Hedging Labor Income Risk over the Life-Cycle

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Non-technical report

1 Summary

Lifetime saving and portfolio choice of investors depend on their expected income, being sensitive both to possible shocks with persistent effect on future labor income and to stock returns fluctuations. Such sensitivity depends in turn on the correlation between shocks to labor and financial income, that is on whether negative fluctuations in labor income tend to reinforce or offset negative fluctuation in financial returns. To the extent that persistent labor income shocks are highly correlated with shocks to risky asset returns, more prudent investors should reduce their exposure to financial risks (Merton, 1969). Conversely, if persistent labor income shocks exhibit a low correlation with financial fluctuations, then investing in risky assets can serve as a hedge against labor income risk. The empirical assessment of such income-hedging motive for stock demand is highly controversial, due to imprecise measurement of the correlation between the permanent component of shocks to earnings and to stock returns. The first difficulty lies in disentangling the permanent component of earnings shocks from the transitory one, because both are unobservable. Thus, the study of households' hedging motives usually relies on the correlation between total labor income growth and stock returns. Second, available estimates of such correlation on U.S. data are often not statistically different from zero, due to the small time-series dimension of earnings in databases such as the Panel Study of Income Dynamics (PSID). As a consequence, stock market participation and portfolio allocations do not respond to available estimates of correlation.

In this study, we propose a novel econometric strategy to estimate individual labor income risk over the life cycle, that allows for an exploration of hedging motives across individuals. Our method is able to derive efficient estimates of the parameters of individual labor income processes, allowing to disentangle the idiosyncratic and the aggregate permanent income risk as well as the correlation between the latter and market returns.

In addition, we recover the individual dynamics of persistent shocks and obtain the overall distribution of correlations between permanent income shocks and stocks returns. The dispersion of this correlation across individuals leads us to conclude that the lack of correlation estimated at the aggregate level is due to the wide range of significant (positive and negative) correlations observed at individual level rather than to the absence of comovement of earnings shocks with market returns.

Once we obtain the dynamics of the unobservable component of labor income at the individual level, we show that both the variability of permanent shocks to income and their correlation with stock returns are significant determinants of the propensity to participate. Those households who refrain from stock investing display positive correlation between their own permanent income innovations and market returns. On the contrary, the correlation with total income shocks is not. Our results confirm the theoretical prediction that what is relevant for households' risk taking decision is the ability of risky financial assets to hedge permanent, instead of pure transitory, labor income risk.

2 Labor income process estimation

The dominant approach in both asset pricing and household finance rests on the calibration of the individual income process. Given the evidence that agents are subject to substantial and highly persistent shocks to earnings (see e.g.. Abowd and Card, 1989, the individual's log labor income is modeled as the sum a function of demographic and personal characteristics (e.g. education) and a stochastic trend hit by permanent and transitory shocks. The former have permanent effects on the level of individual labor income, whereas the latter change only the current level of the income, without effects on future earnings. Moreover, the permanent shock contains an idiosyncratic and an aggregate component which may be correlated with market returns. In particular, the total (log)-labor income $log(Y_{i,t})$ is the sum of a deterministic part $f(t, Z_{i,t})$ and a stochastic part $e_{i,t}$, where $f(t, Z_{i,t})$ is a function of individual's observable characteristics, and $e_{i,t}$ is the stochastic component. This latter is not observable and it is the sum of a permanent component $v_{i,t}$ and a transitory component $\epsilon_{i,t}$.

While sticking to such mainstream approach, we adopt an estimation strategy based on the method of moments to make efficient use of information in PSID, which provides survey data on personal, demographic, and income characteristics of US households. PSID data are available at annual frequency between 1968 and 1996, and every two years from 1997. We use the 26 waves covering the period from 1971 to 1997 when we implement our estimation methodology of the labor income process, to allow comparability with previous studies (see e.g., Cocco, Gomes, and Maenhout, 2005, Guvenen, 2009).

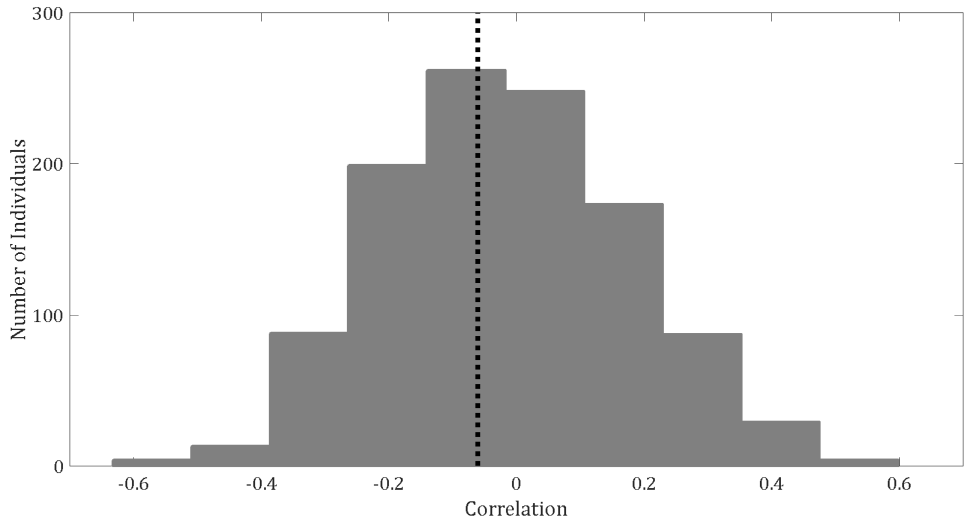
Our method exploits both the cross-sectional variation in labor income as well as its individual time variation available from the panel structure of the data. Thus, we are able to disentangle the idiosyncratic from the aggregate permanent income risks. We uncover that more than 90% of the variance of the permanent shock is idiosyncratic while the systematic component counts only to 7.5% of the variance of the overall permanent shock. This evidence may explain why the absolute value of the correlation between the systematic component of permanent shock and stock return innovation is relatively small in the aggregate.

2.1 Individual dynamics of labor income shocks

We then proceed with the reconstruction of labor income risk over the life cycle for each sample households. To this aim, we retrieve the dynamics over time of the unobservable component of labor income at the individual level with a Kalman filter.

Recovering the individuals' dynamics of the permanent component allows the measurement of the empirical cross-sectional distribution of (otherwise) unobservable individual correlations between such permanent shocks and market returns. In Figure 2, we report the distribution of such correlation coefficients evaluated across individuals. The distribution turns to be centered at -0.053 (emphasized with black dotted line), that is a value very similar to the estimated parameter for the aggregate correlation (see section 4.1). The standard deviation is 0.21.

Figure 1. Individual Correlations
The figure shows the distribution of the correlation between the estimated individual's permanent innovations to the log-labor income and stock return, for the time period going from 1971 to 1996.



Our results confirm a substantial heterogeneity in the comovement of persistent earning shocks with stock returns. The range of individual correlations is indeed very wide, between -0.6 and 0.6, with one third of individuals displaying a correlation not significantly different from zero. Thus, it is not surprising to obtain point estimates near zero or not significant. However, our results highlight that this low point estimate is due to high heterogeneity in individual labor earnings rather than to the absence of comovement with market returns.

Recent studies document that individuals exhibit substantial heterogeneity in terms of labor income, and that such inequality has increased over time - see Guvenen (2009), among others. We add the observation that individuals are heterogeneous also in terms of correlation between income growth and stock market return. Moreover, we show a powerful implication of such heterogeneity. We point out that the estimate of the correlation coefficient over the whole sample yields a statistical zero value since individual correlations are widely scattered across negative and positive values.

3 Explaining stock market participation

We relate the *individual* decision to participate in the stock market directly to *individual* income hedging motives, along with observable personal characteristics. Since data on stock market participation are available on PSID from 1999, we use waves between 1999 and 2011. The data convey information on both direct and indirect stock holdings. They refer to the household that owns any shares of stock in traded corporations including mutual funds, investment trusts and/or IRAs. As for investment opportunities in risky assets, we use the US stock market excess return (from Kenneth French's website).

We perform a probit analysis of the decision to participate to the stock market. The dependent variable is the stock market participation, that is a dummy variable H that takes value 1 in case of participation, and 0 otherwise. The main independent variables of interest are the standard deviation and the correlation with stock market return of different specifications of shocks to (log)-labor income. In Table 1, we include the shocks to the total log-income $log(Y_{i,t})$, and the permanent component of the stochastic shocks to the labor income computed with the Kalman filter, following the estimation methodology described in the previous section.[1]

Column (1) just considers observable characteristics, and all the characteristics explain the propensity to participate. In Column (2), we include only the observed labor income characteristics: log-labor income level, the standard deviation of total income shocks, and their correlation with stock returns. According to our results, the level and the correlation are significant determinants of the participation decision, as in **?**. However, once the individual characteristics are included, in Column (3), the effect of income-return correlation is no longer significant (as in Angerer and Lam, 2009).

In Column (4), we consider the distribution of the individual permanent income shocks: the standard deviation of the permanent income shocks dynamics, and the correlation between the permanent income shocks dynamics and the stock market return. Both variables are statistically significant, and they are still significant when we include demographic characteristics (Column (5)). Finally, results in Column (6) show that the individual's permanent income shocks characteristics have significant explanatory power even when we add the total income shocks standard deviation and correlation with stock return.

[1] In all the regressions, we control for time effects and individual's demographic characteristics, such as age, family size, marital status, education, and (log)-labor income level. We use standard maximum likelihood method to estimate the probit regression.

Table 1 Probit Regression Results
The table reports the probit regression results considering as independent variables the participation decision. The dependent variable is equal to 1, if the individual reports non-zero wealth allocation to stock market on a given wave, and equal to 0 otherwise. The independent variables are individual's demographic characteristics, and the standard deviation and the correlation with stock market return of the shocks to different specifications of (log)-labor income: total (log)-labor income, and permanent component of the stochastic part computed with the Kalman filter (KF) following the estimation methodology described in the previous section. The coefficients are estimated with standard maximum likelihood, and we report in bold those significant at 5% level. We include in all regression the time effects. The total number of observations is N (944) x T (7) = 6608

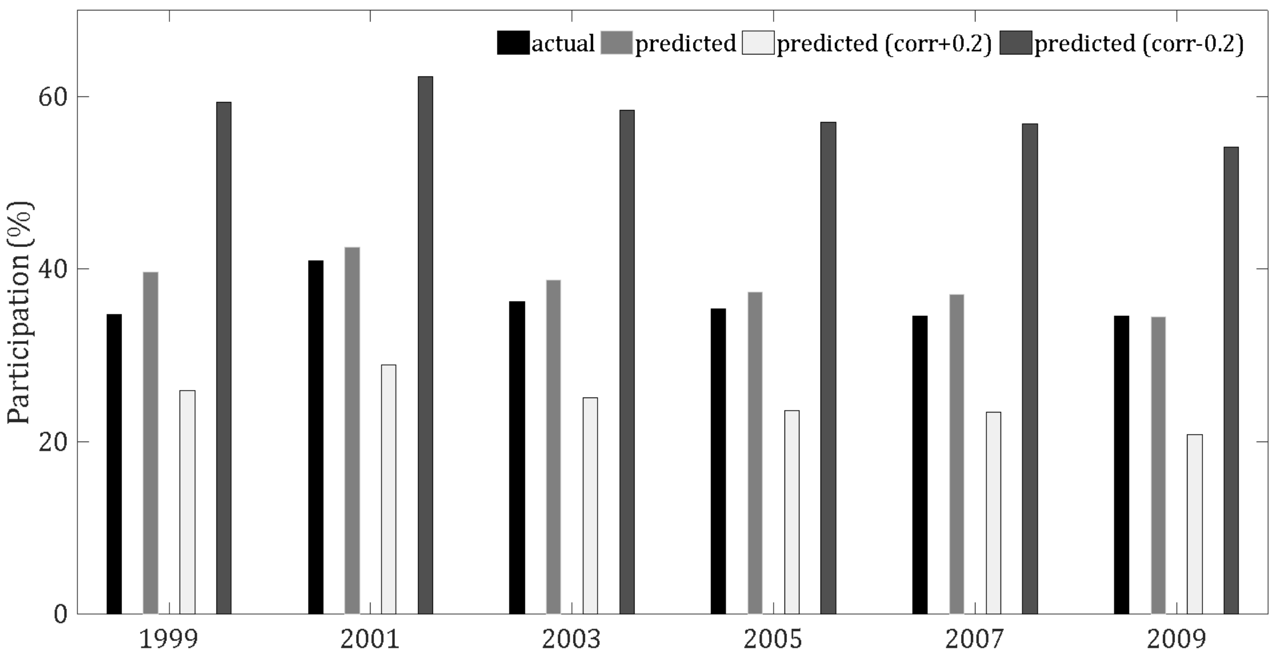
	(1)	(2)	(3)	(4)	(5)	(6)
Age	**0.009**		**0.009**		**0.008**	**0.008**
Family Size	**-0.042**		**-0.041**		**-0.043**	**-0.042**
Marital Status	**-0.140**		**-0.139**		**-0.139**	**-0.140**
Education	**0.165**		**0.165**		**0.166**	**0.166**
Labor Income	**0.191**	**0.309**	**0.191**	**0.308**	**0.191**	**0.191**
Specifications of (Log)-Labor Income Shocks						
Total						
Standard Deviation		-0.039	-0.018			0.049
Correlation		**-0.100**	-0.089			0.065
Permanent (KF)						
Standard Deviation				**-0.564**	**-0.348**	**-0.486**
Correlation				**-0.118**	**-0.152**	**-0.205**
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations = 6586						
Pseudo R^2	0.091	0.035	0.092	0.036	0.093	0.093

4 Predicting stock market participation

We use the probit regression estimates of previous section to predict the level of stock market participation, for each year. We adopt the standard normal distribution results at the base of the probit model.

In particular, for each year, we compute the predicted level of aggregate participation as the average probability across individuals, and we compare it with the actual level of stock market participation, defined as the percentage of individuals in the final sample reporting value of dummy variable H equal to 1. Figure 3 shows that probit regression estimates allow to match quite well actual data on stock market participation. Both predicted and actual level of participation lie around 40% over all the years in the sample.

Figure 2. Actual and Predicted Stock Market Participation
The figure shows the actual stock market participation, and the stock market participation predicted by using the estimates of the Probit regression of Table 3, for each year. Stock market participation is defined as the percentage of individuals in the final sample with a dummy variable H equal to 1. We also show the predicted stock market participation imputing a correlation between the estimated individual's permanent component of the log-labor income shocks and stock return equal to -0.2 and 0.2, respectively, to all individuals in the sample.



We also run the experiment of assigning to all individuals a correlation equal to either -0.2 or 0.2, respectively, instead of the estimated ones and use these values in the prediction of their participation. Results reported in figure 3 show that the individual correlation of the permanent component substantially matters in determining the stock market participation: varying this correlation from -0.2 to 0.2, the level of participation goes from around 20% to around 60%.

A closely related study of hedging motives (Angerer and Lam, 2009) indicates that it is the variance of the permanent component of labor income shocks that mainly affects the share of risky assets (including both stocks and bonds) in household portfolios, without addressing stock market participation and correlations. (**?**) pin down the role of the correlation between labor income shocks and stock returns in explaining stock market participation. However, the estimate of correlation, based on their method, does not explain individual participation in PSID while our method does. Moreover, our method provides an estimate of the correlation that takes into account the theoretical restrictions on the different component of labor income shocks. In particular, we contribute to this literature an efficient estimate of individual correlation, showing that it is the permanent component of labor income shocks that affects hedging in financial markets, while the correlation with total income shocks does not. These results support the theoretical implication that a sufficiently high and positive value of such correlation is able to explain the non-participation to the stock market in addition to the observed low equity share in participants' portfolios (Bagliano, Fugazza, and Nicodano, 2014). We therefore do not have to rely on competing explanation of non participation, such as unawareness, participation costs, crash risk among others.

Our results confirm the theoretical prediction that what is relevant for households' risk taking decision is the ability of risky assets to hedge permanent labor income risk rather than pure transitory shocks. Thus study may contribute to improvements in the personalized design of target date funds. Often the time-series dimension of the data is limited, because of the short tenure of workers. The method we suggest exploits the cross-sectional dimension of the data to circumvent this problem.

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