Endogenous Non-tradable Earnings and Households' Demand for Risky Assets*

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January 18, 2012

Abstract

Using French survey data, we explore empirically whether earnings uncertainty and borrowing constraints decrease households' demand for risky assets, consistent with theoretical predictions. A major empirical problem is the potential endogeneity bias of income risk, as more risk averse households may simultaneously choose safer occupations and invest less in risky assets. Even if we control for households' risk preferences, we find that households respond by increasing their stockholdings in response to earnings uncertainty but not to liquidity constraints. We show that these empirical findings are consistent with an occupational risk-return trade-off, whereby less risk averse households choose riskier occupations and hold riskier portfolios.

Keywords: Portfolio choice, uninsurable earnings, occupational choice, risk aversion, temperance.

JEL Codes: C33, C35, D12, D91.

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*The authors thank Rob Alessie, Michael Haliassos, John Knowles, André Masson, and Pamela Efe for helpful comments, as well as by seminar audiences at the RTN AGE 2002 (Copenhaguen), 2003 (London) and ESEM 2003 conferences. A previous version circulated under a diffeent title, 'Temperance in French Household Portfolios?'. The second author gratefully acknowledges financial support from the ESRC First Grants Scheme, RES-061-25-0327.

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1 Introduction

Important puzzles have been identified in the economics and finance literatures when confronting theoretical predictions with real data (equity premium, non-participation, home bias...). Studies using micro-data have improved our understanding (Guiso *et al.*, 2002). In this paper, exploiting a cross-section of French households, we explore empirically whether earnings uncertainty and borrowing constraints crowd households out from the stock market, consistent with theoretical predictions. So far, the empirical evidence is mixed. Arrondel *et al.* (2010) for France, Guiso *et al.* (1996) for Italy, Massa and Simonov (2006) for Sweden or Haliassos and Bertaut (1995) and Vissing-Jorgensen (2002) for the US provide evidence consistent with theoretical predictions, while Alessie *et al.* (2002) for The Netherlands or Arrondel and Masson (2003) for France, do not. An important issue is how to measure income risk and the extent to which it is exogenous (e.g. Lusardi, 1997, or Fuchs-Schündeln and Schündeln, 2005), as more risk averse households may simultaneously prefer to work in safer occupations and hold more conservative portfolios. To capture earnings uncertainty, we elicit a self-assessed measure (Guiso *et al.,* 1996), and to control for the potential selectivity bias, we instrument income risk and introduce the measure of aversion to gamble on lifetime earnings proposed by Barsky *et al.* (1997).

Even if we control for tastes for risk, our empirical results do not support the proposition that households who are *more* exposed to earnings risk choose to bear *less* financial risk, at odds with the theoretical predictions of the literature on "temperance" in households' portfolios (Kimball (1993), Gollier and Pratt (1996)). However, they do support the negative effect of borrowing/liquidity constraints, confirming that the actual or expected inability to borrow raises risk aversion. To rationalise these apparently contradictory empirical findings, we adopt Drèze and Modigliani's (1966) unpublished insight, according to which the choice of an occupation also has a risk-return component, even if earnings (i.e. the proceedings of human capital) are non-tradable. Saks and Shore (2005) find evidence in the US consistent with individuals choosing optimally their earnings risk exposure early in their lifes. As they age however, households' earnings become progressively beyond their control, because of either the substantial occupational switching costs (Kambourov and Manovskii, 2009), or the important irreversible investments undertaken both at school or on-the-job.

We therefore extend Campbell and Viceira's (2002) static constant relative risk aversion (CRRA) -Lognormal framework to obtain (approximate) analytical solutions for optimal portfolio shares *and* optimal occupational risk exposures. The advantages are three-fold: (i) CRRA preferences display the property of decreasing absolute risk aversion, which empirically explains individuals' occupational risk exposures (Saks and Shore, 2005); (ii) in the face of a zero mean additive background risk on earnings, CRRA preferences are sufficient to trigger a reduction in optimal portfolio risk exposure ("temperance") [1], which is the real trigger behind the negative effect of an uncertain future liquidity requirement. Finally, (iii) the results can easily be extended to an intertemporal framework. The main prediction is that occupational and financial risks become complements, while preserving the negative impact of borrowing and liquidity constraints, as we observe empirically.

The remaining of the paper proceeds as follows: in section 2 we briefly describe the main hypothesis under scrutiny and the corresponding basic econometric specification. In section 3 we describe and explain the construction of the main variables. In section 4, we report the main empirical findings while discussing their robustness. Section 5 presents the theoretical model and discusses it in light of the empirical evidence, and finally section 6 concludes.

2 The Tempering Effect of Background Risk

The classical theory of portfolio choice was developed in a complete markets framework, meaning that all individual risks could be traded. But severe informational restrictions preclude most households from insuring their most important source of lifetime income: their human capital. That observation motivated the reconsideration of the complete markets assumption (Drèze and Modigliani, 1972).

A theoretical extension to incomplete markets of the static portfolio choice model has formalized the following common wisdom intuition: when risk averse households are confronted with a risk beyond their control or 'background' risk, they should decrease their exposure to avoidable risks in order to adjust their desired total risk exposure (e.g. Kimball, 1993, or Gollier and Pratt, 1996). Households observing this behavior are called *temperant*.[2] Accordingly, those who suffer more from uninsurable earnings risk should choose to be less exposed to financial risk, *ceteris paribus*. Also, since income risk entails an uncertain (future) liquidity requirement, currently (or expected to be) liquidity constrained households should hold even safer portfolios.[3]

These theoretical predictions can be summarized by the following reduced form equation for the share (A/F) of risky assets ($A \geq 0$) in total financial wealth (F):

$$\frac{A}{F} = g(\sigma_y, \gamma, cl; \mathbf{X}) \tag{1}$$

Where cl is the expected probability of being liquidity constrained, σ_y is the self-assessed standard deviation of earnings, γ is the coefficient of relative risk aversion and $\mathbf{X}$ is a vector of covariates that include demographics to proxy for heterogeneity in tastes (marital status, family size, gender, urban/rural residence), household income and total net wealth as measures of their initial endowment, and finally variables chosen according to the theory, e.g. transaction/information costs lead to incomplete portfolios (King and Leape, 1998), that will in turn be determined by the stock of

[1] Preferences are then said to be "risk-vulnerable", in Gollier and Pratt's (1996) terminology.

[2] Eeckhoudt and Schlesinger (2006, p. 283) have further characterized *temperance* as a preference for the separation of two independent zero-mean background risks over the bundling of them.

[3] See Gollier (2001), ch. 18.

financial information (proxied by age, education and parents' wealth composition).

3 Empirical Analysis

We rely here on the "Patrimoine 98" wealth survey conducted by the French National Institute of Statistics (INSEE) on a nationally representative sample of 10,207 households, for whom detailed information on earnings, income, wealth and socio-demographic characteristics is available.[4] A part of the questionnaire tries to give us a general idea of individuals' degree of exposure and aversion to risk, as subjectively perceived and assessed by them. Only 4,633 individuals (corresponding to 2,954 households) answered to these questions. Table 1 reports averages of earnings, wealth and demographic characteristics for the total and selected samples.

(Table 1 about here)

The amount of risky assets held (A) in equation (1) is defined by (i) the sum of stocks of privatized public companies, listed shares of private companies and stocks of foreign firms (direct stockholdings), and by (ii) those held through mutual funds and managed investment accounts (indirect stockholdings). We exclude bonds from the risky asset category, as well as homeownership.[5] 20.5% of the sampled households are direct stockholders, while 30% hold risky assets either directly or indirectly.

To construct a proxy for the subjective standard deviation of household income, we asked each income recipient to attribute probability weights (100 points) to given intervals of 5-year-ahead real income increases.[6] The mean of the standard error of anticipated income shocks[7] (between 6.2% and 14.9% of current earnings) is of an order of magnitude similar to the estimates reported by Guiso *et al.* (1996), but surprisingly low when compared to panel data estimates. [8]

To obtain a measure of risk aversion, we follow Barsky *et al.* (1997) and infer risk preferences from hypothetical gambles over life time income. Individuals are assumed to distaste risk and that their preferences are in the constant relative risk aversion (CRRA) class. The outcome is a range measure (in four brackets) for the relative risk aversion coefficient (γ). Out of the 3,483

[4] In Arrondel *et al.* (2010) we exploit data from a different survey, the Delta-TNS 2002 survey, which only covers a representative sample of 4,000 French households within the 35-55 age bracket.

[5] Arrondel and Masson (2003) argue that homeownership status in France is better explained by the flow of services it provides, rather than by the expectation of an investment return.

[6] The sample average of expected income growth (around 1.5%) is roughly consistent with French time series evidence for the preceding period (around 1.8% over 1990-98).

[7] Assuming that five years ahead expected real income is $y_{t+5} = (1+g)y_t$, the formula for the anticipated standard deviation of household income is $StdDev(y_{t+5}) \equiv \sigma_y = y_t\sigma_g$, where y_t is current real income, g is the expected growth rate of real income, and σ_g its standard deviation. In Appendix 2, Table A.2, the frequency distribution for the standard deviation to income ratio σ_y/y_t (when $\pm 50\%$ bounds are used) shows that 41% of the households hold point expectations. Only 8% display a ratio above 15% of current earnings. Although we chose the units-free standard deviation measure of earnings uncertainty, our results remain unchanged when we replace it by the variance or by the standard deviation to income ratio (σ_y/y_t).

[8] The gap between both is commonly explained by (i) overestimation of true "uncertainty" in econometric regressions (Dominitz, 2001), (ii) neglected within interval variation, (iii) underreporting of the probability of very low income events, and/or (iv) measurement error in survey responses. See Guiso *et al.* (1996) or Lusardi (1997) for additional details.

respondents, 43.1% are very risk averse ($\gamma \geq 3.76$) and 39.4% are highly so ($3.76 > \gamma \geq 2$). 11.2% display moderate risk aversion ($2 > \gamma \geq 1$) while only 6.3% qualified as low risk averse ($1 > \gamma$).[9] Controlling for demographic and economic factors, those who are more risk tolerant are also more willing to take risk in financial decisions and more likely to become self-employed (excluding farmers).[10]

Finally, to capture households' ability to gain access to credit markets, two questions in the survey identify both 'discouraged borrowers' and 'turned down applicants'. The variable that proxies for liquidity constraints takes value one if households qualified themselves in either category. 11,7% of the surveyed households are liquidity constrained (346 out of 2954).

4 Econometric Results

To estimate the demand for risky assets as in model (1), a two-stage decision process is assumed. Households choose first whether or not to hold risky assets (a *Probit* model is used) and then they decide how to allocate total financial wealth between safe and risky assets. Conditional on participation, the second stage estimates the fraction of financial wealth invested in risky assets (conditional asset share), introducing the inverse Mills ratio to correct for the selectivity bias. Economic theory predicts that different sets of explanatory variables explain the different stages, e.g. King and Leape (1998) argue that information costs explain essentially the decision to enter the stock market. Accordingly we introduce education and the presence of risky assets in parents' wealth only in the *Probit* model.[11]

(Table 2a about here)

Columns 1 and 2 of Table 2a report the two-step estimation results for the narrowest definition of risky assets (direct stockholdings). Stock of information variables increase the probability of risky asset ownership: Households whose parents owned stocks are about 11.2 percentage points more likely to hold stocks directly. A second-order polynomial in age confirms that the probability of stockownership attains its minimum for young households, increasing through the life cycle to reach a maximum at the age of 46.

Income and net worth induce stock market participation, consistent with the presence of fixed transaction costs (Vissing-Jorgensen, 2002) and/or risk preferences decreasing in wealth (DARA). Households who expect to be liquidity constrained are less likely to invest in risky assets.[12] Moving a household from the 10th to the 90th percentile of probability to be deterred from applying for credit in the future reduces the probability of stockownership by 8,5 percentage points.

Contrary to economic theory predictions, the coefficient of the expected standard deviation of

[9] Sahm (2007) or Chiappori and Paiella (2008) use panel data to confirm that relative risk aversion is constant in both the American HRS and the Italian SHIW, respectively.

[10] In Appendix 1, Table A.3 we show that Barsky *et al.*'s (1997) measure of relative risk aversion predicts earnings risk exposure or prudence in financial attitudes,

[11] When we introduce past gains and/or losses in the stock exchange and a proxy for the quality of portfolio management in the conditional demand equation as additional exclusion restrictions, the results remain unchanged.

[12] To avoid endogeneity issues, we included the predicted probability of being liquidity constrained.

earnings in the Probit equation is positive and significantly different from 0 at the 10-percent level. Households who anticipate lower earnings risk invest less in risky assets: those who reported no risk on earnings were about 2.7 percentage points less likely to hold stocks directly than those in the highest earnings risk decile, ceteris paribus. Consistent with the results of King and Leape (1998), the conditional asset demand equation (Table 2a, column 2) is poorly explained. When we estimate a simple Tobit model for the share of risky assets, the results below column 3 of Table 2a confirm that the income risk coefficient is always positive.

(Table 2b about here)

Since only a small fraction of households report positive amounts of risky assets, we have also explored the sensitivity of the results to a broader definition of risky assets (direct or indirect stockholding) for both the two-step and Tobit estimations (Table 2a, columns 4 and 5, and 6, respectively). For most variables, the estimates are similar to those obtained with the narrow definition, although the effects appear statistically stronger. Since 5-year-ahead real income increases are unbounded above and below in the questionnaire, Table 2a contains the results when $\pm 50\%$ bounds are used. Because households' financial behaviour has been found to be sensible to the size of income shocks (Carroll, 1997), Table 2b reports our estimation results when $\pm 100\%$ bounds are imposed instead. The results remain qualitatively unchanged.[13]

To control for households who, being more risk averse, may have self-selected into safer jobs we: (i) have introduced Barsky *et al.*'s (1997) individual measure of aversion to gamble on life time earnings, and we (ii) instrumented the earnings variance by a qualitative variable capturing the frequency and severity of financial distress at home while young[14]. We also included in the instrument set the own subjective probability of unemployment, past own health problems and own subjective transition probability to self-employment as well as different proxies for social status and portfolio composition of the household head's parents. The positive and significant effect of income risk on either definition of stockholdings remains.

(Table 3 about here)

Following Wooldridge (2002), we first tested the exogeneity of the earnings variance in the discrete choice equation by 2SLS. Given that we could not reject the null, we tested exogeneity in the conditional demand equation under the null in the participation equation. Although the predicted power of the first stage regression is low (the F statistic is only slightly above 2), the t-statistics in the demand equations (reported as chi square statistics in Table 3) do not allow us to reject the hypothesis of exogeneity in either the two-step or in the Tobit specifications. Therefore, the non-instrumented model is preferred as long as the instruments are valid, which is the case.

[13] Unreported results show that when we restrict the sample to households with an active head, the effect of income risk is even stronger: households who have no risk on their earnings were about 5.6 percentage points *less* likely to hold stocks directly than those in the highest earnings risk decile.

[14] Although there is a statistically significant positive correlation between the instrument and Barsky *et al.*'s (1997) measure of risk aversion (LR test statistic $= 9.8, P = 0.0441$), to the extent that the latter is also included separately in the two-stage regression, the potential endogeneity caused by an interegenerational transmission of risk preferences (Kimball *et al.*, 2009) is not an issue.

5 A Theoretical Explanation

The empirical results provide mixed support to households rebalancing their stockholdings away from risky assets to compensate for their exposure to uninsurable income risk. On one hand, liquidity constrained households effectively hold less risky assets. On the other hand, households who are *more* exposed to earnings risk appear to invest *more* in risky assets, against theoretical predictions.

These apparently contradictory findings can be rationalised if households do actually choose their occupations also as a function of the risk embedded in life-cycle earnings profiles (Palacios-Huerta, 2003; Saks and Shore, 2005; Sahm, 2007). [15] The choice of an occupation corresponds then to an optimal earnings risk exposure. However, as they age, the risk on earnings becomes progressively beyond their control, or a background risk. Households find themselves "locked-in" either because of the irreversible nature of human capital investments (at school or on the job) or because of the considerable costs associated with switching occupations (Kambourov and Manovskii, 2009). If preferences towards risk are invariant through the life-cycle, cross-sectional data on portfolios and earnings risk should then reveal that more risk averse households hold both more conservative portfolios and safer occupations. This is precisely what Drèze and Modigliani (1966) claimed in an unpublished extension of their famous article (Drèze and Modigliani, 1972). ([16])

Here, we capture their insight within Campbell and Viceira's (2002) static CRRA-Lognormal framework, extending it to obtain an (approximate) analytical solution with three main advantages: (i) the main effects of interest become apparent, and the conclusions can be easily extended to an intertemporal framework; (ii) we do not need to resort to an intertemporal framework to capture the impact of decreasing risk aversion on occupational choice, empirically identified by Saks and Shore (2005); and (iii) CRRA preferences belong to the broader class of HARA functions, for which Gollier and Pratt (1996) show that individuals exposed to a zero mean additive background risk will optimally choose to invest less in risky assets ("temperance"). In what follows, upper case letters are used for the variables of interest, while lower case letters denote the natural logarithms of them.

The problem a household faces is how to invest her initial financial wealth holdings, W_0, when there are only two assets available: a risky asset promising to deliver tomorrow a random return $\left(1+\widetilde{R}\right)$ and a riskless asset promising the delivery of a sure return $(1+R)$. Her individual objective function is a continuous, differentiable representation of her preferences that admit an expected

[15] A different explanation relies on the intertemporal effect of background risk, examined by Elmendorf and Kimball (2000). They show that a background risk on earnings will also trigger a precautionary increase in savings, part of which will be optimally invested in risky assets by decreasingly risk averse households. Haliassos and Michaelides (2002) provide an in-depth discussion of this mechanism, and calibrate a realistic model of household portfolios using data from the US Survey of Consumer Finances.

[16] Quoting them: "*... de telle sorte que le consommateur exerçant une activité plus aléatoire (par choix) aura également des placements plus risqués (...). C'est le sens de notre proposition* [6.6, p. 29]."

utility form over final consumption,

$$\widetilde{C} = W_0(1 + \widetilde{R}_p) + \widetilde{Y}_e, \tag{2}$$

where $\widetilde{Y}_e$ represents uninsurable *endogenous* earnings. Household earnings come from the inelastic supply of one unit of time, $T = 1$, which can be optimally allocated between a relatively 'riskless occupation' and a relatively 'risky' one. If we denote by β the fraction of available time invested in the risky occupation, $\beta\widetilde{I}$ are the corresponding earnings, and $(1-\beta)I$ the earnings from the time devoted to the safe occupation. Then labour earnings are expressed as:

$$\widetilde{Y}_e = (1-\beta)I + \beta\widetilde{I} = I[1 + \beta(\frac{\widetilde{I}}{I} - 1)] : \tag{3}$$

$$\widetilde{I} = I\exp\{s + \widetilde{\tau}\}, \widetilde{\tau} \sim N(-\frac{1}{2}\sigma_\tau^2, \sigma_\tau^2) \; s > 0 \tag{4}$$

Denoting by α the share of initial wealth invested in the risky asset, the portfolio return is $\widetilde{R}_p = \alpha\widetilde{R} + (1-\alpha)R$. Assuming that household preferences are in the constant relative risk aversion class (CRRA), $u(w) = \frac{w^{1-\gamma}}{1-\gamma} : \gamma \equiv -\frac{wu''(w)}{u'(w)}$, and that earnings and portfolio returns are statistically independent, we can write the solution to her individual optimization problem as [17]:

$$\alpha_{DM} = \frac{1}{\epsilon_e}\left(\frac{E\widetilde{z}}{\gamma\sigma_z^2}\right) \tag{5}$$

$$\beta_{DM} = \frac{1}{1-\epsilon_e}\left(\frac{s}{\gamma\sigma_\tau^2}\right) \tag{6}$$

Where $\frac{1}{\epsilon_e} \equiv 1 + \frac{E\widetilde{Y}_e \exp\{-\frac{1}{2}\sigma_y^2\}}{\exp\{E\widetilde{r}_p + w_0\}}$ is the inverse elasticity of final consumption with respect to financial wealth, or equivalently, it is the ratio of average total wealth (human and non-human) to average financial wealth, $\frac{1}{\epsilon_e} \equiv \frac{\overline{W}+\overline{Y}_e}{\overline{W}} = 1 + \frac{\overline{Y}_e}{\overline{W}}$. Correspondingly, $\frac{1}{1-\epsilon_e}$ denotes the inverse elasticity of of final consumption with respect to human wealth. $E\widetilde{z} \equiv \log\frac{E[1+\widetilde{R}]}{[1+R]}$ denotes the log expected excess returns and σ_z^2 their variance. Finally, $s \equiv \log\frac{E\widetilde{I}}{I}$ is the log expected excess earnings, and σ_τ^2 the corresponding variance. Several remarks follow, mostly on (6):

Remark 1: $s > 0$ denotes the risk premium required by the household in order to devote a positive fraction of its time to the risky occupation. Evidence of such a risk premium has been recently found by Nielsen and Vissing-Jorgensen (2006). [18]

Remark 2: $\frac{1}{1-\epsilon_e}$ captures two effects, *ceteris paribus*: (i) households endowed with more non-human initial wealth devote more time to the risky occupation, obtaining higher expected earnings

[17] Campbell and Viceira's (2002) log-linear approximate solution method proceeds in three steps. First, the budget constraint and the Euler equations are replaced for log-linear second order Taylor approximations around the fixed point solution. Second, it looks for optimal portfolio and job allocations that verify the log-linear equations. Finally, it identifies the coefficients of the optimal allocations using the method of undetermined coefficients. A complete derivation for the general case in which portfolio returns and earnings are correlated, can be found in Appendix 2.

[18] Using a large Danish panel data set on labour incomes, they find that "...individuals require an increase of about 25 percent in their starting labour income in order to be willing to accept an increase in the variance of the permanent shock from its 25th percentile to its 75th percentile".

since $s > 0$. This is the non-human wealth effect empirically identified by Saks and Shore (2005); (ii) it also measures indirectly the extent to which the non-tradability of human capital matters for stockholdings. If final consumption is essentially financed by financial wealth (value of ϵ_e close to 1), the stockholder will behave as if markets were effectively complete. Conversely, if final consumption is essentially financed out of human wealth (value of ϵ_e close to 0), the stockholder will invest agressively in risky assets to take advantage of the positive portfolio return, while taking a more conservative strategy in choosing the time devoted to the risky occupation. The effect of ϵ_e on stockholdings is absent if human capital is tradable, for then (under independence) the optimal portfolio share is the myopic solution[19] :

$$\alpha^* = \frac{E\widetilde{z}}{\gamma\sigma_z^2} \tag{7}$$

$$\beta^* = \frac{1}{1-\epsilon}\left(\frac{s}{\gamma\sigma_i^2}\right) \tag{8}$$

Interestingly, the optimal occupational risk exposure is also weighted by the inverse elasticity of consumption to human wealth, $\frac{1}{1-\epsilon} \equiv 1 + \frac{\exp\{w_0\}}{\exp E\widetilde{y}_e}$, suggesting that the effect identified by Saks and Shore (2005) is also at work *even when human capital is tradable*[20].

Remark 3: More risk averse households (higher γ) rationally choose both safer occupations (6) and more conservative portfolios (5), *ceteris paribus*. This is what the next proposition formalizes:

Proposition 1 *When portfolio returns and labour earnings are independently distributed, both risks are complements even if earnings are non-tradable:* $\frac{d\alpha_{DM}}{d\beta_{DM}} > 0$.

Proof. See appendix 2. ([21]) ■

Hence *across occupations*, differences in risky asset demands are *positively correlated* with differences in non-diversifiable earnings risk.

Remark 4: However, *within occupations* (holding β_{DM} fixed) *individuals display a temperant reaction to earnings uncertainty.* If investments in human capital are sunk, non-tradable and the costs associated with switching occupations are considerable, earnings become effectively a background risk (β_{DM} fixed) as households age. Since CRRA preferences are in the HARA class,

[19] When we allow for an endogenous choice of earnings risk, and that risk can be traded, the budget constraint of the household becomes:

$$\widetilde{C} = \left(W_0 + \widetilde{Y}_e\right)(1 + \widetilde{R}_p)$$

and CRRA preferences together with portfolio returns and earnings being independent joint lognormally distributed guarantee that the "myopic" portfolio share is optimal. See Appendix 2 for a proof.

[20] When human capital is endogenous and tradable, the term $\frac{1}{1-\epsilon}$ captures an allocational imbalance in terms of human versus non-human wealth: if the household only has human wealth to finance consumption, it will still hold the myopic optimal portfolio share but will *ceteris paribus* choose a safer occupation than a household endowed with a very large non-human to human wealth ratio. Hence, it is not because human capital is non tradable that richer households choose high-risk high-return professions in terms of earnings, it is simply because being richer, their consumption depends less on earnings risk (DARA effect).

[21] Proceeding instead as Campbell and Viceira (2002, p.173) do (on the basis of the log-linearized first order Taylor expansion of endogenous earnings), one can find a sufficient condition that depends on the relative risk aversion coefficient γ, i.e. if $\gamma \geq \frac{1}{1-\epsilon_e}$ then $\frac{d\alpha_{DM}}{d\beta_{DM}} > 0$.

the *temperant* effect of a background risk on the optimal portfolio share (5) can be understood by decomposing the difference relative to the optimal portfolio share when markets are complete, (7) :[22]

$$\alpha_{DM} - \alpha^* = \left(\frac{1}{\epsilon_e}\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma} - \frac{E\widetilde{z}}{\sigma_z^2\gamma} \tag{9}$$

$$= \underbrace{\left(\frac{1}{\epsilon_e} - \frac{1}{\overline{\epsilon}}\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma}}_{\text{(-) Risk Substitution Effect (RSE)}} + \underbrace{\left(\frac{1}{\overline{\epsilon}} - 1\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma}}_{\text{(+) Income Effect (IE)}} \tag{10}$$

where $1 < \frac{1}{\epsilon_e} \equiv 1 + \frac{E\widetilde{Y}_e \exp\left\{-\frac{1}{2}\sigma_y^2\right\}}{\exp\{E\widetilde{r}_p + w_0\}} < \frac{1}{\overline{\epsilon}} \equiv 1 + \frac{E\widetilde{Y}_e}{\exp\{E\widetilde{r}_p + w_0\}}$, since $\sigma_y^2 > 0$ means that $\exp\left\{-\frac{1}{2}\sigma_y^2\right\} < 1$.

The equality from (9) to (10) follows from adding and subtracting the optimal portfolio $\frac{1}{\overline{\epsilon}}\frac{E\widetilde{z}}{\sigma_z^2\gamma}$ of a household with certain but non-tradable labour income $y = E\widetilde{Y}_e$. The first additive term in (10) captures the negative effect on the complete markets optimal share α^* of introducing an independent zero-mean background risk $\widetilde{\varepsilon} \equiv \widetilde{Y}_e - y : E\widetilde{\varepsilon} = 0$ (risk-vulnerable reaction, in Gollier and Pratt's, 1996, terminology). The second term in (10) captures the positive effect on α^* of introducing a degenerate independent background risk that assigns probability 1 to its positive mean $E\widetilde{Y}_e = y > 0$, and zero elsewhere. Since CRRA preferences display decreasing absolute risk aversion, richer households are more willing to invest in stocks[23].

Empirical Implication.

Because the variance of log-labour earnings is an increasing function of the optimal occupational risk exposure, $\frac{d\sigma_y^2}{d\beta_{DM}} > 0, \forall \beta_{DM} \in (0,1)$ ([24]), Proposition 1 implies that those households who are more exposed to earnings risk should also invest more in risky assets:

$$\alpha_{DM}^i \mathbf{1}_{\left\{i:\sigma_{y,i}^2 > med\sigma_y^2\right\}} - \alpha_{DM}^i \mathbf{1}_{\left\{i:\sigma_{y,i}^2 \leq med\sigma_y^2\right\}} > 0 \tag{11}$$

where $med\sigma_y^2$ denotes the *median value of the variance of log-earnings*, $\int_0^{med\sigma_y^2} dF(\sigma_y^2) = .5$, and is used as a bechmark.

Inserting (10) into (11), the effect of earnings uncertainty both *within* and *across* occupations

[22] In Arrondel *et al.* (2010) we adopt this same decomposition to study the tempering effect of a *correlated* background risk. Here instead, we assume that it is independently distributed of stock market risk, because the survey question exploited there (Delta-TNS 2002 survey) is unavailable in the data set exploited here (INSEE-Patrimoine 1998 survey).

[23] Campbell and Viceira (2002, pp. 172-3) examine instead the effect of a mean-preserving increase in log-labour earnings uncertainty (σ_y^2) on the optimal allocation to risky assets. Since our model coincides with theirs when the optimal level of exposure to earnings uncertainty is exogenous (β_{DM} fixed), the condition to observe a temperant reaction is the same: Only sufficiently risk averse individuals ($\gamma \geq \frac{1}{\epsilon_e}$) will tilt their portfolios away from risky assets when enduring a mean-preserving increase in earnings uncertainty, $\frac{d\alpha_{DM}}{d\sigma_y^2} < 0$. If however we examine the overall effect of a mean-preserving increase in log-labour earnings uncertainty (σ_y^2) on the optimal allocation to risky assets when β_{DM} is endogenous, even sufficiently risk averse individuals ($\gamma \geq \frac{1}{\epsilon_e}$) will tilt their portfolios ambiguously, $\frac{d\alpha_{DM}}{d\sigma_y^2} \lesseqgtr 0$. The reason is that they are now allowed to switch occupations (choose a safer job) to compensate for the increase in earnings risk. A proof is available upon request.

[24] Explicit expressions for σ_y^2 and $\frac{d\sigma_y^2}{d\beta}$ can be found in Appendix 2, proof of Proposition 1 part (1.i).

is:

$$\left\{ \left[\underbrace{\left(\frac{1}{\epsilon_e^i} - \frac{1}{\overline{\epsilon}^i}\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma^i}}_{\text{(-) RSE: Temperant reaction}} + \underbrace{\left(\frac{1}{\overline{\epsilon}^i} - 1\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma^i}}_{\text{(+) IE}} \right] \underbrace{\mathbf{1}_{\{i:\sigma_{y,i}^2 > med\sigma_y^2\}}}_{\text{HIGH risk occupations}} - \underbrace{\left[\underbrace{\left(\frac{1}{\epsilon_e^i} - \frac{1}{\overline{\epsilon}^i}\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma^i}}_{\text{(-) RSE: Temperant reaction}} + \underbrace{\left(\frac{1}{\overline{\epsilon}^i} - 1\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma^i}}_{\text{(+) IE}} \right] \underbrace{\mathbf{1}_{\{i:\sigma_{y,i}^2 \leq med\sigma_y^2\}}}_{\text{LOW risk occupations}} \right\}}_{\text{(+) ACROSS occupations: Self-selection}} > 0 \tag{12}$$

Hence, to properly identify a temperant reaction empirically, we need to identify occupations within which life-cycle earnings risk is relatively homogeneous since individuals self-select into them as a function of their risk preferences. Expression (12) then suggests to: (i) classify occupations in terms of their life-cycle earnings variance (or another measure of life-cycle earnings risk)[25], defining categorical occupational risk variables for each; (ii) within each category, find the median value of the earnings variance and define a second set of categorical variables, taking value 1 for those who have an earnings variance above the (within occupation risk) median; and finally, (iii) interact the two sets of categorical variables with the variance of earnings. The estimated coefficients for the interactions are predicted to be negative, i.e. the "*(-) RSE: Temperant reaction*" terms in (12), and their joint significance measures the added-up strenght of a *temperant* reaction within each occupation[26]. If the categorical occupational variables are also introduced by themselves (not interacted), and the less risky occupational category is used as reference, expression (12) predicts that the estimated dummy coefficients should be jointly significant and positive, i.e. the "*(+) ACROSS occupations: Self-selection*" term in (12) captures the degree of complementarity between earnings and portfolio risks. Although with the available cross-sectional survey data we cannot disentangle both, notice that according to it, the importance of earnings risk may have been seriously *underestimated* because of the two conflicting effects.

6 Conclusion

While the theory of temperant portfolio choice predicts a negative impact of uninsurable risks on the demand for risky assets, its empirical evaluation is quite a difficult task. Using a comparable methodology to Guiso *et al.* (1996), our empirical results do not support the proposition that income risk depresses households' demand for stocks in France even if we are able to control for differences in risk preferences, and for the potential endogeneity of the self-assessed income risk variable. But liquidity constraints are found to have an empirically sizeable negative impact.

[25] This has recently been done by Saks and Shore (2005) and Nielsen and Vissing-Jorgensen (2006) for the US and Denmark, respectively.

[26] If the size of the different occupational risks are compensated by differences in mean earnings as Nielsen and Vissing-Jorgensen (2006) suggest, then the income effect ("*(+)IE*" term in expression (12)) *within* occupations should be negligible in size and could be empirically ignored.

To rationalize these apparently contradictory findings, a theoretical explanation consistent with restrictions on preferences sufficient to trigger *temperant* portfolio rebalancing in the presence of a background risk is advanced, the origins of which date back to Drèze and Modigliani's (1966) unpublished work. When occupations can be characterized in terms of the riskiness in the associated life-cycle earnings profiles, individuals with different preferences for risk are going to self-select into them accordingly. Since the same risk preferences govern their financial decisions, more risk averse individuals are going to hold both safer occupations and more conservative portfolios. When switching occupations is very costly, and important irreversible investments are undertaken both at school or on the job, as individuals age they loose their ability to choose the optimal degree of occupational risk exposure, which effectively becomes a background risk. Hence, *across* occupations, individuals more exposed to earnings risk are also going to hold riskier portfolios, but to the extent that preferences satisfy the sufficient conditions to observe a temperant reaction, *within* occupations, individuals who are more exposed to earnings risk are also going to hold more conservative portfolios. To the extent that households choose their occupations early in their lives, and that information at that stage is at best incomplete, unanticipated income shocks in mid- or late stages of their life-cycles are likely to trigger a *temperant* reaction across occupations. The effect is re-inforced both by the sunk investments undertaken either at school or on-the-job, as well as by the substantial costs to switch (Kambourov and Manovskii, 2009) towards occupations carrying less earnings risk at the expense of a lower mean.The latter is what drives the negative effect of borrowing/liquidity constraints on financial risk exposure, empirically detected.

Being empirically difficult to disentangle both conflicting effects of earnings risk when exploiting the cross-sectional variation, it is likely that the actual magnitude of the negative impact of earnings uncertainty on households' portfolios has been underestimated. Age-specific group studies, like Lusardi (1998)[27], or realistically calibrated quantitative macroeconomic studies, like Benzoni et al. (2007)[28], point in that direction. Although here we have only examined the implications of a risk-return trade-off in occupational choice within a static portfolio choice model, its extension to an intertemporal dynamic framework promises fruitful future research.

7 References

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[27] Using a similarly elicited measure of earnings risk, Lusardi (1998) exploits the 1992 wave of the American HRS to conclude that the effect of income uncertainty on the savings of the elderly is economically sizable, when it shouldn't.

[28] Benzoni *et al.* (2007) develop a CRRA-Lognormal intertemporal portfolio choice model where labour income is exogenous and uninsurable, but co-integrated with stock market returns. Because of the latter, they are able to show that for reasonable degrees of relative risk aversion, young households opt to stay out from the stock market because earnings and financial returns are strongly positively correlated. It is an open question whether occupational choice would strenghten their insights.

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Appendix 1: Description of Main Variables

We mostly rely here on the "Patrimoine 98" household survey. A nationally representative sample of more than 10,000 households was drawn and a comprehensive interview survey of their wealth was conducted by French National Institute of Statistics (INSEE). Part of the questionnaire tries to give us a general idea of individuals' degree of exposure and aversion to risk, as subjectively perceived and assessed by them. It consists of a recto-verso questionnaire, which was distributed to the interviewees at the end of the first interview. This page submitted to the whole sample of 10,207 households must be filled in individually by the interviewee and his/her spouse (if applicable) and returned by post to the INSEE.

Total net wealth. In the survey, the individual is asked to say in which of the 9 predefined available brackets is her family. Since we are interested in a continuous measure we have used the method of simulated residuals (Gouriéroux et al., 1987). For each asset category, we have computed the value net of debt for each household. We have then regressed the net worth of each asset on some household characteristics. Once we have the estimated total net household wealth per asset category, a normally distributed error is added. After that, we check if the value falls inside the bracket chosen by the individual. If not, another normal error is added and so on until we predict the interval chosen. Doing so allows us to overcome the non-response problem for some households. If there is a missing value, the predicted value plus a normal error is directly used. Total net wealth is given in French francs.

Income. The survey directly asks each respondent to self-report income as a continuous variable. Income refers to the household's annual income in French francs.

Income risk. To construct a proxy for the subjective standard deviation of expected household income, each household is asked to distribute 100 points between different scenarios regarding the evolution of income in the next five years. The procedure mimics the wording in the 1989 " Survey of Household Income and Wealth " (SHIW) carried out by the Bank of Italy, successfully exploited by Guiso et al. (1996), and subsequently loathed by Dominitz and Manski (1997) :

'Within the next 5 years, your household income (earnings, pension), excluding the rise in prices, will have:

-... increased by more than 25%

-... increased by 10 to 25%

-... increased by less than 10%

-... will be constant

-... will have decreased by less than 10%

-... will have decreased by 10 to 25%

-... will have decreased by more than 25%

-... will have marked ups and downs (indicate the minimum and maximum annual income)

You dispose of 100 points to be distributed among the 8 items, according to the degree to which you agree or you disagree with the relative statement.'

The respondent is asked about the subjective relative likelihood $\left(p_k^i\right)$ of different scenarios (k) regarding the percentage change (y) in households' real income five years ahead from the time of the interview,

$y = \frac{y_{t+5}}{y_t} - 1$:

$$p_k^i \equiv \Pr{}_i[y \in \{k\}] = \Pr{}_i\left[\underline{y}_k \leq \frac{y_{t+5}}{y_t} - 1 \leq \overline{y}_k\right]$$

Where for example, scenario $k = 1$ specifies a range of values in the support of the expected income percent change y given by $\left(\underline{y}_k, \overline{y}_k\right) = (.25, +\infty)$. Combining the subjective relative likelihoods, with the median points of the different ranges (imposing a uniform within each subinterval), we can impute a subjective variance (σ_y^2) for the expected five-year ahead percent change (Ey) in each respondent's income,

$$\sigma_y^2 = \sum_k p_k^i (med_k\{y\} - Ey)^2.$$

Since the upper and lower subintervals are unbounded, we impose bounds of $\pm.5$ and ± 1, corresponding to 50% and 100% changes respectively. Since $y = \frac{y_{t+5}}{y_t} - 1$, $\sigma_y^2 = \frac{Var(y_{t+5})}{y_t^2} \equiv \frac{\sigma^2}{y^2}$. We assume that the variance of household income can be proxied by the variance estimated by the respondent or, when there were two respondents in the household, the variance evaluated by the head of the household.

(Table A1 about here)

Table A1 displays the frequency distribution of the ratio of the subjective standard deviation of expected household real income to current income (σ/y). Two such measures are calculated depending on the values adopted for the upper and lower bounds (respectively 50 and 100%). More than forty percent of those surveyed hold point expectations about five-year-ahead real income changes. For almost half (46 percent) of the respondents, the standard error is between 0 and 10 percent. Only five percent display a measure of uncertainty exceeding 15 percent. For the whole sample, the mean of the standard error of earnings to current income ratio is about 6.2 (resp. 14.9) percent.

Relative Risk Aversion. To obtain a measure of risk aversion, we asked individuals about their willingness to gamble on lifetime income according to the methodology of Barsky et al. (1997). The "game" resides in determining sequentially whether the interviewee would accept to give up his present income and to accept other contracts, in the form of lotteries: he has one chance in two to double his income, and one chance in two for it to be reduced by one third (contract A), by one half (contract B), and by one fifth (contract C). More precisely, the question in the survey was:

'Suppose that you have a job which guarantees for life your household's current income R. Other companies offer you various contracts which have one chance out of two (50%) to provide you with a higher income and one chance out of two (50%) to provide you with a lower income.

Are you prepared to accept Contract A which has 50% chances to double your income R and 50% chances that your income will be reduced by one third?

For those who answer YES : the Contract A is no longer available. You are offered Contract B instead which has 50% chances to double your income R and 50% chances that it will be reduced by one half. Are you prepared to accept?

For those who answer NO : you have refused Contract A. You are offered Contract C. which has 50% chances to double your income R and 50% chances that it will be reduced by 20%. Are you prepared to accept?'

This allows us to obtain a range measure of relative risk aversion under the assumption that preferences are strictly risk averse and utility is of the CRRA type. The degree of relative risk aversion is less than 1 if the individual successively accepts contracts A and B; between 1 and 2 if he accepts A but refuses B; between 2 and 3.76 if he refuses A but accepts C; and finally more than 3.76 if he refuses both A and C. Among the 4,633 respondents to the questionnaire, 3,483 individuals participated in the lottery.

(Table A2 about here)

Table A2 reports the fraction of all respondents (first line) and of those older than 50 (second line) who fall into the four risk aversion categories. The results in the second line can be compared to those obtained by Kimball et al. (2008) for the Health and Retirement Survey waves of 1992 (third line) and 1998 (fourth line): most of the respondents in the U.S. are in the high risk aversion category (76% and 74%, respectively, refuse contract A), very much as in France (85%). The main difference between the two countries resides in the distribution between those who accept/reject contract C: In France, 43 percent of those who reject contract A accept contract C, while in the U.S., only 15 percent accept job C (23% in 1998). Although in France only 6 percent accept contract B, in the U.S. the acceptance rate fluctuates from more than twice in 1992 (12.8%) to a similar 7.3 percent in 1998. Kimball et al. (2008) argue that the discrepancy can be explained by the status quo bias from which the wording of the question suffered previous to the 1998 HRS waves. Notice that the wording of the question in French places the respondent in a hypothetical (status quo bias free) situation.

(Table A3 about here)

Table A3 reports the extent to which measured risk aversion predicts risky behaviour in different settings, in an attempt to partially validate it. Since the dependent variables are qualitative (except for income risk, σ/y) we estimate some simple ordered probits (tobit) as a function of the categorical risk aversion variable, and some covariates (constant, age, sex, education, occupational dummies, labor earnings, marital status, number of children, past and current unemployment status, health status and a urban/rural categorical variable). The estimation of the effect of risk aversion on income risk includes, in addition of the aforementioned covariates for the household head, some characteristics related to the parents' head background: social status, a categorical variable taking value 1 if parents experienced financial difficulties during the respondent's youth and categorical variables for the composition of the parents' portfolio. From the table, one can see that measured risk aversion does strongly and significantly explain occupational risk exposure and financial risk taking[29], and to a lesser extent, horse race betting, and playing in the National lottery, slot machines or in casinos.

Appendix 2: Proofs

Derivation of expressions (5) and (6): Earnings are endogenous but non-tradable.

[29] Financial risk taking is captured by a categorical variable with four outcomes, intended to capture the attitude of the respondent towards the wishful balance between safe and risky assets when it comes to place her savings. The wording of the question is (as a fraction of respondents):

Regarding financial investments, do you think that:

(a) one should not take risks; all of one's savings should be invested in safe assets, (69.5%)

(b) a small share of one's savings should be invested in riskier assets, (26.7%)

(c) a large share of one's savings should be invested in risky assets if potential gains make it worthwile, (2.9%)

(d) the bulk of one's savings should be invested in risky assets once there is a chance of very high potential gains (0.9%)

We fully describe Campbell and Viceira's (2002) log-linear approximate solution method while deriving Drèze and Modigliani's (1966) main result in a CRRA-Lognormal framework. We start from the household budget constraint, (2), and substitute in household's earnings (3):

$$\widetilde{C}(\alpha,\beta)=\left[(1+R)+\alpha(\widetilde{R}-R)\right]W_0+I+\beta(\widetilde{I}-I).$$

Dividing the budget constraint by $\widetilde{Y}_e$ and taking logs yields

$$\widetilde{c}-\widetilde{y}_e=\log\left[1+\exp\left\{\widetilde{r}_p+w_0-\widetilde{y}_e\right\}\right],$$

where $\exp\{\widetilde{r}_p\}\equiv(1+\widetilde{R}_p)$. Taking a first order Taylor expansion of the log-budget constraint around $E\{\widetilde{r}_p+w_0-\widetilde{y}_e\}$ yields[30]:

$$\begin{aligned}\log\left[1+\exp\left\{\widetilde{r}_p+w_0-\widetilde{y}_e\right\}\right]\simeq\ & \log\left[1+\exp E\left\{\widetilde{r}_p+w_0-\widetilde{y}_e\right\}\right]-\\ & -\tfrac{\exp E\{\widetilde{r}_p+w_0-\widetilde{y}_e\}}{1+\exp E\{\widetilde{r}_p+w_0-\widetilde{y}_e\}}E\left\{\widetilde{r}_p+w_0-\widetilde{y}_e\right\}+\\ & +\underbrace{\frac{\exp E\left\{\widetilde{r}_p+w_0-\widetilde{y}_e\right\}}{1+\exp E\left\{\widetilde{r}_p+w_0-\widetilde{y}_e\right\}}}_{\equiv\epsilon_e<1}\left\{\widetilde{r}_p+w_0-\widetilde{y}_e\right\}\end{aligned}$$

And using the definition of ϵ, we can rewrite the first two terms on the RHS as $\log\left[\frac{1}{1-\epsilon_e}\right]$ and $-\epsilon_e\log\left[\frac{\epsilon_e}{1-\epsilon_e}\right]$ and define the constant $k_e\equiv\log\left[\frac{1}{1-\epsilon_e}\right]-\epsilon_e\log\left[\frac{\epsilon_e}{1-\epsilon_e}\right]$ so that the log-budget constraint becomes:

$$\widetilde{c}=k_e+\epsilon_e\left\{\widetilde{r}_p+w_0\right\}+(1-\epsilon_e)\widetilde{y}_e$$

Rewriting the return of the portfolio as $\frac{1+\widetilde{R}_p}{1+R}=1+\alpha\left[\frac{1+\widetilde{R}}{1+R}-1\right]$ and taking logs, yields

$$\widetilde{r}_p-r=\log\left[1+\alpha\left(\exp\left[\widetilde{r}-r\right]-1\right)\right].$$

Taking a second order Taylor expansion of the RHS around $\widetilde{r}-r=0$:

$$\begin{aligned}\log\left[1+\alpha\left(\exp\left[\widetilde{r}-r\right]-1\right)\right]\simeq\ & \log\left[1+\alpha\left(\exp\left[0\right]-1\right)\right]+\tfrac{\alpha\exp[0]}{1+\alpha(\exp[0]-1)}\left[\widetilde{r}-r\right]+\\ & +\tfrac{1}{2}\tfrac{\alpha[1+\alpha(\exp[0]-1)]-(\alpha\exp[0])^2}{[1+\alpha(\exp[0]-1)]^2}\left[\widetilde{r}-r\right]^2\end{aligned}$$

And the excess log portfolio return becomes $\widetilde{r}_p-r=\alpha\left[\widetilde{r}-r\right]+\frac{1}{2}\alpha(1-\alpha)\left[\widetilde{r}-r\right]^2$. The authors further replace $\left[\widetilde{r}-r\right]^2$ by its expectation $E\left[\widetilde{r}-r\right]^2\equiv\sigma^2$ so that,

$$\widetilde{r}_p=r+\alpha\left[\widetilde{r}-r\right]+\frac{1}{2}\alpha(1-\alpha)\sigma^2 \tag{A.1}$$

Rewriting labour earnings as $\frac{\widetilde{Y}_e}{I}=1+\beta\left[\frac{\widetilde{I}}{I}-1\right]$ and taking logs, yields $\widetilde{y}_e-i=\log\left[1+\beta\left(\exp\left[\widetilde{i}-i\right]-1\right)\right]$.

[30] In the expression we keep the tildes above the random variables to clarify the exposition. Strictly speaking, the Taylor expansion is done for all possible realizations of the random variables, so that the tildes do not appear.

Taking a second order Taylor expansion of the RHS around $\widetilde{i} - i = 0$ yields:

$$\begin{aligned}\log\left[1+\beta\left(\exp\left[\widetilde{i}-i\right]-1\right)\right] \simeq\ & \log\left[1+\beta\left(\exp\left[0\right]-1\right)\right] + \tfrac{\beta \exp[0]}{1+\beta(\exp[0]-1)}\left[\widetilde{i}-i\right] + \\ & + \tfrac{1}{2}\tfrac{\beta[1+\beta(\exp[0]-1)]-(\beta\exp[0])^2}{[1+\beta(\exp[0]-1)]^2}\left[\widetilde{i}-i\right]^2\end{aligned}$$

Since the authors further replace $\left[\widetilde{i}-i\right]^2$ by its expectation $E\left[\widetilde{i}-i\right]^2 \equiv \sigma_i^2 = \sigma_\tau^2$, household log income becomes:

$$\widetilde{y}_e = i + \beta\left[\widetilde{i}-i\right] + \frac{1}{2}\beta(1-\beta)\sigma_i^2 \tag{A.2}$$

Both expressions (A.1) and (A.2) hold exactly in continuous time. Replacing them in the log-budget constraint yields:

$$\widetilde{c} = k + \epsilon_e\left\{r + \alpha\left[\widetilde{r}-r\right] + \frac{1}{2}\alpha(1-\alpha)\sigma^2 + w_0\right\} + (1-\epsilon_e)\left\{i + \beta\left[\widetilde{i}-i\right] + \frac{1}{2}\beta(1-\beta)\sigma_i^2\right\}$$

Now solving the program:

$$\max_{\alpha,\beta} Eu\left[\widetilde{C}(\alpha,\beta)\right] = \max_{\alpha,\beta}\frac{1}{1-\gamma}E\left[\widetilde{C}(\alpha,\beta)\right]^{1-\gamma}$$

Yields the FOCs:

$$\begin{aligned}E\left[\widetilde{C}(\alpha,\beta)^{-\gamma}(\widetilde{R}-R)W_0\right] &= 0\\ E\left[\widetilde{C}(\alpha,\beta)^{-\gamma}(\widetilde{I}-I)\right] &= 0\end{aligned}$$

which are the standard Euler conditions. They can be rewritten as $E\left[\widetilde{C}(\alpha,\beta)^{-\gamma}(1+\widetilde{R})\right] = E\left[\widetilde{C}(\alpha,\beta)^{-\gamma}(1+R)\right]$ and $E\left[\widetilde{C}(\alpha,\beta)^{-\gamma}(\widetilde{I})\right] = E\left[\widetilde{C}(\alpha,\beta)^{-\gamma}(I)\right]$. Taking logs of both sides in both, and using the facts: (i) $\widetilde{C}, \widetilde{I}$ and $(1+\widetilde{R})$ are jointly lognormally distributed, (ii) $\log EX = E\log X + \frac{1}{2}V\log X$ and (iii) $X \sim \log N(E\log X, V\log X) \Longrightarrow X^t \sim \log N(tE\log X, t^2 V\log X)$ we obtain:

$$\begin{aligned}-\gamma E\widetilde{c} + E\widetilde{r} + \tfrac{1}{2}\gamma^2\sigma_c^2 + \tfrac{1}{2}\sigma^2 - \gamma Cov(\widetilde{c},\widetilde{r}) &= -\gamma E\widetilde{c} + r + \tfrac{1}{2}\gamma^2\sigma_c^2\\ -\gamma E\widetilde{c} + E\widetilde{i} + \tfrac{1}{2}\gamma^2\sigma_c^2 + \tfrac{1}{2}\sigma_i^2 - \gamma Cov(\widetilde{c},\widetilde{i}) &= -\gamma E\widetilde{c} + i + \tfrac{1}{2}\gamma^2\sigma_c^2\end{aligned}$$

Which simplifiy to:

$$\begin{aligned}E\widetilde{r} - r + \tfrac{1}{2}\sigma^2 &= \gamma Cov(\widetilde{c},\widetilde{r})\\ E\widetilde{i} - i + \tfrac{1}{2}\sigma_i^2 &= \gamma Cov(\widetilde{c},\widetilde{i})\end{aligned}$$

And substituting in the approximated log-budget constraint derived above, yields:

$$\begin{aligned}E\widetilde{r} - r + \tfrac{1}{2}\sigma^2 &= \gamma\epsilon_e\sigma^2\alpha + \gamma(1-\epsilon_e)\sigma_{ir}\beta\\ E\widetilde{i} - i + \tfrac{1}{2}\sigma_i^2 &= \gamma\epsilon_e\sigma_{ir}\alpha + \gamma(1-\epsilon_e)\sigma_i^2\beta\end{aligned}$$

And solving the system of equations in α and β yields:

$$\begin{aligned} \alpha_{DM} = & \quad \frac{1}{\epsilon_e}\left[\left(\frac{1}{1-\rho^2}\right)\frac{E\widetilde{z}}{\gamma\sigma_z^2} - \left(\frac{\rho^2}{1-\rho^2}\right)\frac{s}{\gamma\sigma_{iz}}\right] \\ \beta_{DM} = & \quad \frac{1}{1-\epsilon_e}\left[\left(\frac{1}{1-\rho^2}\right)\frac{s}{\gamma\sigma_i^2} - \left(\frac{\rho^2}{1-\rho^2}\right)\frac{E\widetilde{z}}{\gamma\sigma_{iz}}\right] \end{aligned}$$

Where we have denoted $E\widetilde{z} \equiv E\widetilde{r} - r + \frac{\sigma^2}{2} = \log\frac{E[1+\widetilde{R}]}{[1+R]}$ the log expected excess returns, $\sigma_z^2 \equiv \sigma^2$ the variance of the log excess returns and by $\sigma_{iz} \equiv Cov(\widetilde{i} - i, \widetilde{r} - r) = Cov(\widetilde{i}, \widetilde{r}) = \sigma_{ir}$ the covariance between log excess earnings and the log excess returns, so that $\rho = \frac{\sigma_{iz}}{\sigma_i\sigma_z}$ corresponds to the correlation coefficient between both. Finally, $s \equiv E\widetilde{i} - i + \frac{\sigma_i^2}{2} = \log\frac{E\widetilde{I}}{I}$ is the log expected excess earnings and $\sigma_i^2 (= \sigma_\tau^2)$ the variance of the log excess earnings.

Setting $\rho = 0$, expressions (5) and (6) in the main text obtain.

Derivation of expressions (7) and (8): Earnings are endogenous and tradable.

It proceeds in the same way as above, except that the budget constraint is now:

$$\widetilde{C}(\alpha, \beta) = \left[(1+R) + \alpha(\widetilde{R} - R)\right]\left[W_0 + I + \beta(\widetilde{I} - I)\right].$$

Dividing it by $\widetilde{Y}_{cm}$, and taking logs on both sides, yields $\widetilde{c} - \widetilde{y}_{cm} = \widetilde{r}_p + \log\left[1 + \exp\left\{w_0 - \widetilde{y}_{cm}\right\}\right]$. Taking a first order Taylor expansion of the log-budget constraint around $E\left\{w_0 - \widetilde{y}_{cm}\right\}$:

$$\begin{aligned} \log\left[1 + \exp\left\{w_0 - \widetilde{y}_{cm}\right\}\right] \simeq & \quad \log\left[1 + \exp E\left\{w_0 - \widetilde{y}_{cm}\right\}\right] - \\ & - \frac{\exp E\{w_0 - \widetilde{y}_{cm}\}}{1 + \exp E\{w_0 - \widetilde{y}_{cm}\}} E\left\{w_0 - \widetilde{y}_{cm}\right\} + \\ & + \underbrace{\frac{\exp E\left\{w_0 - \widetilde{y}_{cm}\right\}}{1 + \exp E\left\{w_0 - \widetilde{y}_{cm}\right\}}}_{\equiv \epsilon < 1}\left\{w_0 - \widetilde{y}_{cm}\right\} \end{aligned}$$

And using the definition of ϵ, we can rewrite the first two terms on the RHS as $\log\left[\frac{1}{1-\epsilon}\right]$ and $-\epsilon\log\left[\frac{\epsilon}{1-\epsilon}\right]$ and define the constant $k \equiv \log\left[\frac{1}{1-\epsilon}\right] - \epsilon\log\left[\frac{\epsilon}{1-\epsilon}\right]$ so that the log-budget constraint becomes:

$$\widetilde{c} = k + \widetilde{r}_p + \epsilon w_0 + (1-\epsilon)\widetilde{y}_{cm}$$

Since expressions (A.1) and (A.2) remain the same, we can insert them in the log-budget constraint:

$$\widetilde{c} = k + r + \alpha\left[\widetilde{r} - r\right] + \frac{1}{2}\alpha(1-\alpha)\sigma^2 + \epsilon w_0 + (1-\epsilon)\left\{i + \beta\left[\widetilde{i} - i\right] + \frac{1}{2}\beta(1-\beta)\sigma_i^2\right\}$$

which substituted into the unchanged above log-Euler equations, yields:

$$\begin{aligned} E\widetilde{r} - r + \tfrac{1}{2}\sigma^2 &= \gamma\sigma^2\alpha + \gamma(1-\epsilon)\sigma_{ir}\beta \\ E\widetilde{i} - i + \tfrac{1}{2}\sigma_i^2 &= \gamma\sigma_{ir}\alpha + \gamma(1-\epsilon)\sigma_i^2\beta \end{aligned}$$

And solving the system of equations in α and β yields:

$$\begin{aligned} \alpha^* &= \left[\left(\tfrac{1}{1-\rho^2}\right)\tfrac{E\widetilde{z}}{\gamma\sigma_z^2} - \left(\tfrac{\rho^2}{1-\rho^2}\right)\tfrac{s}{\gamma\sigma_{iz}}\right] \\ \beta^* &= \tfrac{1}{1-\epsilon}\left[\left(\tfrac{1}{1-\rho^2}\right)\tfrac{s}{\gamma\sigma_i^2} - \left(\tfrac{\rho^2}{1-\rho^2}\right)\tfrac{E\widetilde{z}}{\gamma\sigma_{iz}}\right] \end{aligned}$$

If portfolio returns and earnings are independent, $\rho = 0$, and expressions (7) and (8) obtain.

Proof of Proposition 1.

The proof proceeds in two steps: (1.i) we obtain the exact moments of the distribution of endogenous earnings $\widetilde{Y}_e$, instead of using its log-linearized first order Taylor expansion (A.2), and (1.ii) we compute the derivative $\frac{d\alpha_{DM}}{d\beta_{DM}}$ using the chain rule of differentiation:

(1.i) Moments of the distribution of earnings $\widetilde{Y}_e$

Here we show that $\widetilde{Y}_e \sim LN(\mu_y, \sigma_y^2)$ with $\mu_y \equiv E\ln\widetilde{Y}_e$, $\sigma_y^2 \equiv Var\ln\widetilde{Y}_e$.

Consider the expressions for labour earnings, (3), and for earnings in the risky occupation, (4). From the latter, we have that:

$$\begin{aligned} \ln\widetilde{I} &= \ln I + s + \widetilde{\tau} \Longrightarrow \ln\widetilde{I} \sim N(\mu_i, \sigma_i^2): \\ \mu_i &= \ln I + s - \frac{1}{2}\sigma_\tau^2, \sigma_i^2 = \sigma_\tau^2 \end{aligned}$$

Hence:

$$\widetilde{I} \sim LN(\mu_i, \sigma_i^2)$$

implying that:

$$\beta\widetilde{I} \sim LN(\mu_i + \ln\beta, \sigma_i^2) \tag{13}$$

and from the properties of lognormally distributed variables, we have that $(1-\beta)I + \beta\widetilde{I} = \widetilde{Y}_e$ is going to be distributed as a shifted lognormal, with location parameter $(1-\beta)I$:

$$\widetilde{Y}_e = (1-\beta)I + \beta\widetilde{I} \sim LN(\mu_y, \sigma_y^2)$$

Finally, we find out μ_y and σ_y^2 using the conditions:

$$E\widetilde{Y}_e = (1-\beta)I + E(\beta\widetilde{I}) \tag{14}$$

$$Var\widetilde{Y}_e = Var(\beta\widetilde{I}) \tag{15}$$

From (13), we have that the RHS of (14) and (15) equal respectively:

$$(1-\beta)I + E(\beta\widetilde{I}) = (1-\beta)I + \exp\left\{\mu_i + \ln\beta + \frac{1}{2}\sigma_i^2\right\} \tag{16}$$

$$Var(\beta\widetilde{I}) = \beta^2\exp\left\{2\mu_i + \sigma_i^2\right\}\left[\exp\left\{\sigma_i^2\right\} - 1\right] \tag{17}$$

whereas from $\widetilde{Y}_e \sim LN(\mu_y, \sigma_y^2)$, the LHS of (14) and (15) equal respectively:

$$E\widetilde{Y}_e = \exp\left\{\mu_y + \frac{1}{2}\sigma_y^2\right\} \tag{18}$$
$$Var\widetilde{Y}_e = \exp\left\{2\mu_y + \sigma_y^2\right\}\left[\exp\left\{\sigma_y^2\right\} - 1\right] \tag{19}$$

Inserting these expressions into the LHS and the RHS of (14) and (15), we obtain:

$$\begin{aligned}
\mu_y &= \ln\left[(1-\beta)I + \exp\left\{\mu_i + \ln\beta + \frac{1}{2}\sigma_i^2\right\}\right] - \frac{1}{2}\sigma_y^2 \\
\sigma_y^2 &= \ln\left[1 + \frac{\exp\left\{2(\mu_i + \ln\beta) + \sigma_i^2\right\}\left[\exp\left\{\sigma_i^2\right\} - 1\right]}{\left[(1-\beta)I + \exp\left\{\mu_i + \ln\beta + \frac{1}{2}\sigma_i^2\right\}\right]^2}\right]
\end{aligned}$$

further substitution of the expression for σ_y^2 above into μ_y, as well as the expressions for μ_i and σ_i^2 into both, yields:

$$\begin{aligned}
\mu_y &= \ln\left[\frac{\left[(1-\beta)I + \beta I\exp\{s\}\right]^2}{\left[(1-\beta)I + \beta I\exp\{s\} + (\beta I)^2\exp\{2s\}\left[\exp\left\{\sigma_\tau^2\right\} - 1\right]\right]^{\frac{1}{2}}}\right] \\
\sigma_y^2 &= \ln\left[1 + \frac{(\beta I)^2\exp\{2s\}\left[\exp\left\{\sigma_\tau^2\right\} - 1\right]}{\left[(1-\beta)I + \beta I\exp\{s\}\right]^2}\right]
\end{aligned}$$

Notice that $\frac{d\sigma_y^2}{d\beta} = \frac{2\beta I^3\exp\{2s\}\left[\exp\left\{\sigma_\tau^2\right\}-1\right]}{\exp\left\{\sigma_y^2\right\}\left[(1-\beta)I+\beta I\exp\{s\}\right]^3} > 0$.

(1.ii) Computing the derivative $\frac{d\alpha_{DM}}{d\beta_{DM}}$ *using the chain rule of differentiation:*

$$\begin{aligned}
\frac{d\alpha_{DM}}{d\beta_{DM}} &= \frac{d\alpha_{DM}}{d\epsilon_e}\frac{d\epsilon_e}{d\beta_{DM}} \\
&= \frac{d\alpha_{DM}}{d\epsilon_e}\left(\frac{\partial\epsilon_e}{\partial E\widetilde{y}_e}\frac{dE\widetilde{y}_e}{d\beta_{DM}}\right), \forall(\alpha,\beta) \in (0,1)^2
\end{aligned}$$

where $\frac{d\alpha_{DM}}{d\epsilon_e} = -\frac{\alpha_{DM}}{\epsilon_e} < 0$, $\frac{\partial\epsilon_e}{\partial E\widetilde{y}_e} = -(1-\epsilon_e) < 0$ and, after tedious algebraic computations:

$$\frac{dE\widetilde{y}_e}{d\beta_{DM}} = \frac{3[(1-\beta)I+\beta I\exp\{s\}]I(\exp\{s\}-1)+[\beta I(\exp\{s\}-1)-1]2\beta I^2\exp\{2s\}\left[\exp\left\{\sigma_\tau^2\right\}-1\right]}{2[(1-\beta)I+\beta I\exp\{s\}]\left[(1-\beta)I+\beta I\exp\{s\}+(\beta I)^2\exp\{2s\}[\exp\{\sigma_\tau^2\}-1]\right]} > 0$$

if $I > \frac{1}{\beta(\exp\{s\}-1)}$, a merely technical restriction.[31] Hence $\frac{d\alpha_{DM}}{d\beta_{DM}} > 0$.

[31] For realistic values of I and s, only when $\beta \to 0^+$ will the condition be violated. But, under the condition that $s > 0$, $\beta \in (0,1)$ because risk aversion only has a second order effect under CRRA preferences (as in the classic Arrow portfolio choice problem).

Table 1. Sample Characteristics: "Patrimoine 98" INSEE survey

Average household's characteristics	**Respondents**	**Total sample**
Total net wealth (mean in French francs)	749,000	701,500
Financial wealth (mean in French francs)	245,000	220,000
Household income (mean in French francs)	156,750	152,800
Direct stockholdings* (1)*:		
Mean share (% of financial wealth)	19.0	21.0
In total sample (% of households)	20.5	15.0
Direct and indirect stockholdings* (2)*:		
Mean share (% of financial wealth)	27.0	27.8
In total sample (% of households)	30.0	23.1
Age of head (% of households)		
less than 30 years old	11.5	11.8
30-40 years old	17.3	19.1
40-50 years old	18.8	20.3
50-60 years old	16.1	15.9
60-70 years old	15.3	13.4
more than 70 years old	21.1	19.5
Social status of head (% of households)		
Farmer	4.6	5.1
Self employed (small production unit)	7.0	8.3
Self employed (big production unit)	0.2	0.4
Liberal profession	1.1	1.1
Executive	13.8	11.8
High qualified employee	21.8	18.8
Low qualified employee	20.0	19.4
High qualified workers	18.6	20.9
Low qualified workers	9.9	11.6
Inactive	2.8	2.7
Education of the head (% of households)		
No diploma	16.7	20.8
Primary school	33.4	33.7
High school	14.7	14.5
Some college	14.2	13.0
College	12.7	11.3
More than college	8.3	6.7
Household composition (% of households)		
Single	32.6	30.0
Couple without children	28.7	26.0
Couple with one child	12.0	13.3
Couple with two children	11.6	13.2
Couple with three children or more	5.3	6.9
Single with children	5.9	6.4
Other cases	3.8	4.2
Urban resident (%)	56.1	59.5
Probability of liquidity constraints (% of households)	11.7	9.8
Relative risk aversion (CRRA)(3)(4)		
3.76 ≤ CRRA	41.3	
2≤CRRA<3.76	40.2	
1≤CRRA<2	11.9	
CRRA < 1	6.5	
Coefficient of variation of earnings(4)(5)	6.2-14.9	
Number of households	2,954	10,207

Source: "Patrimoine 98" INSEE survey

(1) Direct stockholding : the household holds equities directly

(2) Direct and indirect stockholding : the household holds equities either directly or through mutual funds

(3) The coefficient of relative risk aversion constructed as in Barsky *et al.* (1997).

(4) Household's characteristics refer to the head except for income risk and relative risk aversion. For these two variables, when there were two respondents, we imputed the one corresponding to the head of the household.

(5) Since five year ahead real income increases were unbounded above and below in the questionnaire, the two reported values for mean income risk are computed imposing lower and upper bounds of 50% of real income increases, and 100% respectively.

Table 2a. The demand for risky assets*

	Direct stockholding			*Direct and indirect stockholding*		
Variables	**(1) Probit**	**(2) Demand equation[(1)]**	**(3) Tobit[(1)]**	**(4) Probit**	**(5) Demand equation[(1)]**	**(6) Tobit[(1)]**
	Est. (s.e.)	Est. (s.e.)	Est. (s.e.)	Est. (s.e.)	Est. (s.e.)	Est. (s.e.)
Total net wealth (10E-7)	4.017 (0.409)	1.401 (1.500)	1.052 (0.116)	4.929 (0.409)	-0.184 (1.599)	1.329 (0.124)
Total net wealth squared (10E-14)	-2.003 (0.295)	-0.070 (0.817)	-0.487 (0.082)	-2.618 (0.288)	0.926 (0.927)	-0.634 (0.090)
Income (log.)	0.120 (0.066)	-0.159 (0.155)	0.026 (0.018)	0.048 (0.058)	-0.089 (0.138)	0.008 (0.018)
Income risk (standard error of future income*10E	0.418 (0.247)	-0.315 (0.513)	0.102 (0.070)	0.556 (0.242)	-0.700 (0.484)	0.125 (0.074)
Age(10E-1)	0.233 (0.151)	-0.447 (0.352)	0.057 (0.044)	0.277 (0.141)	0.040 (0.323)	0.109 (0.045)
Age squared (10E-2)	-0.018 (0.014)	0.049 (0.033)	-0.004 (0.004)	-0.020 (0.013)	0.008 (0.030)	-0.007 (0.004)
Education						
Primary school	0.145 (0.125)		0.029 (0.037)	0.104 (0.115)		0.019 (0.037)
High school	0.239 (0.143)		0.069 (0.042)	0.403 (0.130)		0.131 (0.042)
Some college	0.348 (0.139)		0.099 (0.040)	0.425 (0.129)		0.143 (0.041)
College	0.428 (0.148)		0.115 (0.043)	0.445 (0.138)		0.153 (0.044)
More than college	0.460 (0.154)		0.114 (0.044)	0.496 (0.146)		0.154 (0.046)
Parents own risky assets	0.413 (0.088)		0.108 (0.025)	0.328 (0.087)		0.094 (0.027)
Proxy for liquidity constraints	-1.765 (0.597)	0.762 (1.800)	-0.513 (0.173)	-2.337 (0.558)	3.044 (1.832)	-0.707 (0.180)
Constant relative risk aversion (CRRA)						
No answer	0.236 (0.104)	0.276 (0.249)	0.064 (0.030)	0.165 (0.098)	0.157 (0.225)	0.052 (0.031)
2≤CRRA<3.76	0.238 (0.078)	0.260 (0.193)	0.075 (0.023)	0.185 (0.074)	0.005 (0.174)	0.056 (0.024)
1≤CRRA<2	0.177 (0.116)	0.434 (0.271)	0.071 (0.033)	0.150 (0.110)	0.407 (0.247)	0.073 (0.035)
CRRA<1	0.284 (0.146)	0.183 (0.339)	0.088 (0.042)	0.273 (0.140)	0.364 (0.306)	0.104 (0.044)
Constant	-3.712 (0.787)	0.069 (2.321)	-0.951 (0.225)	-2.825 (0.696)	-0.861 (2.116)	-0.887 (0.221)
Inverse Mills ratio		0.173 (0.449)			-0.457 (0.456)	
$\chi^2(17)$ or Pseudo R2	278.38		0.208	381.58		0.219
Number of observations	2,384	467	2,384	2,384	617	2,384

Source: "Patrimoine 98" INSEE survey.

(1) The dependent variable in demand equation (2) is the logistic transformation of the share (p) of risky assets in financial wealth: log p/(1-p). In Tobit estimation (3), the dependent variable is the share of risky assets in financial wealth.

(2) Since five year ahead real income increases were unbounded above and below in the questionnaire, income risk is computed imposing lower and upper bounds of 50% of real income increases.

* Households' characteristics refer to the head except for income risk and relative risk aversion. For these two variables, when there were two respondents, we imputed the one corresponding to the head of the household. Reference groups are: no diploma, single, CRRA≥ 3.76, no specific management.

Table 2b. The demand for risky assets*

	Direct stockholding			Direct and indirect stockholding		
Variables	**(1) Probit** Est. (s.e.)	**(2) Demand equation[(1)]** Est. (s.e.)	**(3) Tobit[(1)]** Est. (s.e.)	**(4) Probit** Est. (s.e.)	**(5) Demand equation[(1)]** Est. (s.e.)	**(6) Tobit[(1)]** Est. (s.e.)
Total net wealth (10E-7)	4.026 (0.409)	1.428 (1.503)	1.053 (0.116)	4.935 (0.409)	-0.142 (1.596)	1.329 (0.123)
Total net wealth squared (10E-14)	-1.977 (0.294)	-0.114 (0.811)	-0.481 (0.082)	-2.583 (0.287)	0.844 (0.916)	-0.625 (0.090)
Income (log.)	0.132 (0.065)	-0.184 (0.155)	0.027 (0.018)	0.058 (0.057)	-0.120 (0.136)	0.009 (0.018)
Income risk (standard error of future income*10E	0.111 (0.078)	0.051 (0.159)	0.034 (0.022)	0.177 (0.078)	-0.124 (0.150)	0.045 (0.024)
Age(10E-1)	0.234 (0.152)	-0.450 (0.352)	0.059 (0.044)	0.283 (0.141)	0.045 (0.324)	0.111 (0.045)
Age squared (10E-2)	-0.019 (0.014)	0.050 (0.033)	-0.004 (0.004)	-0.020 (0.013)	0.008 (0.030)	-0.008 (0.004)
Education						
Primary school	0.142 (0.125)		0.029 (0.037)	0.101 (0.115)		0.018 (0.037)
High school	0.235 (0.143)		0.068 (0.042)	0.400 (0.130)		0.131 (0.042)
Some college	0.346 (0.139)		0.099 (0.040)	0.425 (0.129)		0.143 (0.041)
College	0.426 (0.147)		0.115 (0.043)	0.443 (0.138)		0.152 (0.044)
More than college	0.466 (0.154)		0.116 (0.044)	0.504 (0.146)		0.156 (0.046)
Parents own risky assets	0.412 (0.088)		0.108 (0.025)	0.328 (0.087)		0.094 (0.027)
Proxy for liquidity constraints	-1.772 (0.598)	0.742 (1.802)	-0.515 (0.173)	-2.352 (0.559)	3.004 (1.833)	-0.710 (0.180)
Constant relative risk aversion (CRRA)						
No answer	0.235 (0.104)	0.277 (0.249)	0.064 (0.030)	0.163 (0.098)	0.158 (0.225)	0.052 (0.031)
2≤CRRA<3.76	0.242 (0.078)	0.255 (0.194)	0.076 (0.023)	0.189 (0.074)	-0.004 (0.174)	0.057 (0.024)
1≤CRRA<2	0.181 (0.115)	0.418 (0.272)	0.071 (0.033)	0.151 (0.110)	0.391 (0.247)	0.072 (0.035)
CRRA<1	0.287 (0.146)	0.146 (0.338)	0.088 (0.042)	0.273 (0.140)	0.347 (0.306)	0.104 (0.044)
Constant	-3.834 (0.780)	0.293 (2.327)	-0.970 (0.223)	-2.934 (0.695)	-0.598 (2.118)	-0.904 (0.220)
Inverse Mills ratio		0.192 (0.448)			-0.429 (0.454)	
$\chi^2(54)$ or Pseudo R2	277.04		0.208	380.17		0.220
Number of observations	2,384	467	2,384	2,384	617	2,384

Source: "Patrimoine 98" INSEE survey.

(1) The dependent variable in demand equation (2) is the logistic transformation of the share (p) of risky assets in financial wealth: log p/(1-p). In Tobit estimation (3), the dependent variable is the share of risky assets in financial wealth.

(2) Since five year ahead real income increases were unbounded above and below in the questionnaire, income risk is computed imposing lower and upper bounds of 100% of real income increases.

* Households' characteristics refer to the head except for income risk and relative risk aversion. For these two variables, when there were two respondents, we imputed the one corresponding to the head of the household. Reference groups are: no diploma, single, CRRA≥ 3.76, no specific management.

Table 3. Specification tests

Test	*Test Statistic*	*p-value*	*Conclusion*
Instruments correlated with endogenous variable	$F = 19{,}12$	<0,0001	Good instruments
Probability of direct stockholding ownership [1]			
Endogeneity	$\chi^2(1) = 0{,}5782$	0.447	Not endogenous
Validity of instruments	$F(4{,}2326)=0{,}60$	0.660	Good instruments
Probability of direct or indirect stockholding ownership [1]			
Endogeneity	$\chi^2(1) = 1{,}20$	0.273	Not endogenous
Validity of instruments	$F(4{,}2326) = 1{,}28$	0.275	Good instruments
Share of direct stockholding in financial wealth [2]			
Endogeneity	$\chi^2(1) = 3{,}51$	0.086	Not endogenous
Validity of instruments	$F(5{,}464) = 0{,}37$	0.869	Good instruments
Share of direct or indirect stockholding in financial wealth [2]			
Endogeneity	$\chi^2(1) = 0{,}049$	0.945	Not endogenous
Validity of instruments	$F(5{,}617) = 0{,}61$	0.694	Good instruments

Source: "Patrimoine 98" INSEE survey

(1) The probability is estimated by a two-step approach (Wooldridge, 2002, p.473), where the first stage is a linear projection of the earnings variance on the instrument set, while the second is a Probit that includes the predicted errors of the first stage regression. The chi-square statistic reported is actually the (t-statistic)² of the coefficient estimate of the predicted errors. To test for the exogeneity of the instruments, we regress the Probit predicted residuals on the set of instruments.

(2) Given that the earnings variance is exogenous in the participation equation, the conditional demand is estimated following a two-step approach (Wooldridge, 2002, p. 567). In the first stage we estimate the inverse Mills ratio from a probit of the discrete choice variable on the exogenous variables and the set of instruments. The second step estimates by 2SLS the conditional asset demand including the estimated inverse Mills ratio both in the set of regressors and in the set of instruments. The null hypothesis of exogeneity is tested using the usual t-statistic on the second stage estimated coefficient for the predicted errors of the first stage regression (reported as a chi-square statistic). To test whether instruments are exogenous, we regress the 2SLS predicted errors on the set of instruments (including the inverse Mills ratio).

Table A1 : Frequency Distribution of the Subjective Standard Deviation to Current Earnings' Ratio (σ/y)

σ/y (%)	Number of observations in the sample[(1)]	Frequency (%)[(1)]
0	977	41.0
0-2.5	145	6.1
2.5-5.0	320	12.7
4.0-7.5	406	14.9
7.5-10.0	232	5.9
10.0-15	182	11.7
more than 15	122	7.8
Mean : 6.2[(1)]-14.9[(2)]	2,384	100.0

Source : "Patrimoine 98" INSEE survey
(1) The lower and the upper bound are equal to 50%.
(2) The lower and the upper bound are equal to 100%.

Table A2 : Risk aversion in France and in the U.S.

	Rejection of Contract A		**Acceptance of Contract A**	
	Rejection of contract **C**	Acceptance of contract **C**	Rejection of contract **B**	Acceptance of contract **B**
	$3.76 \leq \gamma$	**$2 \leq \gamma < 3.76$**	**$1 \leq \gamma < 2$**	**$\gamma < 1$**
France (total sample)	43.1	39.4	11.2	6.3
France (≥ 50 years old)	48.6	36.8	8.7	5.9
U.S.A. (≥ 50 years old)	64.6	11.6	10.9	12.8

Source : "Patrimoine 98" INSEE survey, Health and Retirement Survey (cf. Barsky*et al.* 1997)

Table A3 : Does Measured Risk Aversion Predict Behavior? Regressing Behavior on Risk Aversion and Demographic Variables

Dependent variable	CRRA value	Regression coefficient of risk aversion (SE)	Pseudo R2
Income risk (σ/y)	No answer	-0,012 (0,005)	0.22
	γ>3,76		
	2≤γ<3.76	0,015 (0,004)	
	1≤γ<2	0,019 (0,006)	
	γ<1	0,021 (0,007)	
Financial attitudes(1)	No answer	0,413 (0,123)	0.11
	γ>3,76		
	2≤γ<3.76	0,990 (0,093)	
	1≤γ<2	0,987 (0,135)	
	γ<1	1,557 (0,170)	
Horses race bets	No answer	0,299 (0,147)	0.07
	γ>3,76		
	2≤γ<3.76	0,325 (0,125)	
	1≤γ<2	0,129 (0,196)	
	γ<1	0,324 (0,228)	
National lotteries	No answer	0,119 (0,090)	0.05
	γ>3,76		
	2≤γ<3.76	0,347 (0,075)	
	1≤γ<2	0,224 (0,114)	
	γ<1	0,440 (0,151)	
Slot machines	No answer	0,014 (0,170)	0.09
	γ>3,76		
	2≤γ<3.76	0,466 (0,137)	
	1≤γ<2	0,415 (0,198)	
	γ<1	0,360 (0,260)	
Casino	No answer	0,061 (0,298)	0.12
	γ>3,76		
	2≤γ<3.76	0,446 (0,239)	
	1≤γ<2	0,629 (0,312)	
	γ<1	0,979 (0,359)	

Source : "Patrimoine 98" INSEE survey

The dependent variables are qualitative except for income risk. There are four categories for "financial attitudes" (cf. *infra*), three (yes several times a year, yes but rarely, no) for "horses race bets" (5.6%; 8.1%; 86.3%) and "national lotteries" (23.3%; 29.2%; 47.6%) and two (yes or no) for "slot machines" (8.7%; 91.3%) and "casino" (2.9%; 97.1%). The estimated qualitative regressions include the following covariates the coefficients of which are not reported : constant, age, sex, occupational dummies, labor income, marital status, number of children, unemployement dummies (past, actual), health problem dummies, urban/rural dummies and education (years). The tobit model of (σ/y) includes the same covariates for the household's head, and some characteristics of the parents' head : social status, dummies for financial difficulties during respondent's youth and portfolio composition dummies

(1) Regarding financial investments, do you think that (as a fraction of respondents):
-one should not take risks ; all of one's savings should be invested in safe assets (69.5%
-a small share of one's savings should be invested in riskier assets (26.7%)
-a large share of one's savings should be invested in risky assets if potential gains make it worthwhile (2.9%
-the bulk of one's savings should be invested in risky assets once there is a chance of very high potential gains (0.9%