participation endogenous and hence a function of the assumed income process as in Polkovnichenko (1998). This tends reduce the risk-sharing capacity of new entrants, since the most risk-tolerant agents already hold stocks when entry is endogenous. For simplicity, and to put an upper bound on this effect, we assume that participation is completely exogenous.

[14]These parameter assumptions are consistent with the estimates reported by Heaton and Lucas (1998).

increase in participation on the premium relative to the risk-free rate is higher in each case, however, because of the greater volatility of the nonmarketed income of stockholders. As in table 8 the greatest impact of participation is in the skewed dividend case, where the equity premium falls by 1.71 percent when participation increases from 50 percent to 100 percent.

4.2.6 Simultaneous changes

As discussed in the introduction, each of the factors that we have looked at individually has been suggested as a fundamental reason for the stock price run-up. We have seen that none of these factors alone is sufficient to produce a large change in required equity returns, and hence the large run-up in stock prices. Here we examine the best case for the model, simultaneously changing a number of parameters. The stylized historical past is characterized by a β of 0.95^{25}, dividends as described in the "skewed dividend case", and a participation rate of 50 percent. Income processes are heterogeneous as described in the previous subsection, so that 50 percent of stockholders have highly volatile income that is correlated with dividends. Risk aversion α is fixed at 5 and η is fixed at 0.2. The stylized present is described by a β of 0.96^{25}, reflecting an upward revision of expected life expectancy, low volatility dividends as in Table 6 reflecting a considerable increase in diversification, and a participation rate of 80 percent. All else is as in the past. This results in a risk-free rate that rises from 0.17 percent to 3.73 percent, and an expected return on stocks that decreases from 6.82 percent to 4.84 percent. The equity premium is substantially reduced from 6.65 to 1.11 percent. We conclude then, that assuming reasonable changes in a number of variables simultaneously can account for changes in expected returns in keeping with what appears to be the case in the U.S. economy.

5 Conclusions

In this paper, we have looked at a number of potential fundamentals-based explanations for the recent stock price run-up. In particular, we focussed on whether changes in market participation patterns or changes in portfolio diversification are likely to account for a substantial fraction of the rise in stock prices. We conclude that the changes in participation that have occurred over this decade are unlikely to be a major part of the explanation. This conclusion is based both on the data, which suggest only small changes in participation for wealthy households, and the model, which implies that participation changes have to be quite extreme to substantially affect expected returns. Increased portfolio diversification, however, is likely to have had a larger effect. There is empirical evidence that households have significantly diversified their portfolios, selling individual stocks and buying mutual funds. An important difference between poorly diversified portfolios and a market index is the likelihood of catastrophic outcomes. When this is reflected in model parameters, the expected equity premium falls by more than 4 percent.

More generally, we can construct scenarios that are loosely consistent with the data in which the required return on stocks falls by 2 percent. As shown in section 3.1 using a calibrated Gordon growth model, this amount of change in expected returns goes at least half way towards justifying the current high level of the price dividend ratio in the U.S. market. We interpret this as quite a positive result, especially because it is difficult to produce much variation in the predicted equity premium in this class of models. The model also predicts an increase in the real risk-free rate, which also appears to be consistent with the data.

These results depend in an important way on changes in diversification and, to a lesser extent, on income heterogeneity. There is evidence that entrepreneurs and managers tend to be large stockholders who bear a sizeable amount of undiversifiable risk in the form of their own businesses. Still, we do not have a complete picture of the income and wealth characteristics of large stockholders, and we are uncertain about the extent of their diversification. We also do not have a satisfactory understanding of how older stockholders, who own a substantial fraction of the market, view the risk of stock ownership. Looking even more closely at the characteristics of large stockholders remains a useful direction for future research.

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Table 1: Regression of one-year stock returns on lagged P/D over the period 1871 to 1998

$$\log(R^s_{t+1}) = \alpha + \beta \log(P_t/D_t) + \epsilon_t$$

Coefficient	Estimate	Standard Error[a]
α	0.28	0.02
β	-0.07	0.05

[a]Corrected for conditional heteroskedasticity and autocorrelation using the procedure of Newey and West (1997) and two years of lags.

Table 2: Average response by age and survey year to questions to about risk aversion from the SCF. Implied population standard deviations in parentheses.

Year	Age		
	< 35	35 to 65	> 65
1989	3.14 (0.88)	3.32 (0.77)	3.63 (0.61)
1992	3.19 (0.84)	3.26 (0.81)	3.64 (0.60)
1995	3.07 (0.87)	3.18 (0.82)	3.58 (0.68)

Table 3: Growth Rates Implied by the Gordon Growth Model

r^s	Long-Run g to Match Historical P/E	Long Run g to Match 1998 P/E	Ten-Year g to Match 1998 P/E with 2% Tail
0.05	0.014	0.029	0.064
0.07	0.034	0.049	0.134
0.09	0.054	0.069	0.189
0.11	0.074	0.089	0.236
0.13	0.094	0.109	0.280
0.15	0.114	0.129	0.320

Table 4: Net Purchases of Stocks by Individuals. (Billions of Dollars)

Year	Net Purchases	Purchases through mutual funds	Purchases outside mutual funds
1995	-116.1	91.3	-207.4
1996	-101.9	218.4	-320.3
1997	-179.0	190.2	-369.2

Table 5: Proportion of Population that Holds Stock by Wealth Cohort

	A. 1989						
Percentile Range	$< 25\%$	26%-50%	51%-75%	76%-90%	91%-95%	96%-99%	$> 99\%$
Range in \$	< 801	801 to 40,051	40,052 to 121,500	121,501 to 279,001	279,001 to 456,000	456,001 to 1,767,730	$> 1,767,730$
	2.3%	13.0%	21.6%	36.7%	55.4%	65.8%	84.3%
	B. 1995						
Percentile Range	$< 25\%$	26%-50%	51%-75%	76%-90%	91%-95%	96%-99%	$> 99\%$
Range in \$	$< 1,101$	1,102 to 40,500	40,501 to 126,251	126,252 to 309,501	309,502 to 574,000	574,001 to 1,814,330	$> 1,814,331$
	4.7%	17.8%	28.7%	47.8%	62.8%	78.3%	82.0%

Table 6: Average Annual Returns as a Function of Participation.

Percent Stockholders	$E(r^b)$	$E(r^s)$	$E(r^s - r^b)$
100%	4.42%	5.47%	1.05%
90%	4.40%	5.48%	1.08%
80%	4.38%	5.49%	1.11%
70%	4.37%	5.50%	1.13%
60%	4.35%	5.51%	1.16%
50%	4.33%	5.52%	1.19%
40%	4.32%	5.53%	1.21%
30%	4.32%	5.55%	1.23%

Table 7: The Effect of Diversification on Portfolio Volatility

number stocks	monthly std. dev.	annual std. dev.
1	16.0%	55.4%
2	11.7%	40.4%
3	9.8%	33.9%
4	8.7%	30.2%
5	8.0%	27.7%
10	6.3%	21.9%
20	5.3%	18.3%
100	4.3%	14.9%
500	4.1%	14.1%

Table 8: Average Returns as a Function of Participation and the Dividend Process.

Percent Stockholders	$E(r^b)$	$E(r^s)$	$E(r^s - r^b)$
A. Low Dividend Volatility Case			
100%	4.42%	5.47%	1.05%
50%	4.33%	5.52%	1.19%
B. High Dividend Volatility Case			
100%	3.81%	5.57%	1.76%
50%	3.51%	5.67%	2.16%
C. Correlated High Dividend Volatility Case			
100%	3.38%	5.87%	2.49%
50%	3.36%	5.95%	2.59%
D. Skewed Dividend Case			
100%	1.54%	6.17%	4.63%
50%	0.47%	6.93%	6.46%

Table 9: Average Returns as a Function of Participation and the Dividend Process. Heterogeneous Income Risk.

Percent Stockholders	$E(r^b)$	$E(r^s)$	$E(r^s - r^b)$
	A. High Dividend Volatility Case		
100%	3.74%	5.49%	1.75%
50%	3.42%	5.58%	2.16%
	B. Correlated High Dividend Volatility Case		
100%	3.32%	5.79%	2.47%
50%	3.28%	5.85%	2.57%
	C. Skewed Dividend Case		
100%	1.18%	6.12%	4.94%
50%	0.17%	6.82%	6.65%

Figure 1: Price-Dividend Ratio and Price-Earnings Ratio, 1871-1998

__ Price-Dividend Ratio, _._._. Price-Earnings Ratio

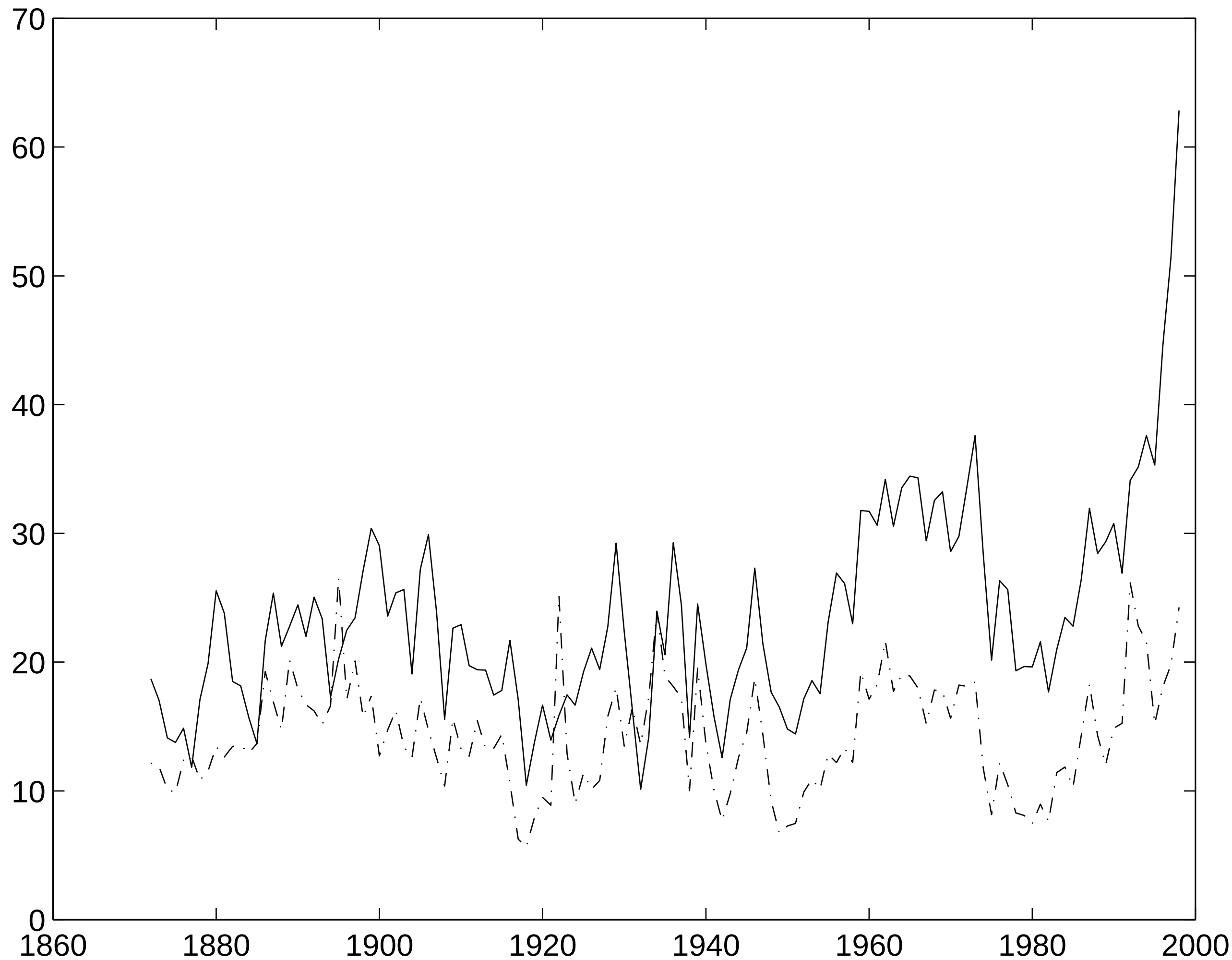

Figure 2: Percentage of Stock Held by Income Percentile

O: 1995, X: 1989

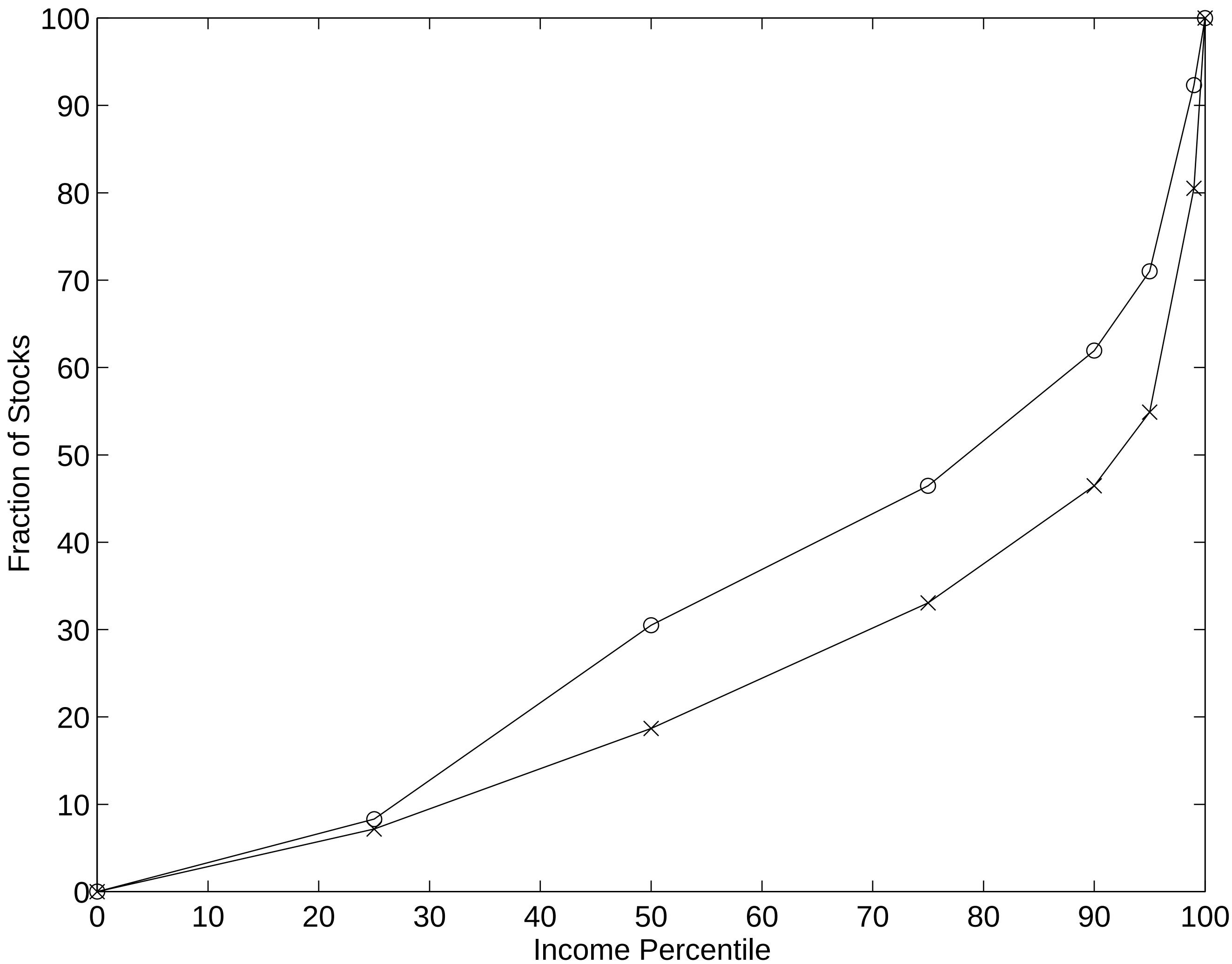

Figure 3: Percentage of Stock Held by Wealth Percentile

O: 1995, X: 1989

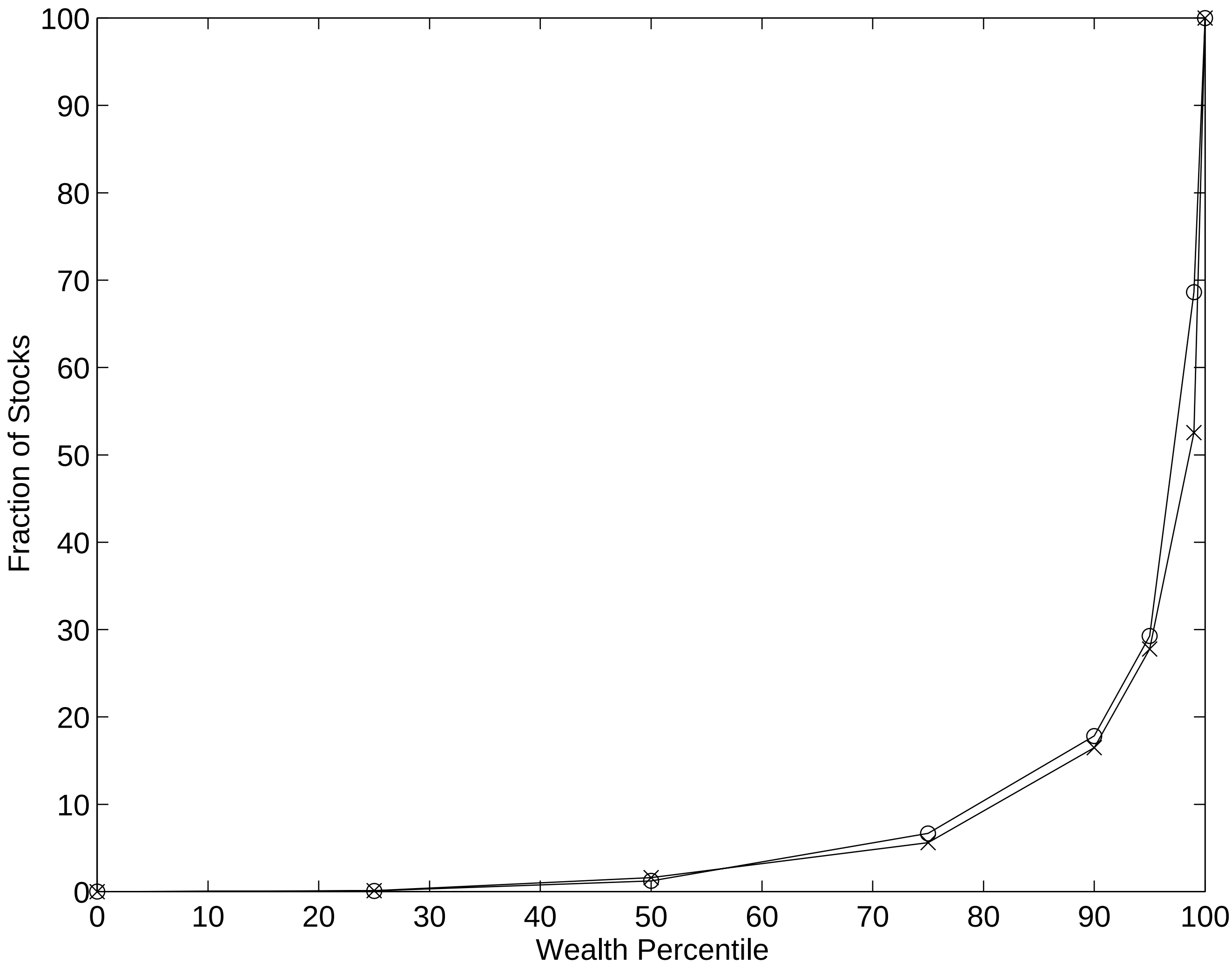

Figure 4: Foreign Net Investment and Returns