The effect of the run-up in the stock market on labor supply

Ing-Haw Cheng and Eric French

Introduction and summary

There are many anecdotes of people who quit their job after having their stock market wealth increase dramatically. This article assesses whether these anecdotes represent isolated incidents or whether the stock market has significantly affected U.S. labor supply. There are two main reasons why this is an important question. First, quantifying the effects of stock market fluctuations may help forecast future variation in labor force growth, employment, and unemployment. If the stock market suddenly dropped, it is possible that many people would rapidly reenter the labor market in order to rebuild enough wealth to finance their retirement. This would cause the number of potential workers in the economy to increase. If the number of new jobs grew more slowly than the number of new workers, short-term unemployment problems would result. This would exacerbate the potential unemployment problems caused by more conservative hiring practices of employers after a market downturn.

Second, we are interested in evaluating the extent to which the consumption response to variations in stock prices is consistent with economic theory. Current estimates of the marginal propensity to consume out of stock wealth, that is, the "wealth effect" often described in the popular press, range from .01 to .05. This means that each additional dollar in stock wealth increases consumption one to five cents annually. The estimate more consistent with simple economic models that posit that people eventually consume their wealth (see Poterba, 2000) is .05. If a dollar increase in stock wealth results in only a one cent increase in consumption, then 99 cents would be saved until next year. Assuming the 99 cents earns a 3 percent post-tax rate of interest, it would grow to approximately $1.02 next year. Therefore, people would not eventually consume all of their wealth, contrary to the simple economic models. If the post-tax interest rate is 3 percent, people must have a marginal propensity to consume of at least .03. Poterba (2000) suggests .04 as a reasonable lower bound.

However, these simple economic models assume that labor supply does not respond to variations in wealth. If much of the stock market wealth goes toward affording people increased leisure in addition to increased consumption of market goods, then the .01 estimate for the marginal propensity to consume market goods may be consistent with economic models that account for the effect of wealth on labor supply. People would eventually "consume" all of their wealth, but mostly in the form of increased leisure. If individuals consume three cents worth of leisure in the form of reduced earnings (that is, their earnings drop by three cents each year) in addition to a one cent increase in consumption of market goods in response to a $1 increase in wealth, then total consumption would be four cents in response to a $1 increase in wealth. This story is perfectly consistent with the theory that individuals eventually consume all their wealth.

In this article, we present estimates of the size of the increase in wealth in the U.S. economy from 1994 to 1999. Recent stock returns are high by historical standards. We also show that growth rates in stock prices are difficult to predict. Therefore, most of the recent increase in wealth caused by rising stock prices represents an unanticipated increase to national wealth. We estimate that every dollar held in stocks on December 31, 1994, resulted in $1.12 in unanticipated wealth shocks if those stocks were held until December 31, 1999. We estimate that the unanticipated component

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of the increase in national wealth from 1994 to 1999 was $5.8 trillion in 1999 dollars.

In order to understand how many people may have been affected by the run-up in the stock market, we examine the distribution of stock market wealth in the economy. The more concentrated the distribution, the fewer people whose labor supply will be directly affected by stock market variations. Using data on the distribution of stock market wealth and on stock returns, we estimate the distribution of unanticipated increases in wealth for different groups of the population. We show that about 15 percent of all individuals aged 55 and over had an unanticipated wealth increase of $50,000 in 1999 dollars or more between December 31, 1994, and December 31, 1999.

Next, we show changes in labor force participation rates for different age groups in different years. Holding all else equal, we would expect groups with large unanticipated increases in wealth to reduce their labor force participation rates. As it turns out, this is not the case. Individuals aged 55 and above have the highest levels of stock wealth (both directly and through pensions) and, thus, have had the greatest unanticipated increases in wealth. However, labor force participation rates for individuals aged 55 and older have increased over the last five years.

In our view, one should not take these counterintuitive results as evidence against the theory that the run-up in stock market wealth has decreased labor force participation rates. Instead, we believe these results imply that the run-up in the stock market has not been the primary determinant of recent changes in labor force participation rates. There are many other reasons that labor force participation rates should be rising for older workers. For example, the strong economy has resulted in increased wages and improved employment opportunities for older workers. Importantly, too, the Social Security System has reduced the work disincentives for those eligible for Social Security benefits.

In order to understand how increases in stock market wealth affect aggregate labor supply, we use two basic approaches. First, we use estimates from two previous studies to predict the change in labor supply for a given unexpected change in wealth. Imbens et al. (1999) estimate the effect on labor supply of winning a lottery, which presumably represents an unanticipated change in wealth. Again assuming that the wealth increase is unanticipated, Holtz-Eakin et al. (1993) estimate the labor supply effect of receiving an inheritance. Both papers suggest that unanticipated increases in wealth reduce work hours and labor force participation rates. Using these estimates and the distribution of wealth, we predict the likely decline in work hours caused by the run-up in the stock market. Our estimates suggest that in the absence of the run-up in the stock market (but holding all else equal), labor force participation rates today would be .78 percentage points higher for men aged 55–64, 1.94 percentage points higher for women aged 55–64, and 1.16 percentage points higher on aggregate.

Our second approach to predicting the effect of the run-up in the stock market on labor supply is to simulate the effect using a dynamic structural model described in French (2000). French estimates the model using data on life cycle profiles for assets, hours worked, and labor force participation rates. Simulations from the model closely mimic the life cycle profiles in the data. Therefore, the model is also potentially able to closely mimic the behavioral effects of the run-up in the stock market. Our simulations imply that in the absence of a run-up in the stock market, labor force participation rates would have been 1.3 percentage points higher for men aged 65 and above and 3.2 percentage points higher for men aged 55–64. In other words, the simulation model predicts much larger behavioral responses than the estimates from other studies. We discuss why the simulation model may overestimate the behavioral responses and the estimates from other studies may underestimate the behavioral responses later in the article. Overall, our view is that the predictions from the lottery and inheritance studies form a lower bound on the effect of the stock market on labor supply and the simulation model forms an upper bound.

Lastly, we present estimates of the marginal propensity to consume leisure (also known as the marginal propensity to earn out of wealth). Recall that an estimate of the marginal propensity to consume market goods of .01 is consistent with the life cycle model only if the marginal propensity to consume leisure is at least .03. The estimates from the direct lottery and inheritance studies are in the range of .01. In other words, for every $1 increase in wealth, aggregate earnings decline one cent. The simulation model predicts a larger marginal propensity to consume leisure—about .02. In either case, the marginal propensity to consume leisure is too small to reconcile a marginal propensity to consume consumption goods of .01 with a life cycle model. Therefore, either the life cycle models are wrong or the .01 estimate of the marginal propensity to consume market goods is wrong.

Increase in national wealth in the 1990s

We provide evidence that the increase in wealth caused by the run-up in stocks was largely unanticipated and estimate the unanticipated wealth shock.

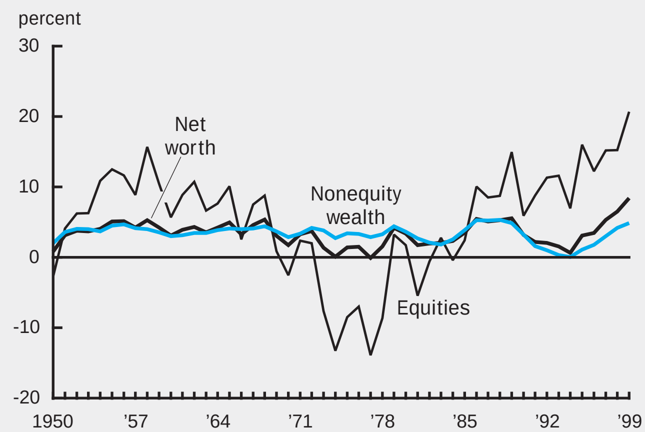
The issue of whether the increase in the level of wealth was anticipated is important. If people knew in December 1994 that five years in the future they would have higher levels of wealth, then it is possible that they would have reduced the number of hours worked in 1995–99, knowing that they would be able to finance their low levels of work because of the anticipated run-up in the stock market.[1] Therefore, we would not expect to see any correlation between stock market gains and labor supply.[2]

Figure 1 shows the growth in household net worth in the economy from 1945 to 1999. While household wealth not in equities rose at a moderate rate of 27 percent over the decade, the market value of equities increased 260 percent between December 31, 1989, and December 31, 1999. The value of equities rose by almost $9.5 trillion during the 1990s, comprising about 64 percent of the growth in wealth. Figure 1 also shows that changes in household wealth in this period are largely explained by changes in the value of equities. Figure 2 shows growth rates in the value of equities, based on Federal Reserve Board data, and growth rates in the stock market, as measured by the Center for Research in Security Prices (CRSP). The appendix describes the CRSP measure in greater detail. The two measures are almost perfectly correlated (with differences relating to treatment of dividends and American stockholdings overseas.)

Figure 3 shows rates of return in the stock market over five-year horizons, with the latest being the rate of return between December 31, 1994 and December 31, 1999. Figure 3 also shows the results from a simple forecasting model (described in box 1), which uses information on five-year Treasury bond yields and stock returns from 1950 to 1999 to predict stock returns. We compute the difference between five-year total stock returns and total returns on five-year Treasury bonds, that is, the “excess” return on the stock market. Between 1950 and 1999, the excess return was 45 percent over five years. The forecast of the five-year return in the stock market is the sum of the excess return (which is assumed constant) plus the five-year Treasury bond return. The predicted five-year return has increased over time because interest rates have increased.

FIGURE 1

Five-year average growth rate of household wealth
(1999 billions of dollars)

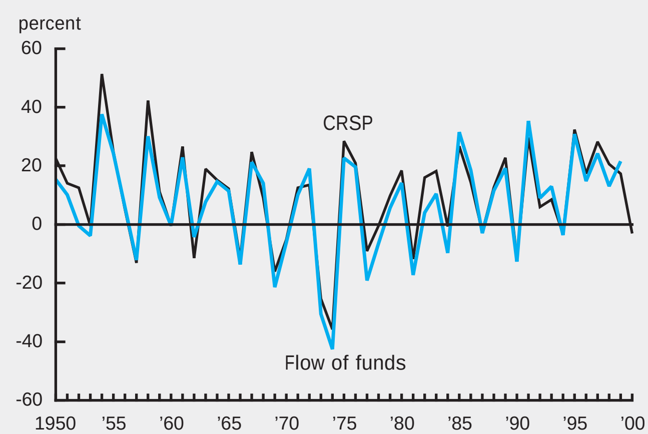


Source: Data from Board of Governors of the Federal Reserve System, *Flow of Funds Accounts*, 1946–99.

Figure 3 shows there have been very large differences between the predicted return and the five-year realized return. Over the past five years, the average annual rate of return in excess of the Treasury bond rate has been 16.4 percent. The five-year excess return was 93 percent. This is well above the historical average of a 45 percent excess return over five years. It has not been since the 1950s that there has been such a large, sustained increase in the stock market. Moreover, because stocks represented about twice as large of a share of national wealth in 1994 than in 1950, the growth in national wealth was greater in

FIGURE 2

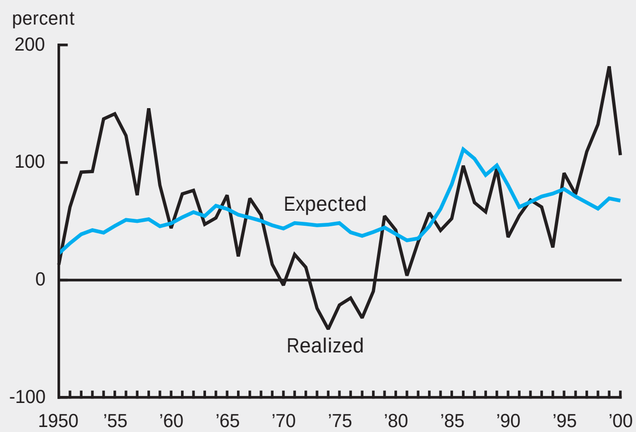
One-year return in the stock market



Sources: Board of Governors of the Federal Reserve System, *Flow of Funds Accounts*, 1950–99, and Center for Research in Security Prices, 1950–2000.

FIGURE 3

Five-year total return in the stock market



Note: In 1999 dollars.
Sources: Center for Research in Security Prices, 1946–2000, and Treasury bond data, 1946–2000.

the late 1990s than in the 1950s. Figure 3 shows that $1 invested in December 31, 1994, would have reached $2.82 in December 31, 1999, compared with a predicted level, based on the historical average, of $1.70. This means that every $1 invested in December 31, 1994, resulted in a windfall gain of $1.12 by December 31, 1999. Because stock market wealth constituted just over 15 percent of aggregate wealth in 1994, the run-up in stock market wealth resulted in national wealth being 17 percent greater in 1999 than it would have been if returns had been as expected. The run-up in the stock market represents a $5.8 trillion shock to national wealth.

It seems unlikely that people anticipated the high rates of return during the late 1990s. For one thing, why did many people not invest in stocks at all? Rates of return on risk-free assets declined in the late 1990s. If stocks were a sure bet, nobody would ever prefer bonds to stocks.

Another way of looking at the problem is to ask whether any historical relationships would predict high stock returns in the late 1990s. We investigate two relationships, described in detail in box 1. First, people might believe that if returns were high in the recent past they would continue to be high in the future. We find that since 1950 high returns over the previous four years and the previous ten years have indicated high returns in the near future. However, as figure 3 shows, the 1980s and early 1990s were not remarkably good years for the stock market. The second historical relationship we investigate is that between price/dividend ratios and stock returns. When price/dividend ratios are high, stocks are possibly overpriced and should perform poorly in the near future. We do see this pattern in stock market data from 1950 onwards. However, in 1994 price/dividend ratios were already high. Therefore, the statistical evidence indicated that stocks would perform poorly in 1995–99. If people were making forecasts according to this simple statistical model, every dollar in the stock market on December 31, 1994, would have led to a $1.46 unexpected gain in wealth by December 31, 1999. Therefore, assuming a constant excess return of stocks over bonds leads to a conservative estimate of the unexpected shock to the stock market.

Unexpected wealth changes in the population

Given a U.S. population of just under 300 million and an aggregate wealth shock of about $5.8 trillion, the run-up in the stock market from 1994 to 1999 represents an unanticipated increase in wealth of $20,000 per person. This is roughly enough to finance one year out of the labor market with no change in consumption of market goods for every individual in the U.S. However, because wealth in stocks is highly concentrated among the wealthy, we would expect the effect on labor supply to be smaller than it would be if stock market wealth were evenly distributed. Our information on the distribution of stock market wealth comes from two sources—data on non-pension stock market wealth from the *Panel Study of Income Dynamics* (PSID) and pension wealth data from other studies that used data from the Health and Retirement Survey (HRS).

The PSID is a nationally representative dataset that includes demographic information, the value of non-pension wealth held by individuals, and breakdowns of wealth into various components, including stock wealth. The stock market wealth measure includes the value of stocks in mutual funds, IRAs, and Keogh plans, in addition to directly held stocks. Juster et al. (1999) show that respondents in the PSID report over 85 percent of their stock market wealth and over 75 percent of total wealth.[3] They also find that the distribution of wealth in the PSID is extremely accurate for everyone but the wealthiest 2 percent of the population. To adjust for the slight underreporting of stock market wealth in the PSID, we multiply stock market wealth in the PSID by 1/.85 = 1.18. The PSID does not provide information on who controls the wealth within households. We assume that non-pension

BOX 1

Predicting stock returns

This section shows the method we use to compute the difference between the k-year realized and expected returns. Denote the return over the past year as r_i (for example, r_{1995} is the one-year rate of return from the end of December 31, 1994, through the end of December 31, 1995) and the gross return over a k-year horizon as $R_{t_0 \to t_k}$, where $t_k = t_0 + k$ (for example, if $k = 5$ and $t_0 = 1994$, the five-year return is $R_{1994 \to 1999}$, the return from the end of December 31, 1994, through December 31, 1999). We measure all returns and growth rates in real terms. The k period rate of return is

$$1)\quad R_{t_0 \to t_k} = \prod_{i=1}^{k} (1 + r_{t_0 + i}).$$

We can compare this to the gross k-year expected return, which we forecast as:

$$2)\quad \hat{R}_{t_0 \to t_k} = R^f_{t_0 \to t_k} + excess_{t_0 \to t_k},$$

where

$$3)\quad excess_{t_0 \to t_k} = R_{t_0 \to t_k} - R^f_{t_0 \to t_k} = \alpha + \varepsilon_t,$$

α is the constant excess rate of return, ε_t is a white-noise random variable, and $R^f_{t_0 \to t_k}$ represents the continuously compounded return on a k-year risk-free asset. The rationale for forecasting the excess stock return (that is, stock returns net the risk-free return) is that the k-year total return of a risk-free asset is known in advance at time t_0; for example, we can easily find information regarding yields on five-year Treasury bonds today, and thus compute the associated five-year holding period return (assuming the bond is held until maturity). Thus, the only variables in the forecast at time t_0 of future expected returns is the average excess return over the sample period and the five-year Treasury bond return.

The unexpected windfall for an investor at time t_1, who had M dollars in the stock market at time t_0 is thus simply

$$\Delta \hat{A}_t \equiv M(R_{t_0 \to t_k} - \hat{R}_{t_0 \to t_k}),$$

where $R^f_{t_0 \to t_k}$ is the predicted stock market return given by equations 2 and 3.

Equation 3 is an extremely simple model of forecasting excess stock returns; in fact, the predicted value $\widehat{excess}_{t_0 \to t_1}$ is simply the mean of the risk premium over the entire time span. Other models have been suggested. Cochrane (1997) recommends several possible indicators that track long-horizon market movements relatively well. In particular, he suggests that the price/dividend (P/D) ratio is a good indicator of long-horizon market movements. When P/D ratios are high, stocks are overpriced and, thus, stock prices should grow slowly.

The regression

$$4)\quad excess_{t_0 \to t_k} = R_{t_0 \to t_k} - R^f_{t_0 \to t_k} = \alpha + \beta \frac{P_{t_0}}{D_{t_0}} + \varepsilon_t$$

using excess returns over k = five-year horizons of the CRSP NYSE value-weighted portfolio from the end of 1954 to the end of 1996 (that is, using stock market information from the start of 1950 to the end of 1996) and five-year Treasury yields (see the appendix for more information) gives a point estimate of $\beta = -5.30$ with an R^2 of 0.54. Using these estimates, the predicted excess return for December 31, 1994, to December 31, 1999, is –27 percent. This is an implausible prediction given that if people expected stock returns to be lower than bond returns, nobody would invest in stocks. However, extending the regression to include 1997–99 as in-sample years cuts the point estimate to –2.79. Using these estimates, the predicted excess return for December 31, 1994, to December 31, 1999, was 12 percent. If anything, these estimates indicate that our model would actually underestimate the unexpected wealth shock during 1994–99, since our model simply predicts the market to return the mean historical excess return plus the going return on bonds, whereas more complex models predicted the market would perform poorly. In fact, our estimate for unexpected windfalls 1994–99 using equation 3 is \$1.12 on every dollar, whereas the same estimate using equation 4 and our own data is \$1.46 on every dollar (in 1999 dollars).

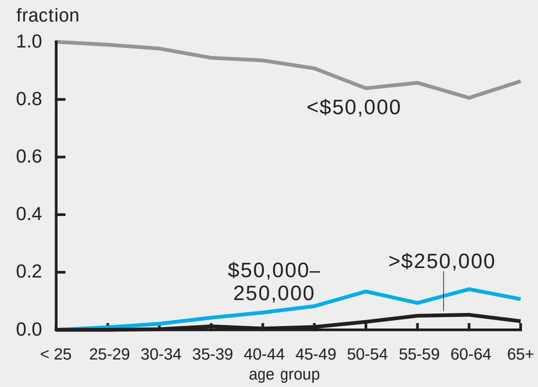
Interestingly, forecasting the following unrestricted version of equation 3 using 1954–99 data,

$$R_{t_0 \to t_k} = \alpha + \beta R^f_{t_0 \to t_k} + \varepsilon_t,$$

yields a point estimate of $\beta = 0.95$ with a standard error of 0.40 (not including adjustments for heteroskedasticity and serial correlation), so one cannot statistically reject our model where we assume $\beta = 1$.

FIGURE 4

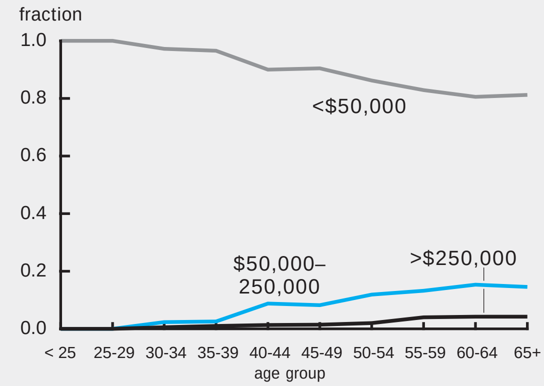
Fraction of women in stock value groups



Sources: PSID data, 1994, and authors' calculations.

FIGURE 5

Fraction of men in stock value groups



Sources: PSID data, 1994, and authors' calculations.

household wealth is split evenly among spouses, with each receiving 50 percent. Browning et al. (1994) show that consumption between husbands and wives is close to an even split, regardless of the resources brought into a household.[4] We attribute pension wealth to the individual receiving the pension.

Figures 4 and 5 show the distribution of stock market wealth by age of the individual for women and men. The data show two things. First, older individuals have more stock market wealth than younger individuals. The fraction of the population with over $50,000 in stock market wealth is less than 4 percent for households where the head is younger than 54. Second, most individuals have little stock market wealth. Even for households aged 55 and older, less than 13 percent had over $50,000 in the stock market (including stocks, mutual funds, IRAs, and Keogh plans).

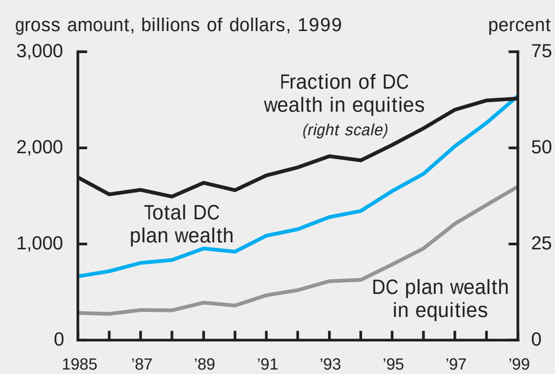
Gustman and Steinmeier (1999) show that pension wealth is very broadly held in the population and constitutes a large portion of overall wealth. Not surprisingly, the run-up in the stock market has led to an increase in pension wealth for many people. Figure 6 shows total national wealth held in defined contribution pension plans. In this type of plan, individuals contribute a portion of their income and the account's value grows by that amount plus the rate of return on the plan's portfolio of assets. Data from the Federal Reserve Board's *Flow of Funds* shows that by 1999 about 12 percent of all U.S. wealth in equities was held by defined contribution pension plans and that the amount of stock wealth in defined contribution pension plans rose 182 percent from 1994 to 1999.

The other major type of pension plan, the defined benefit pension plan, provides benefits that are specified by the employer. These benefits do not depend on the rate of return for assets in the pension fund. If there is a run-up in the stock market, the employer gets the windfall. Likewise, in the event of a market crash, the employer must make up the shortfall if pension fund reserves are low. Therefore, changes in the stock market affect the stock price of the firm holding the pension reserves but do not affect the wealth level of employees at the firm.

Gustman and Steinmeier (1999) show that in their HRS sample of older workers, 66 percent of all households are covered by a pension plan. Of the households covered, 48 percent are covered by a defined benefit plan, 21 percent are covered by a defined contribution plan, and 31 percent are covered by some combination of defined benefit and defined contribution plans. Defined contribution pension plans tend to be less generous than defined benefit pension plans and joint

FIGURE 6

Defined contribution pension wealth and equity composition



Source: Board of Governors of the Federal Reserve System, *Flow of Funds Accounts*, 1985–99.

plans. In 1992, average wealth held in defined contribution plans at age 65 was $57,000 in 1999 dollars. In contrast, the amount held in defined benefit plans was $135,000 and the amount held in combined plans was $153,000. We assume that half the wealth in combined plans is in the form of defined benefit wealth and the other half is in defined contribution wealth. This means that 35 percent of all households in the HRS held an average level of wealth in defined contribution plans equal to $69,000 at age 65 in 1994. The other 65 percent held no defined contribution wealth. Given that 40 percent of defined contribution plan pension wealth is in the form of equities, 35 percent of all elderly households would have an average of $28,000 in the stock market by age 65. Since $28,000 invested in the stock market on December 31, 1994, would have resulted in an unanticipated windfall of about $31,000 by December 31, 1999, a large number of elderly households would have received a large unexpected increase in wealth because of their pensions.

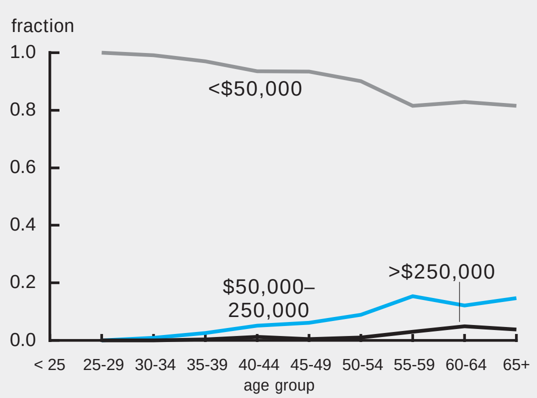
Because the PSID only has data on whether respondents were covered by a pension plan and whether they contributed to that plan in 1989, we assume that those who were contributing to a defined contribution plan in 1989 were also contributing in 1994. If the individual was not contributing in 1989, we assume that person never contributed to a defined contribution pension plan. The fraction of the population covered by a pension does not vary much by age, except for those under 35 who have lower coverage rates. We assume that individuals over 35 who are contributing to a defined contribution plan contribute a fixed amount after age 35. We assume individuals younger than 35 contribute for only one year.

Younger households would also have had windfalls from increases in stock market wealth, although the windfalls would be smaller. To calculate the amount of pension plan wealth at each age, we assume a 2.3 percent real rate of return on pension investments, the same amount of pension contributions each year, that the worker starts working at a firm that provides a defined contribution plan at age 35, and that the level of wealth in the defined contribution plan would be $69,000 at age 65, on average. For example, an individual who contributes $1,550 annually would have an imputed defined contribution wealth of $10,000 at age 40, $28,000 at age 50, and $53,000 at age 60.[5]

Given the distribution of stock market wealth in the economy and the rates of return on stocks computed in the previous section, we compute a measure of unexpected wealth increases for different segments of the population. Recall that $1 invested in December 31, 1994, would have resulted in $1.12 in unanticipated wealth gains by December 31, 1999. Figures 7 and 8 show the distribution of wealth shocks in the economy for women and men. The differences between these figures and figures 4 and 5 are twofold. First, figures 7 and 8 include information on pensions for 1994. Second, figures 7 and 8 do not describe total stock wealth but how stock wealth in 1994 became wealth shocks in 1999. These figures make two points clear. First, there is a sizable minority of individuals who received wealth shocks in excess of $50,000. Second, individuals aged 55 and older received most of the wealth shocks; 21 percent of all individuals aged 55 and older received unanticipated wealth gains in excess of $50,000. Given that most individuals had earnings below $50,000, an unanticipated wealth gain of $50,000 could replace at least one year of earnings for most individuals.

FIGURE 7

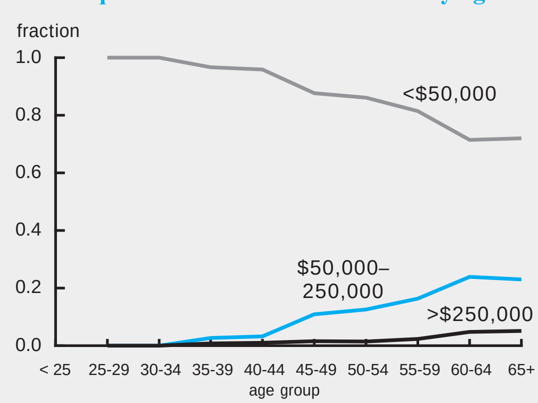
Unexpected wealth shocks for women by age



Sources: PSID data, 1989 and 1994, and authors' calculations.

FIGURE 8

Unexpected wealth shocks for men by age



Sources: PSID data, 1989 and 1994, and authors' calculations.

Changes in labor force participation rates

Estimates of the level of unexpected wealth increases show that a sizable minority of the population had large unexpected increases in wealth. Most of these increases in wealth are concentrated among individuals aged 55 and above in 1999 (or 50 and above in 1994). Therefore, we would expect this group to have the largest declines in labor force participation rates between 1994 and 1999.

Figures 9 and 10 show labor force participation rates between 1980 and 2000. For men aged 55 and above, labor force participation rates have been rising recently, following a steady decline from 1980 to 1993. For women aged 65 and above, labor force participation rates have remained steady since 1994. For women aged 55–64, labor force participation rates have been rising since 1994. These data show that the rise in the stock market has not been the dominant source of changes in labor force participation rates for individuals aged 55 and over. The trends do not support the wealth effect hypothesis.

However, we argue that this should not be taken as evidence that the unanticipated increase in wealth has resulted in no change or an increase in labor force participation rates. Instead, in our view, the data provide evidence that other factors have offset the effects of the increase in the stock market. Among these factors are recent increases in wages in the economy. Moreover, the Social Security System has reduced the work disincentives for individuals 65 and older. Social Security benefit accrual is now closer to actuarially fair for individuals aged 65–70 than it was in 1994.[6] It is not clear what effect the stock market may have had on labor participation rates for individuals aged 55 and above in the absence of other factors.

Next, we look at the likely behavioral responses to the run-up in the stock market, holding all else equal.

Estimates of the effect of unanticipated wealth increases on labor supply

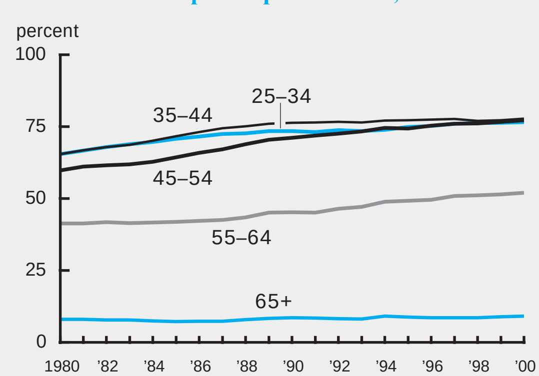
Here, we present estimates of the effect of unanticipated wealth increases on labor supply holding all else equal. Estimating the effect of an unanticipated wealth increase on labor supply is difficult because, usually, changes in wealth are anticipated or are accompanied by wage changes. The labor supply response to an anticipated wealth increase is different from the labor supply response to an unanticipated wealth increase. If the wealth change is anticipated, we expect a small labor supply response after receipt of the wealth. If people know they will receive a large sum of money tomorrow, their labor supply may not change much between today and tomorrow. They may already have reduced their labor supply in anticipation of having the wealth in the near future.

Inheritance and lottery studies

Table 1 presents estimates of the effects of inheritances on labor supply. Inheritances cause plausibly unanticipated changes in wealth. Holtz-Eakin et al. (1993) estimate the effect of receiving an inheritance on labor force participation rates. Using tax records, they observe whether reported earnings are positive (our measure of labor force participation) both before (in 1982) and after (in 1986) the receipt of an inheritance. They find fairly large effects on labor force participation and earnings. Among single households who receive a small inheritance (average of $13,000) in their sample, labor force participation rates increase from 89.9 percent to 91.1 percent (column 4), or an increase of 1.2 percent (column 5). Single households

FIGURE 9

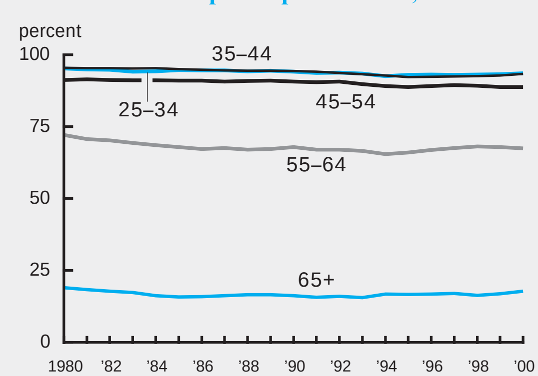
Labor force participation rates, women



Source: CPS data, 1980–2000.

FIGURE 10

Labor force participation rates, men



Source: CPS data, 1980–2000.

who receive a medium-sized inheritance (average of $120,000) show a labor force participation rate decline from 82.7 percent to 80.5 percent, or a decline of 2.2 percent. We interpret these changes in labor force participation rates to mean that in the absence of a medium-sized inheritance, labor force participation rates would have increased 1.2 percent instead of declining 2.2 percent for those who received the medium-sized inheritance. Therefore, labor force participation rates would have been 3.4 percent higher (column 6) had those individuals not received a medium-sized inheritance. Those who receive a large inheritance (average of $609,000) show a labor force participation rate decline of 9.8 percent from 75.4 percent to 65.6 percent. If these people had not received an inheritance, their labor force participation rate would have increased 1.2 percent. Therefore, receiving the inheritance potentially reduces their labor force participation by 11.0 percent. Holtz-Eakin et al. find similar results for married couples. Receiving a medium inheritance reduces average labor force participation rates within the household by 3.8 percent, and a large inheritance reduces labor participation by 4.2 percent.

Most of the individuals who received inheritances were young. Singles who received small inheritances (the youngest group) were aged 33.4, on average, and the mean age of couples who received large inheritances (the oldest group) was 44.7 years. Therefore, the sample in the Holtz-Eakin et al. study is significantly younger than the segment of the general population that has received most of the stock wealth gains. Since it is likely that large wealth gains have larger labor supply effects for those who are nearing retirement than for younger individuals, our view is that the inheritance study most likely understates the labor supply effects from the run-up in the stock market.

Joulfaian and Wilhelm (1994) find slightly smaller but similar effects using data from the PSID. Their results show that the results in Holtz-Eakin et al. are not specific to a particular dataset. Joulfaian and Wilhelm also estimate the effect of inheritances on consumption using PSID data.[7] They find that the marginal propensity to consume all goods out of inheritance wealth is about .0012. This is an order of magnitude smaller than the .01 to .05 marginal propensity to consume out of stock wealth estimated in most studies. This evidence suggests that people may anticipate inheritances and that the inheritance estimates, therefore, may underestimate the effect of unanticipated wealth changes on labor supply.

TABLE 1

Effect of inheritance on labor force participation

	Mean inheritance level	Inheritance difference	Mean pre-inheritance income	Participation rate		Participation change	Inheritance effect	Observations
	(---Dollars---		---)	(---Percent---			---)	
Single								
Small	13,359		20,863	1982	89.9	1.2		730
				1985	91.1			
Medium	119,610	106,251	23,027	1982	82.7	–2.2	–3.4	544
				1985	80.5			
Large	608,858	595,499	19,586	1982	75.4	–9.8	–11.0	358
				1985	65.6			
Married couples								
Small	13,323		60,867	1982	77.0	–0.1		1,078
				1985	76.9			
Medium	125,554	112,231	59,340	1982	73.1	–3.9	–3.8	994
				1985	69.2			
Large	597,037	583,714	66,804	1982	68.8	–4.4	–4.2	628
				1985	64.4			

Notes: Participation rate is the sum of people working divided by two multiplied by the number of households. In 1999 dollars. “Inheritance difference” is the difference between the inheritance level received and a small inheritance level. “Inheritance effect” is the difference between the participation change for a given inheritance level and the participation change for a small inheritance level. Small inheritance level is $0–43,000; medium is $43,000–255,000; and large is $255,000 and above.

Imbens et al. (1999) use data from the state lottery of Massachusetts to estimate the effect of winning the lottery on changes in hours worked and earnings. They use data on individuals who received a prize, ranging in present value from $100 to over $1,000,000.[8] A subsample of winners received a questionnaire about purchases made, labor supply, and earnings several years after they won the prize. Many of the players released their Social Security earnings records. Therefore, one can see the earnings of an individual both before and after winning the prize as measured by earnings reported to the Social Security Administration.

Unfortunately, those who won medium and large prizes included both season ticket holders and those who purchased tickets one at a time, whereas those who won a small prize included only season ticket holders. As a result, individuals who won the small prizes were much older (average age of 53.2) than individuals who won medium-sized (average age of 44.6) or large (average age of 48.5) prizes. This makes the lottery study less than perfect, although Imbens et al. attempt to overcome this problem. Moreover, sample sizes in the study are relatively small. There were a total of 496 respondents in the entire study.

Given these caveats, Imbens et al. (1999) estimate the effect of annual lottery winnings on annual labor income. Lottery winners who won a medium-sized or large prize (that is, more than several thousand dollars) received labor income for 20 years. We compute the present value of the lottery winnings and use their estimate of the effect of annual winnings on labor income to compute the effect of lottery winnings on labor income, a measure of labor force participation. Results from these computations suggest that $1 in lottery winnings reduces labor income by one cent annually. In other words, the marginal propensity to consume leisure out of wealth shocks is about .01.

Imbens et al. also find that the marginal propensity to consume leisure out of wealth shocks is greatest for individuals ages 55–65. For example, they find that for individuals younger than 55, the marginal propensity to consume leisure is .0082, whereas for individuals aged 55–65, the marginal propensity to consume leisure is .0132. This is an important point given that much of the stock market wealth is held by individuals aged 55–65. Imbens et al. also find that the marginal propensity to consume leisure is the same for both men and women. Lastly, they find that the marginal propensity to consume leisure is greater for individuals who won small amounts than for individuals who won large amounts. For example, it is .0091 for individual with almost no winnings and .0076 for individuals with close to $500,000 in winnings. It is these final two numbers that we will use to predict the labor supply response to changes in wealth.

Also somewhat interestingly from this study, the Social Security earnings records show that the labor supply response to winning a lottery is not immediate. It is several years before labor supply fully declines in response to the wealth effect. Therefore, the labor supply response to the run-up in the stock market may not be immediate either. Other studies have also found that the consumption response to changes in the stock market is not immediate (see Dynan and Maki, 2000, for example).

The lottery and inheritance studies are not the only studies of the effect of financial resources on labor supply. Blundell and MaCurdy (1999) survey a wide range of approaches to estimating the effect of income on labor supply. The majority of these studies find that increased non-labor income reduces labor supply. Assuming that income is constant over the life cycle, one can compute the annuity value of a lifetime increase in income. Given the estimates surveyed in Blundell and MaCurdy and the computed annuity value of increases in income, we estimate the change in labor supply given a change in wealth. Measured against the results from most other studies, the estimates in the lottery and inheritance papers are relatively small, although there are enormous differences in estimates from study to study. An average estimate of the effect of the annuity value of income on labor supply from Blundell and MaCurdy is about twice as large as the inheritance and lottery estimates. Therefore, our view is that the results from the inheritance and lottery surveys represent conservative estimates of the true effects of unanticipated wealth gains on labor supply.

Our interpretation of the studies

We expect unanticipated changes in wealth to lead to larger changes in labor supply for low-income workers than for high-income workers. An unanticipated $50,000 wealth change replaces two years of labor income if a worker earns only $25,000 dollars per year. In other words, this worker could retire two years earlier and still consume that same amount at each age as a result of the unanticipated $50,000 wealth change. On the other hand, if the same worker earns $50,000 per year, the $50,000 unanticipated wealth change replaces only one year of earnings.

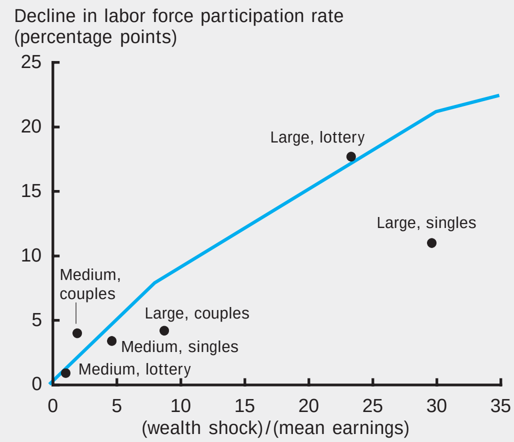
High-wage workers have been receiving most of the wealth gains from the stock market. Mean annual income for all households in the 1994 PSID is $36,500, but mean income is $52,900 in 1994 for households with unanticipated stock wealth gains of $50,000–$250,000 and $94,300 for households with unanticipated stock wealth gains in excess of $250,000. Therefore, $1 in unanticipated wealth gains probably has a smaller effect for individuals with large stock wealth gains than for people who receive an inheritance. We overcome this problem by measuring the labor supply response to wealth divided by income, as described below. This procedure assumes someone with twice the income of another person would need twice the unanticipated wealth gain of the other person to cause the same labor supply response.

Figure 11 uses the information in table 1 and results from the lottery study to plot changes in labor force participation rates against the amount of unanticipated wealth change divided by the mean earnings of people with that unanticipated wealth change. Labor force participation rates and unanticipated wealth shocks are relative to the reference group of small inheritance receivers in the inheritance study. Thus, the points for labor force participation rates are shown in column 6 of table 1 and the points for inheritances are shown in column 2 of table 1. The average pre-inheritance earnings for the different groups are shown in column 3. Therefore, four points in figure 11 are the four values in column 6 plotted against the values in column 2 divided by the values in column 3. We divide inheritances by two for married couples (the husband and wife each get one half), just as we divide household unanticipated wealth shocks by two for married couples in the PSID. The other two points on figure 11 are the two points previously described from the lottery study.

For example, single individuals who receive an average $120,000 inheritance ($106,000 above the reference group of those who receive a small $12,000 inheritance) have $23,000 in income before receipt of the inheritance. Therefore, the value of their unanticipated wealth gain divided by earnings is 4.6. They show a 3.4 percent drop in labor force participation. Couples who receive an average inheritance of $125,000 (or $112,000 above the reference group of couples) have an average of $59,000 in annual earnings. This results in both the husband and wife having $56,000 in inheritance wealth gain and $29,500 each in annual earnings. Therefore, the wealth shock divided by average earnings is (56,000/29,500) = 1.9. Both husbands and wives show an average decline in labor force participation of 3.8 percent.

FIGURE 11

Predicted participation rate response to wealth shocks



Note: "Medium, singles" refers to singles who received a medium inheritance; "large, singles" refers to singles who received a large inheritance; "medium, couples" refers to couples who received a medium inheritance; "large, couples" refers to couples who received a large inheritance; "medium, lottery" refers to winners of a medium-sized lottery prize; "large, lottery" refers to winners of a large lottery prize.
Source: Holtz-Eakin et al. (1993) and Imbens et al. (1999).

To use the stock market wealth gain information to predict the effect of the stock market run-up on labor force participation rates, we need a functional form for the effect of unanticipated wealth gains on labor force participation. Because we have only six data points to fit and some of the data points seem more reliable than others, we use no formal criteria to measure the functional form for how stock market gains affect labor force participation. Instead, we fit the data free-hand to an assumed functional form. We follow three guidelines. First, the functional form is "close to" the individual points in figure 11. Second, we believe that the incremental (or marginal) effect of increasing stock wealth gains on labor force participation is smaller for very high levels of stock wealth gains than for low stock wealth gains. The millionth dollar increase in stock market gains will most likely have a smaller effect on the probability that one drops out of the labor force than one's first dollar of gains. Finally, an unanticipated wealth shock that is close to zero should have a labor supply response that is close to zero. Our assumed functional form for the effect of an unanticipated wealth shock on the labor force participation rate is

$$5)\quad E\left[\Delta LFPR_{it} \,\middle|\, \left(\frac{\Delta \hat{A}_{it}}{\bar{E}_j}\right)\right] = \beta\left(\frac{\Delta \hat{A}_{it}}{\bar{E}_j}\right),$$

where

$$6)\quad \beta\left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right)=\begin{cases} .010\times\left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right) & \text{if } \left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right)<8 \\ .032+.006\times\left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right) & \text{if } 8\le\left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right)<30 \\ .152+.002\times\left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right) & \text{if } \left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right)\ge 30, \end{cases}$$

where $E[\Delta LFPR_{it} \mid \left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right)]$ is the expected change in labor force participation rates given a change in $\left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right)$ and $\Delta\hat{A}_{it}$ is the unexpected wealth shock of individual i at time t. Also, $\bar{E}_j$ is mean earnings for individuals in an unexpected wealth shock cell (for example, men with over $250,000 of unexpected wealth gains) in 1994. The functional form for equation 5 is plotted on figure 11.

Recall from the introduction that understanding the marginal propensity to consume leisure is of central importance to understanding the marginal propensity to consume goods. Also recall that the life cycle model predicts that the marginal propensity to consume leisure plus the marginal propensity to consume market goods should add up to at least .04. Our interest is in whether the marginal propensity to consume leisure is a large fraction of that .04 number. An attractive feature of the specification in equation 5 is that the marginal propensity to consume leisure through the labor force participation decision is parameterized. For example, equation 6 shows that if

$$\left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right)<8, E[\Delta LFPR_{it} \mid (\frac{\Delta\hat{A}_{it}}{\bar{E}_j})]=.010\times\left(\frac{\Delta\hat{A}_{it}}{\bar{E}_j}\right).$$

Note that this means that the average change in labor income for individuals in wealth cell j is

$$E[\Delta LFPR_{it} \mid (\frac{\Delta\hat{A}_{it}}{\bar{E}_j})]\times E_j=.010\times(\Delta\hat{A}_{it}),$$

or a marginal propensity to consume leisure of .01. In other words, for every unexpected $1 gain in wealth, earnings decline by one cent. This number is below the estimates of a one- to five-cent increase in consumption that most studies have found for the effect of stock market values on consumption. Therefore, the dominant behavioral response to increases in stock market wealth is in the form of increased consumption of goods, not in reduced labor force participation that leads to reduced earnings. Because the earnings response to changes in stock market wealth is small, life cycle models that ignore the effect of wealth on labor supply are not severely biased.

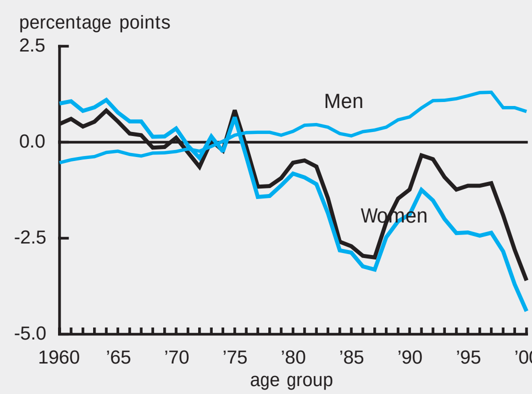
Predicted changes in labor participation due to stock market

Given the assumed labor supply function and the distribution of wealth shocks in the economy, we predict the aggregate labor supply response to the increase in stock wealth. Figure 12 shows that the predicted decline in labor force participation rates is about 1 percent for most groups, but that these estimates vary by group. For men aged 25–34, the predicted decline in labor force participation rates is .05 percent. Because older men have greater stock wealth than younger men, the predicted decline in labor force participation rates is greater for older men—.9 percent for men 55 and older.

We find larger predicted labor supply effects from the stock market for women. Women have lower earnings than men, but we assume women in married households have 50 percent of household wealth. Therefore, a $1 increase in wealth for a woman replaces a larger share of her lifetime resources than a $1 increase in wealth for a man. While this result depends critically upon the assumption of a 50/50 split of wealth for married households, most studies of income effects show larger income effects for women than for men, so we believe the results presented here are reasonable. The predicted labor supply response of women aged 25–34 to the increase in stock market wealth is a .17 percent decline in labor participation. The predicted

FIGURE 12

Change in labor force participation induced by wealth effect



Sources: Authors' calculations and PSID data.

decline becomes greater with age. For women aged 55 and over, the predicted response is a 2 percent decline in labor force participation rates.

Simulations of effect of unexpected wealth changes

Next, we describe an alternative approach to predicting the labor supply response to unanticipated changes in wealth. These results are from a dynamic model described in French (2000), which aims to accurately model the incentives individuals face over their life times. In this model, we characterize the preferences of people in the economy for consumption versus leisure, and we model how consumption and labor supply decisions by people of various ages are affected by changes in wages, wealth, taxes, and the structure of Social Security benefits. Individuals within the model choose consumption, work hours (including the labor force participation decision), and whether to apply for Social Security benefits. They are allowed to save, although assets must be non-negative. Therefore, they trade off the value of consumption in the present against the value of consumption in the future. Their annual income depends on asset income, labor income, and Social Security benefits. Individuals face federal and state income taxes as well as payroll taxes. When making these decisions, they are faced with several forms of uncertainty: survival uncertainty, health uncertainty, and wage uncertainty. The most interesting aspect of the model is the detailed modeling of the Social Security incentives to exit the labor market. Individuals who are younger than age 62 are ineligible for Social Security benefits. Once eligible for Social Security benefits, the individual faces a tradeoff of the value of receiving benefits in the present versus deferring them and receiving greater annual benefits in the future. Once the individual is drawing Social Security benefits, he or she faces the Social Security earnings test, which is a large tax on labor income above a certain threshold level.

There are seven preference parameters within the model. One parameter describes an individual's willingness to trade consumption in the present for consumption in the future. Another parameter describes an individual's willingness to trade goods for leisure. These preference parameters are estimated using data from the PSID. Given that individuals in the model face the same incentives as individuals in the data, they should behave just like individuals in the data at the true preference parameters. At the estimated parameters, the decisions of individuals in the model are very similar to those of individuals in the data. Therefore, we believe that the estimated parameters are "close to" the true preference parameters and that the model accurately describes how people behave. Consequently, we believe we can usefully apply the model to understand how the run-up in the stock market affects labor supply. We discuss the estimation of preference parameters in box 2.

Our simulated life cycle profiles for hours, labor force participation rates, and assets match the data very well. Simulated labor force participation rates begin to decline around age 55 and decline very rapidly at the exact ages of 62 and 65, when there are the strongest Social Security incentives to exit the labor market. Given that the model fits the data very well within sample, it potentially predicts well. Further details are in French (2000).

The model is useful in that it overcomes the previous problems in the lottery and inheritance studies. Most importantly, predictions from the lottery and inheritance studies assume that two individuals of different ages should have the same labor supply response to a $50,000 wealth shock given the same income. However, our expectation is that $50,000 in wealth at age 60 would generate a larger labor supply response than $50,000 at age 30. The 30-year-old will most likely save the money toward an early retirement, whereas the 60-year-old may use the money

BOX 2

Method of simulated moments

The method of estimating preference parameters in the simulation model is called the Method of Simulated Moments. It can be described as follows. First, we estimate life cycle profiles for assets, hours worked, and labor force participation rates using *Panel Study of Income Dynamics* (PSID) data. Second, we estimate individual histories of health and wage shocks using PSID data. Third, we solve the model backwards, obtaining optimal decisions for consumption, work hours, and whether to apply for Social Security benefits for each possible level of assets, wages, health status, and potential Social Security benefits. Fourth, we simulate individual life cycle profiles for assets, hours worked, and labor force participation rates using the individual histories of health and wage shocks and the decision rules from the structural model. Finally, we aggregate the simulated profiles and the data profiles by age and compare them. Preference parameters that create simulated profiles that *look like* the profiles from the data are considered the true preference parameters. Details are in French (2000).

immediately to retire early. The lottery and inheritance studies do not address this problem.

This model also overcomes the question of whether the wealth changes in the inheritance studies are anticipated. If inheritances are anticipated, estimates from the inheritance study will be biased towards zero effect on labor supply. Therefore, the predicted decline in labor force participation rates caused by the run-up in the stock market is biased toward a zero effect. Using simulations, one can generate wealth shocks that are completely unanticipated.

Earlier, we estimated that the run-up in the stock market resulted in aggregate wealth levels being 17 percent higher than they would have been had the late 1990s been average years for the stock market. We assume that these increases in wealth are taxed at 33 percent. Therefore, we assume that every $1 in wealth results in $0.17 in pretax unanticipated wealth gains and $0.11 in post-tax unanticipated wealth gains.

Because we do not formally model rates of return as a function of wealth and age, the simulation model potentially overstates the labor supply response to the run-up in the stock market. Using PSID data, we find that older individuals and individuals with high wealth have more of their portfolios invested in stocks than younger and lower wealth individuals. This tends to overstate the effect of the run-up in the stock market on labor supply. In our model, low-income individuals receive too much unanticipated wealth; and it is low-income people who are the most prone to dropping out of the labor market. However, wealthier and older individuals usually pay higher taxes. This attenuates the problem of high wealth people having higher rates of return since more of the return is taxed away. To the extent that the model does not completely overcome this problem, we are overstating wealth shocks for low wealth (and, thus, low-income) people.

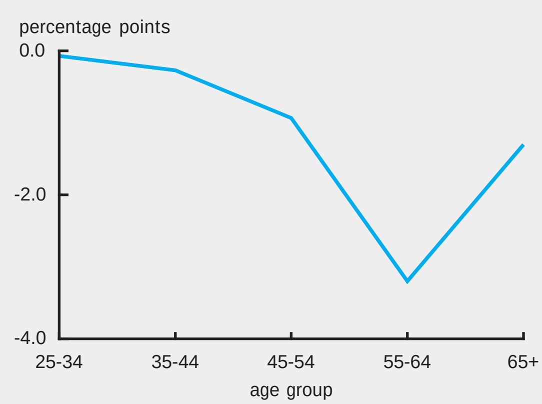
Figure 13 presents the simulated changes in labor force participation rates for men of different age groups. There are two striking differences when comparing the simulated changes against the predicted changes using the lottery and inheritance studies. The first is that the simulation study predicts much larger effects than the inheritance and lottery studies. For men aged 55–64, the simulations predict a 3.2 percentage point decline in labor force participation, whereas the inheritance and lottery studies predict only a .78 percentage point decline. As we described earlier, the inheritance and lottery studies might understate the effect of unanticipated wealth changes on labor supply. Inheritances are potentially anticipated and younger individuals usually receive inheritances. In the lottery study, the small prize group is much older than the medium and large prize groups, so the small prize winners are more likely to retire.

The second striking difference between the two sets of predictions is that our simulation only gives such large predictions for men aged 55–64. For men aged 65 and older, the simulation study predicts a 1.3 percentage point decline in labor force participation rates. This result is much closer to the results of the inheritance and lottery studies, which show a .90 percentage point increase for men aged 65 and above. The simulation study therefore provides a useful insight. Men younger than 55 are unlikely to drop out of the labor force regardless of the positive wealth shock. Most men older than 65 have already dropped out of the labor force. Men aged 55–64 are near the time when they exit the labor market. Therefore, the estimates from the other studies probably understate the effect of stock wealth on labor supply between the ages of 55–64 vis-à-vis other ages. Recall that the lottery study came to the same conclusion.

This last point is particularly important for assessing the estimates from the inheritance study. Recall that the inheritance study mostly uses information on individuals aged 35–44. Note that the predicted decline in labor force participation from the simulation study is only –.27 percent. This is only twice as large as the prediction for men aged 35–44 when using data from the inheritance study. This reaffirms our earlier point that by focusing on individuals aged 35–44, the inheritance study probably underestimates the labor supply response to changes in wealth for individuals aged 55–64. Figure 13 shows that this underestimate is likely to be significant.

FIGURE 13

Simulated change in labor force participation for men induced by wealth effect



Conclusion

In this article, we quantitatively assess the effect of the run-up in the stock market on aggregate labor supply. We arrive at our conclusions using three steps. First, we estimate the total size of the aggregate wealth shock. We find that every dollar invested in the stock market on December 31, 1994, produced on average $1.12 in stock wealth gains by December 31, 1999. Given the aggregate level of wealth in stocks in 1994, the aggregate unanticipated increase in wealth between 1994 and 1999 was $5.8 trillion, which represents an unanticipated increase in wealth of almost $20,000 per person in the U.S.

Second, we estimate the magnitude of the unanticipated wealth shock for different age groups. Using PSID data, we find that very few people younger than age 55 today benefited greatly from the run-up in the stock market. About 15 percent of all individuals aged 55 and above had unanticipated wealth increases of greater than $50,000. For most individuals, $50,000 would be more than enough to afford an additional year of retirement without any change in the consumption of market goods.

Third, we predict the effect of the run-up in the stock market on labor supply. We find that labor force participation rates for individuals aged 55 and older have increased since 1995. Increases in stock market wealth should cause reductions in labor force participation rates, all else equal. This implies that the stock market has not been the dominant factor influencing labor force participation rates from 1995 to the present. Other factors, such as rapidly rising wages, seem to be more important.

We use two approaches to predict the effect of rising stock prices on labor supply. In the first approach, we take estimates of the size of the wealth effect from other studies. Although nobody has used variation in stock prices to estimate the wealth effect on labor supply, researchers have used data on inheritances and lotteries to estimate the effect of wealth on labor supply. Using estimates from these studies and the estimated distribution of wealth shocks to different groups of people in the economy, we estimate that in the absence of a run-up in the stock market, aggregate labor force participation rates would be 1.16 percent higher today. We believe that these are conservative predictions of the stock market effect.

Our second approach is to use simulations from a model described in French (2000). We find that simulations from this model give much larger predictions of the effect of the run-up in the stock market. The predicted decline in labor force participation rates for men is over 1 percent, on average. (The model does not address the labor supply response of women.) The simulations also predict that the largest effects should be at age 55–64, when men are considering exiting the labor force. For this age group, the predicted decline in labor force participation rate is 3.2 percent. These results might overstate the effect. Therefore, we interpret the predictions based on estimates from the lottery and inheritance studies as a lower bound on the effect and the simulations as an upper bound.

Lastly, we note that the lottery, inheritance, and simulation studies imply that for every $1 in increased wealth, earnings decline by one to two cents. As we noted at the outset, total consumption of goods plus leisure must rise by at least four cents to be consistent with the life cycle model. This means that consumption of goods must rise by at least two or three cents in order to be consistent with the life cycle model. Most empirical estimates are in the range of one to five cents; as such, results at the lower end of this range are at odds with the life cycle model. Therefore, our work provides additional evidence that either the marginal propensity to consume market goods is at least 2–3 percent or that the life cycle model is not a reasonable model of consumer behavior.

APPENDIX: DESCRIPTION OF DATA

Risk-free asset data

We calculate the risk-free five-year return as the continuously compounded return on holding five-year Treasury instruments to maturity. To obtain the zero coupon rate, we use data that have been adjusted using a Fisher/Zervos technique. We obtained Fisher/Zervos estimates for 1961 to the present from the Federal Reserve Board of Governors, Division of Research and Statistics (courtesy of Mark Carey). For returns prior to 1961, we use five-year Treasury bonds. There is only a small difference in returns between the two data series (during periods of overlap).

Stock market data

Stock market annual returns (including dividends) for 1926 to the present are from the Center for Research in Security Prices (CRSP) Index Series, No. 100080, a value-weighted portfolio of all NYSE, AMEX, and NASDAQ stocks. We impute missing entries for 1999–2000 using 1970–2000 S&P 500 total return (including dividend reinvestment) data. Values represent end of December 31 to end of December 31 returns.

Flow of funds data

Our data on the market value of equities owned by households (and related data) are from the Federal Reserve Board of Governors, *Flow of Funds Accounts of the United States*. All values are in 1999 billions of dollars and represent year-end levels. Equities in pensions include defined contributions pensions only. Equities are defined as shares of ownership in financial and nonfinancial corporate businesses, both common and preferred shares of domestic corporations, and U.S. purchases of shares of foreign corporations (including ADRs).

Price level data

We use December levels from the Consumer Price Index for all urban consumers (1999 = 100) to make our price adjustments.

PSID data

We use the 1989 and 1994 waves of PSID data in our analysis of stock and pension wealth. Our 1989 sample excludes those who do not provide an answer regarding pension status or do not respond to whether they contributed to a pension (for either husband or wife in the household). The 1994 sample includes only those families in the 1989 sample, less those who changed marital status or whose head of household had changed since 1989. We use the 1989 weights wherever applicable.

Juster et al. (1999) show that the 1989 PSID accounts for approximately 85 percent of household stock wealth in the *Survey of Consumer Finances* (SCF). Limiting the sample to only those who match between 1989 and 1994 (less those who experienced a change in marital status or change in household head during those years) results in a 30 percent higher mean stock wealth than the full 1994 sample (using 1994 weights, when both are scaled by 1/0.85 = 1.18), so we adjust by scaling down 1994 stock wealth by a total factor of 1.18/1.30 = 0.91. In order to analyze men and women separately, we assume that allocation of non-pension stock wealth in married households is 50 percent to each spouse.

To analyze 1989 pension wealth, we use a simplified model assuming constant lifetime accrual amounts (in 1999 dollars) with a real return of 2.3 percent per year. Using figures from Gustman and Steinmeier (1999) and assuming that half the wealth in combined pension plans is in the form of defined benefit wealth, the average level of wealth in defined contribution plans per household is \$69,000 (1999 dollars). Assuming that it is at age 65 when the amount is \$69,000, and that it is at age 35 when the worker starts contributing, we compute a schedule of pension wealth at each age. We give workers less than 35 years old one year's worth of pension accrual and workers older than 65 the maximum amount (\$69,000). Assuming a 5 percent contribution rate, we use our imputed annual accrual level to impute the associated level of annual earnings. We then assign each worker (who has a defined contribution plan) a level of pension wealth equal to the previously calculated pension wealth level (associated with their age), scaled by the ratio of their 1988 earnings (from the PSID) to the imputed mean level of earnings from the HRS. To analyze the amount of pension wealth in stocks, we assume that stocks comprise 50 percent of pension wealth. To find pension wealth in 1994, we use the previously calculated schedule of pension wealth to assign a new level of pension wealth based on the individual's new age, again using 1988 earnings to scale the amount.

We make a number of other imputations to account for shortcomings in the PSID data. First, since the 1989 PSID data contains only 1988 earnings (not the pre-retirement earnings level, which is the earnings level in question), we impute the level of earnings of pre-retirement work as follows. For individuals who are covered by a pension and work more than 1,000 hours, we do not modify their level of earnings; if they work less than 1,000 hours, we take their pre-retirement earnings as the earnings in the data plus the mean earnings of those who work more than 1,000 hours, less the mean earnings of those who work less than 1,000 hours. To obtain a person's 1994 earnings (required for the computation of labor supply elasticities), we look to the person's earnings in the 1995 PSID and proceed in a similar fashion.

The 1989 PSID pension question does not allow retired persons to indicate whether they were covered by a pension while they were working; therefore, we take positive pension income as an indicator for a pre-retirement pension. To find whether that pension is a defined contribution pension, we perform the following procedure. If a person indicates pension coverage in response to the direct PSID question regarding pension coverage, we take the response to whether they contribute toward that pension as given. If a person indicates no pension coverage, but is receiving positive pension income, we assign the person a random number (according to a uniform [0,1] distribution); if that number is less than the probability of having a defined contribution plan (given age and pension coverage), we assume the pre-retirement pension is a defined contribution plan (otherwise not). We calculate the probability of having a defined contribution plan as follows:

Pr(DC | age, pension = yes) = Pr(DC | age) / Pr(Pension | age),

where

Pr(DC | age) = Pr(PSID DC = yes | age) + [Pr(PSID DC = yes | PSID Pen = yes) × Pr(receiving pension income | age)].

Lastly, to find the people who are covered by defined contribution plans in 1994, we simply carry over those who were covered in 1989, since the 1994 PSID data release at this time does not include any questions regarding defined contribution pensions.

NOTES

[1]This effect would be ambiguous, however, as people may have wished to work more hours in 1995–99 in order to generate more wealth. Increased wealth could in turn be invested in the stock market.

[2]One caveat to this article is that it is not clear why the stock market rose in the first place. Our analysis assumes that the stock market rose for reasons unrelated to future productivity growth—perhaps financial markets have become more efficient. If the stock market rose because of beliefs about increasing productivity in the future, then there are three effects that we do not consider here. First, people should believe that wages will rise rapidly in the future because of increased productivity. Not only would stockholders feel wealthier, but so would all individuals who believe that they will be working in the future. If this is true, our analysis underestimates the true wealth shock to the economy and, thus, underestimates the true effect of the run-up in the stock market on labor supply. Second, any change in future beliefs about productivity is likely to be accompanied by wage changes in the present and near future. This potentially increases hours worked as incentives for work are greater. This offsets the wealth effect. Third, interest rates should rise if people believe productivity will rise, because higher productivity leads to higher demand for capital. If interest rates are relatively high (as they are today), people should work more hours today so that they can develop greater wealth that will earn a high rate of return. Again, this offsets the wealth effect. Any rapid change in stock prices will likely be accompanied by these three additional effects, if the change in prices reflects changing beliefs about future productivity. Therefore, it is not clear how labor supply would respond to a large stock market change in the future. However, we believe that we have increased understanding of the effect of the stock market on labor supply by focusing on the direct effect.

[3]This is done by comparing the PSID to another dataset, the *Survey of Consumer Finances*, and assuming that respondents in the *Survey of Consumer Finances* report 100 percent of their assets. The *Survey of Consumer Finances* is considered to have extremely high quality data on wealth, although the respondents probably report slightly less than 100 percent of their assets.

[4]They do note that when the husband's income accounts for 75 percent of total household income instead of 50 percent, the husband's share of consumption rises by about 2 percentage points. This shows that assuming an even split is not perfect but is roughly correct. They also note that consumption of women's clothing is slightly higher than men's, but again assuming an even split of resources is roughly correct.

[5]Using the previously described procedure to estimate defined contribution wealth, we aggregate defined contribution wealth in our PSID sample up to the national level. In other words, we take aggregate wealth in the PSID and multiply it by the ratio of U.S. households to PSID households. We compare this estimate to defined contribution wealth in the *Flow of Funds*. We find that our PSID defined contribution measure is 15 percent greater than the *Flow of Funds* measure.

[6]See *Social Security Bulletin Annual Statistical Supplement*, 1997, p. 60.

[7]Unfortunately, the PSID measures only food consumption not total consumption. The consumption results show that the marginal propensity to consume food out of inheritances is about .1 percent, far lower than the 1 percent to 5 percent marginal propensity to consume out of changes in stock wealth that most studies find (Parker, 1999; Ludvigson and Steindel, 1999; and Dynan and Maki, 2000). Because food is a necessity, the marginal propensity to consume food is lower than the marginal propensity to consume all consumption goods. For example, Attanasio and Weber (1995) show that for every 1 percent increase in food consumption, total consumption rises about 1.2 percent.

[8]All calculations assume that the after-tax real interest rate is 2.3 percent and the inflation rate is 3.3 percent.

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