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Temperance in Stock Market Participation: Evidence from France

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We explore empirically whether earnings uncertainty and borrowing constraints deter households from the stock market, consistent with the predictions of theoretical studies of portfolio choice in the presence of uninsurable earnings. Since recent extensions highlight the importance of the correlation between earnings and financial risks, here we use a self-assessed proxy from the DELTA-TNS 2002 cross-sectional survey to empirically assess the impact. Although income risk does not affect the participation decision of households' reporting a negative correlation, it does lower the participation of those who report a non-negative sign, consistent with economic theory predictions.

Introduction

There has been growing interest in the implications of incomplete markets for both theoretical and empirical reasons. Perhaps among the most important ones are the puzzles identified in the economics and finance literatures when confronting theoretical predictions with real data ('equity premium', 'non-participation', 'home bias', etc.). The recent availability of household-level financial datasets is guiding new theoretical developments and shaping the understanding of older ones, with new puzzles emerging.

The classical, complete markets, theory of portfolio choice predicts that household demand for stocks depends on the expected excess return of stocks, the objective stock market risk (variance) and households' subjective perception of that risk (risk aversion). The observation that severe informational restrictions preclude most households from insuring their labour earnings motivates the re-consideration of the complete markets assumption. Drèze and Modigliani (1972) observe that an important consequence of the non-insurability of earnings risks is that portfolio and labour market decisions become connected. Intertemporal extensions to incorporate non-tradeable and undiversifiable income (e.g. Viceira 2001), borrowing and liquidity constraints (e.g. Koo 1999), indivisibilities like housing (e.g. Flavin and Yamashita 2002), age (e.g. Gollier and Zeckhauser 2002) or information and transactions costs (e.g. Haliassos and Michaelides 2003; King and Leape 1998; Vissing-Jorgensen 2003) are also examined empirically thanks to the increased availability of household-level data. Here, we examine these theoretical developments on a sample of French households.

One of the most recent theoretical extensions of the classical portfolio choice model formalizes the following common wisdom intuition: when risk averse households are confronted with a risk beyond their control – exogenous or 'background' risk (hereafter) – they should be willing to decrease their exposure to other avoidable risks in order to adjust their desired total risk exposure. Households engaging in such behaviour are called 'temperant'.[1] Accordingly, those households who suffer more from labour-market uncertainty should choose to be less exposed to financial risk even if they are independent, *ceteris paribus*. Although there is empirical evidence supporting this theoretical prediction using household-level data (Guiso *et al.* 1996, for Italy; Massa and Simonov 2006, for Sweden; Haliassos and Bertaut 1995, and Vissing-Jorgensen 2003, for

the US), other empirical studies are not able to confirm it (Alessie *et al*. 2002, for The Netherlands; or Arrondel and Calvo Pardo 2002, Arrondel and Masson 2003 for France).

More recently, surprising empirical results about the correlation between earnings and financial risks have emerged. Contrary to the educated intuition received from equilibrium economic models, both risks tend to be independent in the aggregate (Davis and Willen 2000) and differently correlated depending on the income decomposition criterion chosen (Heaton and Lucas 2000). Vissing-Jorgensen (2003) for the US and Massa and Simonov (2006) for Sweden provide empirical evidence on the absence of a significant impact of the correlation on households' demand for risky assets using individual longitudinal datasets. Yet, both the standard theory of portfolio choice and empirical work emphasize the importance of the correlation component, e.g. in addressing the home-bias puzzle (Bottazzi *et al*. 1996; Julliard 2004; Palacios-Huerta 2001). Confronted with such an ambiguity, we follow Dominitz and Manski (1997) and Manski (2004) and propose individually self-assessed measures that proxy both the correlation and earnings uncertainty from a French household survey (DELTA-TNS 2002). We find that *earnings risk has a significant negative impact on households' decision to hold risky assets for those whose earnings are non-negatively correlated with financial returns, although income risk does not affect the participation decision of households' reporting a negative correlation*, in line both with the results obtained for other countries and theoretical predictions.

The rest of the paper proceeds as follows. In Section I we summarize the theoretical assumptions and empirical implications underlying the adverse impact of correlated undiversifiable earnings on financial risk taking (temperant stockholding behaviour). In Section II, we describe the 'DELTA-TNS 2002' household survey and assess empirically the theoretical predictions on households' decisions to invest in stocks. Section III concludes.

I. Temperant Stockholdings with a Correlated Background Risk

Specializing to the assumptions of Kimball (1993), Arrondel and Calvo Pardo (2002) extend the results of this literature to *dependent* background risks. The novel theoretical implication that will be the object of empirical scrutiny in the next section can be illustrated in the static portfolio choice model, without loss of generality. There, the problem that a household faces is how to invest her current wealth W_0 when there are only two assets available: a risky asset promising to deliver tomorrow a random return $(1 + \widetilde{R})$ 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 utility form over final wealth $\widetilde{W}_f = W_0(1 + \widetilde{R}_p) + \widetilde{Y}_c$, where $\widetilde{Y}_c$ represents uninsurable earnings. Denoting by α the share of initial wealth that is invested in the risky asset, the return on the portfolio is $\widetilde{R}_p = \alpha\widetilde{R} + (1 - \alpha)R$. Assuming that household preferences are in the constant relative risk aversion class (CRRA), $u(w) = w^{1-\gamma}/1 - \gamma : \gamma \equiv -wu''(w)/u'(w)$, and that the net return on the risky asset and earnings are jointly log-normally distributed, we can write the solution $\overline{\alpha}$ to her individual optimization problem using Campbell and Viceira's (2002) approximation technique as:

$$(1) \qquad \overline{\alpha} = \left(\frac{1}{\varepsilon_c}\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma} - \left(\frac{1-\varepsilon_c}{\varepsilon_c}\right)\beta \in \underset{\alpha}{\operatorname{argmax}}\, Eu[(1+R)W_0 + \alpha(\widetilde{R} - R)W_0 + \widetilde{Y}_c]$$

Where $1/\varepsilon_c \equiv 1 + E\widetilde{y}_c \exp\left\{-1/2\,\sigma_y^2\right\}/\exp\{E\widetilde{r} + w_0\}$ is the inverse elasticity of total wealth with respect to financial wealth when labour income is stochastic and non-tradeable, with σ_y^2 defined as the variance of log earnings. $E\widetilde{z} \equiv \log E[1 + \widetilde{R}]/[1 + R]$ denotes the log expected excess returns, σ_z^2 their variance and $\beta = \sigma_{yz}/\sigma_z^2$ captures the covariance between log earnings and log excess returns, i.e. $\sigma_{yz} \equiv \mathrm{Cov}(\log \widetilde{Y}_c, \log[1 + \widetilde{R}]/[1 + R])$.

Let α^* denote the optimal portfolio demand when markets are complete, i.e. $\alpha^* = E\widetilde{z}/\sigma_z^2\gamma$. We can then decompose the effect of correlated earnings uncertainty on the optimal share of risky assets as:

$$\overline{\alpha} - \alpha^* = \left(\frac{1}{\varepsilon_c}\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma} - \left(\frac{1-\varepsilon_c}{\varepsilon_c}\right)\beta - \frac{E\widetilde{z}}{\sigma_z^2\gamma} \tag{2}$$

$$= \underbrace{\left(\frac{1}{\varepsilon_c} - \frac{1}{\varepsilon}\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma}}_{(-)\text{ Risk substitution effect}} + \underbrace{\left(\frac{1}{\varepsilon} - 1\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma}}_{(+)\text{ Income effect}} - \underbrace{\left(\frac{1}{\varepsilon_c} - 1\right)}_{\substack{\text{Hedging effect:}\\ (-)\text{ if }\beta>0;(+)\text{ if }\beta>0}}\beta \tag{3}$$

where $1 < 1/\varepsilon_c < 1/\varepsilon \equiv 1 + E\widetilde{y}_c/\exp\{E\widetilde{r} + w_0\}$. $1/\varepsilon$ denotes the inverse elasticity of total wealth with respect to financial wealth when labour income is non-stochastic but non-tradeable.

The equality from (2) to (3) follows from adding and subtracting the optimal portfolio $(1/\varepsilon)E\widetilde{z}/\sigma_z^2\gamma$ of a household with certain but non-tradeable labour income $y = E\widetilde{y}_c$. The first additive term in (3) captures the negative effect on the complete market's optimal share α^* of introducing an independent zero-mean background risk $\widetilde{\varepsilon} \equiv \widetilde{y}_c - y : E\widetilde{\varepsilon} = 0$ (risk-vulnerable reaction, in Gollier and Pratt's (1996) terminology). The second term in (3) captures the positive effect on α^* of introducing a degenerate independent background risk that assigns probability 1 to its positive mean $E\widetilde{y}_c = y > 0$, and zero elsewhere. Since CRRA preferences display decreasing absolute risk aversion, richer households are more willing to invest in stocks. The last term in (3) captures the 'hedging effect' to the extent that we allow for correlated earnings $\widetilde{y}_c$. Notice that it is interacted with an increasing function of the inverse elasticity ($(1/\varepsilon_c) - 1$), which is itself an increasing function of the earnings variance σ_y^2; i.e. households with a 'small' income risk have a 'small' hedging motive.

Remark 1: (*Empirical implication*) Since available data on the correlation proxy is just categorical (no correlation, positive or negative), within each correlation category we cannot disentangle the risk substitution effect from the hedging effect. Then, the hypothesis that will be the object of empirical scrutiny in the next section follows from (3) as:

$$\begin{aligned} &\underbrace{\left[\left(\frac{1}{\varepsilon_c} - \frac{1}{\varepsilon}\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma} - \left(\frac{1}{\varepsilon_c} - 1\right)\beta_i\right]\mathbf{1}_{\{i:\beta_i \geqslant 0\}}}_{(-)\text{ Risk substitution effect} + \text{Hedging effect}} + \\ &+ \underbrace{\left[\left(\frac{1}{\varepsilon_c} - \frac{1}{\varepsilon}\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma} - \left(\frac{1}{\varepsilon_c} - 1\right)\beta_i\right]\mathbf{1}_{\{i:\beta_i < 0\}}}_{(+/-)\text{ Risk substitution effect} + \text{Hedging effect}} + \underbrace{\left(\frac{1}{\varepsilon} - 1\right)\frac{E\widetilde{z}}{\sigma_z^2\gamma}}_{(+)\text{ Income effect}} \end{aligned} \tag{4}$$

where $1_{\{i:\beta_i<0\}}$ is the indicator function that takes value 1 if household i assessed a negative correlation, and value 0 otherwise. Below each term, theoretical predictions on the sign of the bracketed term are reported.

Remark 2: (*Effect on participation*) Arrow (1965) establishes that under complete markets, if the expected excess return of investing in risky assets is positive, every risk-averse household whose preferences can be represented by a differentiable felicity function should invest in risky assets. Haliassos and Bertaut (1995) notice that this theoretical prediction lacked empirical support using the 1983 US *Survey of Consumer Finances*, and call it the *stockholding puzzle*. Under incomplete markets, however, even if the stock market delivers a considerable positive risk premium, households whose incomes covariate positively with the stock market will optimally choose not to hold stocks if participation increases their global risk exposure beyond their wishes. To the extent that at the individual level this correlation changes with the educational level and sector of activity (Davis and Willen 2000), professional status and asset ownership (Heaton and Lucas 2000) or stockownership status (Palacios-Huerta 2001), this is likely to generate cross-sectional variation in participation.

Remark 3: (*Risk aversion as a determinant of the participation equation*) If transaction costs are present (ex. sign-up or brokerage fixed fees), differences in risk aversion will also determine the decision to participate if households become less risk averse as their wealth or income increases (e.g. Haliassos and Michaelides 2003). Further, conditioning on income and wealth, households with riskier incomes are also less prone to pay the fee for investing in risky assets.

II. Empirical Evidence

Guiso *et al*. (1996) are the first to provide empirical support to the adverse impact of unavoidable income risk and anticipated liquidity constraints on households' stock-holding decisions using Italian data. Using their same specification and similarly constructed relevant variables, we confirm their findings on French household data *once* we condition on the correlation between earnings and financial returns. But if we exclude the correlation variable, income risk has no effect on the decision to invest in risky assets, at odds with theoretical predictions.

Data description and risk variables

We rely on the 'Mode de vie et épargne' household survey conducted by DELTA and Taylor Nelson-Sofres in 2002 (DELTA-TNS 2002) on a sample of 4000 French households with individuals between 35 and 55 years old, representative of the French population in the age bracket. Only 2518 households answered, of which 2460 could be exploited. This survey contains information on earnings, income, wealth, socioeconomic status and demographic characteristics of the household. Questions that capture the degree of individual exposure and aversion to risk include those proposed by Barsky *et al*. (1997), based on relative risk aversion to lotteries on lifetime labour income, and by Guiso and Paiella (2004), based on the degree of absolute risk aversion to financial lotteries. Finally, a question to proxy for the correlation between earnings and financial risk as subjectively perceived by individuals is for the first time available.

The DELTA-TNS 2002 survey contains qualitative information on the distribution of household financial assets in ten categories: cash, transactions and savings accounts, homeownership savings accounts, bonds (Treasury bills, certificates, fixed-rate long-term bonds and other government paper), stocks from privatized public companies, private companies' listed stocks, stocks of foreign firms, mutual funds and managed investment accounts, annuities, life insurance contracts and contributions to complementary pension plans. Table 1 reports the proportion of households holding each asset.

We define direct stockholdings as the sum of stocks of privatized public companies, listed stocks of private companies and stocks of foreign firms held. Indirect stockholdings are those held through mutual funds and managed investment accounts. Although in some countries government bonds have a considerable risk of default justifying their inclusion in the risky asset holdings (i.e. Guiso *et al.* 1996), this is not the case of France and we therefore exclude them. As well, we exclude home ownership from the risky asset category despite it being highly illiquid and indivisible (and therefore risky), because French households mostly buy houses for the flow of services they provide rather than as a financial investment. Still, in the estimation we control for the level of total net worth (real plus financial) and include a dummy variable that takes value one when home-ownership status is observed. The proportion of households who hold stocks directly is 21%, and 33% either directly or indirectly. Although low, the participation rates are similar to those obtained from previous INSEE surveys and to the figures from other European countries studied in Guiso *et al.* (2003).[2] The extent to which such low participation rates in financial risk are explained by both earnings risk and the expectation of being liquidity constrained is subject to empirical scrutiny.

Available data to capture earnings uncertainty is scarce, as we show below. Therefore we construct a proxy for the individual income variance as follows: we estimate it

TABLE 1
HOUSEHOLDS' FINANCIAL ASSETS[1]

Financial assets	Percentage holding the asset[1]
Cash, transactions and savings accounts	84.6
Homeownership savings (and current) accounts	61.1
Bonds	4.6
Stocks from privatized public companies	20.8
Other stocks	17.6
Stocks of foreign firms	4.3
Mutual funds and managed investment accounts	12.0
Life insurance contracts	46.9
Annuities	17.6
Contributions to complementary pension plans	20.8
Stockholdings[2]	
Direct	21.0
Direct and indirect[3]	33.0

Source: 'DELTA-TNS 2002'.
Notes:
[1]The sample only includes households whose head is between 35 and 55 years old.
[2]Direct: the household holds stocks of privatized, foreign or other firms publicly listed.
[3]Direct and indirect: the household holds equities directly and indirectly (through mutual funds and managed investment accounts).

conditional on a vector of characteristics from the wealth INSEE survey 'Patrimoine 98', and predict earnings uncertainty for DELTA-TNS 2002 households. Since each labour income recipient in 1998 was asked to attribute probability weights to given intervals of real income increases five years ahead, we can match 1998 and 2002 data.[3] This procedure facilitates the comparison with previous results (Guiso *et al.* 1996) and partially overcomes the potential endogeneity problem of this measure; viz. that more risk-averse households hold both safer occupations and tend to participate less in the stock market (Lusardi 1997). Criticisms to the use of this self-assessed measure of income risk are well known: the variance is a sufficient indicator of risk only for a very restrictive class of preferences, potentially underestimates the probability of very low income events, and is too low when compared to panel data estimates.[4]

Table 2 reports descriptive statistics for the sample (columns 1 and 2), by the sign of self-assessed correlations (columns 3 and 4, for non-negative and negative correlations, respectively) and for varying levels of earnings uncertainty (columns 5 and 6, for low and high levels, respectively). The sample average of the predicted income risk is 6.3%, strikingly low when compared with the values from the precautionary savings literature, i.e. between 10 and 20% of the earnings' level (e.g. Deaton (1992) reports a standard error of 15% for next year's expected earnings in the US), but of the same order of magnitude as in Guiso *et al.* (1996). A decomposition of the sample by varying levels of income uncertainty below and above the median of the predicted distribution (Table 2, columns 5 and 6) confirms that households with higher uncertainty hold marginally less risky assets, are younger, financially poorer, earn less at work, have more irregular incomes (discrete income risk variable), are more often unemployed, women and risk averse (see below), hold lower educational degrees but are better informed (as proxied by parents holding risky assets, and having access to internet), and are more often liquidity constrained than households in the low-income risk group.

As suggested in Section I, a test of the proposition that undiversifiable earnings crowds households out of the stock market requires controlling for its potential covariation with financial returns, as well as for all variables that determine the decision to invest in the stock market. To control for the correlation, a question in the survey asks households about the reasons that may lead big firms to downsize the labour force: a binding bankruptcy constraint (a positive correlation is assumed, $\rho > 0$) or the expectation of a positive price impact on the firm's listed stocks (a negative correlation is attributed, $\rho < 0$). From Table 2, 62% report a negative correlation, while 34% report a positive one. The remaining 4% are non-respondents. The descriptive statistics in Table 2 by the reported sign of the correlation, columns 3 and 4, show that households who assessed a negative correlation participate more often in the stock market (as predicted by the theory), are more risk averse (see below), work more often in a big firm and are considerably more educated.

This last point seems to be at odds with the current consensus that the earnings of college-educated household heads covary positively with financial returns (e.g. Haliassos and Michaelides 2003), and if accepted, would relegate our variable to an informational proxy status. But Palacios-Huerta (2001, 2003) notices that standard panel data computations of the correlation have neglected the skill premium component of earnings. Since this skill premium is negatively correlated with the returns to domestic capital, taking it into account reverses the positive correlations obtained by Campbell (1996) for stockholders (see Table 1 in Palacios-Huerta 2001). More recently, Lustig and Van Nieuwerburgh (2006) also find evidence of a robust negative correlation between human capital and financial returns in the US.[5]

TABLE 2
SAMPLE CHARACTERISTICS[1]

	Whole sample		Non-neg. corr. ($\rho \geqslant 0$)	Neg. corr. ($\rho < 0$)	Low-income risk[8]	High-income risk[8]
	Mean	SD				
Continuous variables	(1)	(2)	(3)	(4)	(5)	(6)
Financial wealth[2,3]	169,409	1,111,641	220,190	137,804	198,642	140,177
Income[2,4]	202,067	256,637	204,419	200,605	234,016	170,120
Standard deviation of expected income[2]	11,920	12,127	11,949	11,901	11,056	12,783
Income risk[5]	0.0637	0.035	0.0630	0.0642	0.0445	0.0830
Age[6]	45	7	45	45	49	41
Absolute risk aversion $(10^5)^2$	29	14	27	31	29	30
Discrete variables	% of the sample					
Risky asset holdings[7]	33		27	38	34	33
Inheritance	19		19	20	22	17
Inter vivos transfers and gifts received	52		52	52	50	54
Paris	16		16	16	14	17
Parents own risky assets	24		22	25	22	26
Internet	33		31	34	31	35
Women	15		15	15	17	14
Homeownership	67		67	67	73	61
Child (if No. of children >0)	44		47	43	23	65
Liquidity constraints[2]	20		20	20	15	24
She has been unemployed	52		52	52	43	62
Working in a big firm	16		14	17	16	17
Relative risk aversion (CRRA)						
Non-respondents	7		8	7	12	2
CRRA <1	8		22	20	11	4
$1 \leqslant$ CRRA <2	20		24	30	21	19

TABLE 2
CONTINUED

	Whole sample		Non-neg. corr. ($\rho \geqslant 0$)	Neg. corr. ($\rho < 0$)	Low-income risk[8]	High-income risk[8]
	Mean	SD				
Continuous variables	(1)	(2)	(3)	(4)	(5)	(6)
$2 \leqslant$ CRRA < 3.76	28		37	37	19	37
CRRA $\geqslant 3.76$	37		10	6	36	38
Correlation between income risk and stock market risk[2]						
$\rho > 0$ (positive correlation)	34				32	35
$\rho < 0$ (negative correlation)	62				61	62
Non-respondents	4				6	3
Discrete income risk variable						
Non-irregular income	77		74	78	79	74
Irregular income	20		20	20	16	23
Non-respondents	4		7	2	5	3
Education of the head of the household						
No diploma or primary level	6		7	5	3	9
Primary or secondary level	41		45	39	43	40
Baccalaureate	21		19	21	19	22
Graduate	25		22	27	27	23
Postgraduate	7		7	7	8	6
Number of households	**2406**		**923**	**1483**	**1203**	**1203**

Source: DELTA-TNS 2002. The sample only includes households whose head is between 35 and 55 years old.
Notes: Absolute risk aversion takes value 0 for risk neutrals and 40 for the most risk averse.
[1]Households who are risk lovers are dropped off the sample (54).
[2]See the Appendix for further details about the construction of the variables.
[3]Financial wealth: household's total financial wealth in French francs.
[4]Income: household's annual income in French francs.
[5]Income risk (σ/y): standard deviation of expected income estimated from 'Patrimoine 98' using DELTA-TNS 2002 households' characteristics, per unit of income y. See the Appendix and Table A1 for details.
[6]Age: age of the head of the household.
[7]Risky asset holdings: the household holds equities either directly (includes national and foreign stocks) or indirectly (through mutual funds).
[8]Low-income risk and high-income risk households are those, respectively, below and above the median of the income risk distribution (σ/y).

Contrary to most of the existing studies, two different questions that proxy households' degree of risk aversion are available. The first mimics the methodology of Barsky *et al.* (1997) and assumes that households' risk preferences are in the constant relative risk aversion (CRRA) class: 8% of the sample has a CRRA coefficient lower than 1, for 20% it is between 1 and 2, for 28% it is between 2 and 3.76, and for 37% the risk aversion coefficient is greater than 3.76. The second is based on work by Guiso and Paiella (2004), who construct a measure of the coefficient of absolute risk aversion. It asks individuals their maximum willingness to pay to enter a lottery representing a relatively large financial risk (around 16% of average annual income).[6] We use the first to obtain estimates of the subjective income variance and the second to estimate the probability of participation, since the wording of the question directly refers to financial risk-taking.[7] More importantly, accounting for risk aversion significantly reduces endogeneity issues regarding occupational choice and financial risk-taking attitudes.[8]

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 placed themselves in either category, and is similar to the one used by Guiso *et al.* (1996). Of the 2460 surveyed households, 481 are liquidity constrained (20%).[9] Households exposed to higher earnings risk (by both the discrete and predicted income risk proxies) are also more likely to be liquidity constrained, in line with theoretical predictions.[10]

Empirical results

For estimation purposes, we assume that households' indirect utility function can be written as a linear function of household i observable characteristics $\mathbf{x}_i$, plus an error term e_i normally distributed. The error term includes household-specific factors affecting utility. Let $U_i^s = \beta_s' \mathbf{x}_i + e_i^s$ be the indirect utility function of stockholders, and $U_i^0 = \beta_0' \mathbf{x}_i + e_i^0$ for non-stockholders ($s = 0$). Since the indirect utility function cannot be observed, only participation status, we accordingly define the dichotomous variable y_i that takes value one if the household participates, and 0 otherwise:

$$(5) \qquad \Pr(y_i = 1|\mathbf{x}_i) = \Pr(U_i^s - U_i^0 > 0) = \Pr(\beta' \mathbf{x}_i + e_i > 0|\mathbf{x}_i) = \Phi(\beta' \mathbf{x}_i)$$

where $\Phi(.)$ denotes the standard normal cumulative distribution function. The vector $\mathbf{x}_i$ contains a proxy for anticipated liquidity constraints (cl_i), the proxy for income risk ($\sigma_{i,y}/y_i$), the coefficient of absolute risk aversion (γ_i), the proxy of the subjectively assessed correlation (ρ_i) and its interaction with income risk (see above), and a vector $\mathbf{w}_i$ of other variables previously demonstrated to be significant in explaining positive stockholdings such as age, gender, labour income, financial wealth, homeownership status, *inter vivos* or *mortis causa* transfers, and a set of variables that proxies for the stock of financial information (living in Paris, parents' stockownership status and having access to the internet).[11] Since demographic factors give also an approximation of potential future sources of income risk the exclusion of which can lead to mis-specification problems (Burgess *et al.* 2000), we include a dummy that takes value one if the household has children. Finally, to control for inertial factors (mainly incentive remuneration schemes) that may explain involuntary stock market participation, we also introduce the variable 'working in a big firm'. In specification (5), income risk is assumed to be exogenous.

If capital markets are imperfect (transaction or informational costs) households' income and wealth influences portfolio choice.[12] The empirical analysis reveals that their effect is best captured by a second-order polynomial. Although this facilitates the comparison with existing results in the literature (Guiso *et al.* 1996, 2003; Haliassos and Bertaut 1995; King and Leape 1998), it has the disadvantage of introducing heteroscedasticity in the error term e_i specified to be of the general form:

$$(6) \qquad \mathrm{Var}(e_i|\mathbf{x}_i) = [\exp(\omega' w_i)]^2 : w_i \equiv \text{Financial wealth}$$

Table 3 reports the regression results of the heteroscedastic probit estimation by measures of income risk.[13] The variables have the expected signs with minor differences across columns.[14] Financial wealth has a positive effect on participation and is significant at the 1% level.[15] An increase in financial wealth from the first decile (6500 euros) to the ninth decile (410,000 euros) increases the probability of participation by 25%. Income also increases the probability of participation in the stock market, moving from the first to the ninth decile increases the probability of stockownership by 7%. The effects are consistent with fixed transaction and information costs of accessing the stock market, as well as of decreasing aversion to financial risk taking, since both capture households' initial endowments other than housing. Homeownership status has a positive and significant effect, increasing the probability of participation by 7%. Heaton and Lucas (2000) rationalize this finding by means of the negative correlation detected between housing and financial risks, i.e. owning a house serves as a hedge against financial fluctuations. But it can also be interpreted as a proxy for total wealth if transaction costs are present, so that homeowners are less risk averse because they are wealthier.

Previous empirical studies find that education increases the probability of participation. We excluded it because of its strong correlation with income and the set of information variables. More information significantly increases the probability of participation: Having the internet at home[16] raises the probability of participation by 11% and if parents hold risky assets, the probability increases by 16%.[17] Households living in Paris are 13% more likely to hold risky assets. The age variables indicate that the probability of owning risky assets is lower for younger households, although it has a hump-shaped effect reaching its maximum at the age of 46. Younger individuals are less informed (King and Leape 1998), tend to be more often liquidity constrained (Haliassos and Michaelides 2003) and have a stronger preference for homeownership (Flavin and Yamashita 2002) but enjoy greater labour supply flexibility (Bodie *et al.* 1992).[18]

In accordance with theoretical predictions, more risk-averse individuals have a lower probability of participation. Surprisingly, once we control for risk aversion, being a woman significantly reduces the probability of being a stockholder (by 8%), confirming the results obtained by Schubert *et al.* (1999). Households with children are 3% less likely to invest in the stock market. Having received an inheritance or *inter vivos* transfers increases the probability of participation (6 and 3%, respectively), but the latter is only significant at 10%.

Households who have been liquidity constrained or who think that they will be so in the future are less likely to participate[19] (around 13%). The effect of liquidity constraints reinforces the risk substitution effect, in line with the empirical results obtained by Guiso *et al.* (1996) and with theoretical predictions. Deaton (1992) explains how the expectation of being liquidity constrained in the future leads prudent households to save more ('buffer stock'), while Elmendorf and Kimball (2000) prove that the positive wealth effect of increased precautionary savings that leads decreasing risk averse (DARA) households

TABLE 3
HETEROSCEDASTIC PROBIT ESTIMATION

Direct and indirect risky asset holdings	Discrete income risk	Instrumented income risk	Interacting instrumented income risk and correlation
Variables	(1)	(2)	(3)
Financial wealth (10E-6)	6.046 (0.855)	6.098 (0.852)	6.142 (0.852)
Financial wealth squared (10E-12)	− 1.788 (1.379)	− 1.798 (1.409)	− 1.846 (1.424)
Income (10E-6)	0.85 (0.462)	0.865 (0.474)	0.852 (0.474)
Income squared (10E-12)	− 0.288 (0.246)	− 0.284 (0.252)	− 0.285 (0.254)
Discrete income risk *dummy*	0.155 (0.092)	–	–
Neg. corr. between income risk and stock market risk	0.323 (0.074)	0.324 (0.074)	–
Income risk	–	0.649 (1.243)	–
Income risk effect[1]			
For individuals with $\rho \geqslant 0$	–	–	− 2.963 (1.547)
For individuals with $\rho < 0$	–	–	1.519 (1.179)
Working in a big firm	0.591 (0.091)	0.578 (0.091)	0.58 (0.091)
Age	0.121 (0.049)	0.124 (0.049)	0.123 (0.049)
Age squared (10E-3)	− 1.319 (0.513)	− 1.343 (0.517)	− 1.33 (0.513)
Inheritance	0.155 (0.089)	0.163 (0.089)	0.167 (0.089)
Inter vivos transfers	0.111 (0.072)	0.112 (0.072)	0.111 (0.073)
Paris	0.341 (0.099)	0.332 (0.099)	0.34 (0.099)
Parents own risky assets	0.498 (0.084)	0.491 (0.084)	0.496 (0.084)
Whether the individual answers the risk-aversion question	0.873 (0.176)	0.859 (0.176)	0.871 (0.176)
Absolute risk aversion	− 0.02 (0.004)	− 0.019 (0.004)	− 0.019 (0.004)
Internet	0.308 (0.075)	0.31 (0.075)	0.312 (0.075)
Woman	− 0.292 (0.113)	− 0.281 (0.114)	− 0.279 (0.114)
House ownership	0.157 (0.083)	0.153 (0.083)	0.154 (0.083)
Child (if children > 0)	− 0.087 (0.084)	− 0.09 (0.085)	− 0.08 (0.085)
Liquidity constraints	− 0.334 (0.099)	− 0.31 (0.098)	− 0.316 (0.098)
Constant	− 4.682 (1.15)	− 4.793 (1.168)	− 4.524 (1.159)
Omega[2] (financial wealth)	1.652 (0.324)	1.678 (0.328)	1.692 (0.327)
LR specification statistic (distributed $\chi^2(1)$)	51.94	53.85	54.83
Wald statistic[3] (distributed $\chi^2(20)$)	307.80	305.67	303.85
Number of households	2406	2406	2406

Source: DELTA-TNS 2002 survey and own calculations. The sample only includes households whose head is between 35 and 55 years old.
Notes: The numbers reported are the estimated coefficients. Standard errors are in brackets. Absolute risk aversion takes value 0 for risk neutrals and 40 for the most risk averse. Definitions of the variables are reported in Table 2 footnotes.
[1]The parameter ρ captures the correlation sign between income risk and stock market risk. A different coefficient for income risk is computed depending on the sign of the correlation. See expression (4) in the text for details.
[2]Estimate of the financial wealth coefficient in the heteroscedastic error specification (expression (6) in the text).
[3]Wald test of joint significance.

to invest more in stocks is dominated by the negative increase in risk if households are also decreasingly prudent (DAP), resulting in an overall reduction in stockownership.

The available correlation proxy is an imperfect assessment of the covariation of individual earnings with the rate of return risk. Still it has the advantage of being self-assessed, and behaves empirically in accordance with the theoretical predictions: households who assess a negative sign, $\rho<0$, are 9 percentage points more likely to participate (at a 1% level of significance, in both columns 1 and 2, Table 3). A possible interpretation comes from Bottazzi *et al.* (1996) or Danthine and Donaldson (2002): a negative average correlation indicates that redistributive shocks dominate over the cycle. In accordance with this observation, individuals reporting a negative correlation answered that, 'big firms downsize their labour force because they want to increase the price of their stock market shares'.[20] A probit regression of the probability to assess a negative sign confirms 'working in a big firm' and 'having received college-education or above' as the two main determinants.[21] Another possible interpretation in terms of the skill premium content of wages rationalizes the second main determinant: educated individuals tend to have counter-cyclical labour earnings, and therefore have a higher propensity to become stockowners because the returns to human capital are negatively correlated with the stock market (Palacios-Huerta 2001). The skill premium interpretation is consistent with the descriptive evidence in the bottom row of Table 2: college-educated households (last two rows) tend to report a negative sign (columns 3 and 4) and have lower income risk (columns 5 and 6), while less than college-educated ones (rows three to five from the bottom) tend to report a non-negative sign (columns 3 and 4) and have higher income risk (columns 5 and 6). While Vissing-Jorgensen (2003) or Massa and Simonov (2006) have not been able to find evidence of a correlation effect using longitudinal individual-level data, none of them has considered the potential skill premium content of wages that is consistent with our self-assessed correlation proxy.[22]

Column 1 reports the estimation results using the discrete income risk dummy. A one is assigned to those who report either irregular or a mix of regular and irregular household earnings, while a zero is attributed otherwise. Contrary to available empirical evidence for other countries and economic theory predictions, it has no significant effect.[23] The absence of a negative effect is confirmed by the results in column 2, where the predicted measure of the expected earnings variance substitutes the discrete variable, to take into account heterogeneity in earnings risk exposure.[24]

Finally, in column 3 we decompose the effect of expected income risk using the self-assessed correlation proxy to separate those who assess a negative sign ($\rho<0$) from the rest ($\rho \geqslant 0$).[25] For households whose earnings are negatively correlated, the effect of earnings risk on participation is ambiguous, consistent with expression (4): they tend to participate less to the extent that their detrended labour income is risky (negative *risk substitution effect*), but tend to participate more to the extent that it is negatively correlated and can use the stock market as a hedge (positive *hedging effect*). Consistently, a positive but insignificant coefficient (at 10%) is obtained empirically. As well, for those who assess a non-negative correlation, expression (4) states that both the income risk and the correlation effect go in the same direction (negative *risk substitution and hedging effects*). Overall, a negative impact on participation is obtained (significant at 5%). The point estimate implies that households reporting a non-negative correlation are 4.45 percentage points less likely to hold risky assets than households reporting a negative sign. For those households who assess a non-negative sign, moving a household from the tenth percentile of relative income risk to the ninetieth percentile,

decreases the probability of holding assets by 4.3 percentage points, all other things being equal. Contrary to the empirical results obtained below columns 1 and 2 in Table 3, we do therefore find evidence of a negative impact of uninsurable earnings risk on stockownership when conditioning on the correlation coefficient. But within each correlation category, we cannot disentangle the risk substitution effect from the hedging effect as cross-sectional variation within categories (different magnitudes) is unavailable.

III. Conclusion

> The main challenge incorporating background risks is to specify a realistic model for the joint distribution of these risks with asset returns .... (Brandt forthcoming)

There has been a resurgence of interest in the implications of incomplete markets for portfolio choice theory, motivated by the number of portfolio puzzles identified in the literature. One of the most active research areas has concentrated on the study of the determinants of stock market participation and stockholdings. Considerable progress has been made in understanding the interactions between income risk, rate of return risk, borrowing constraints and transactions costs. Using measures proxying for income risk and liquidity constraints available in the literature, we test whether they affect the stockownership decision controlling for the correlation between earnings and rate of return risk as self-assessed by households. Exploiting the DELTA-TNS 2002 household survey, the empirical results confirm the theoretical prediction that non-negatively correlated background risks reduce the willingness to bear financial risk, crowding households out from the stock market. The theory is unconclusive about the effect of income risk for temperant households with negatively correlated earnings, a fact corroborated by our empirical results. Moreover, we find evidence that borrowing and liquidity constraints reduce households' propensity to invest in risky assets.

Quantitatively, the effects identified confirm the relative importance of the different factors as obtained in the literature: transactions costs and informational barriers, liquidity constraints, taste for risk parameters and income risk. Each of them is, by decreasing order of magnitude, important to explain households' decisions to enter the stock market.

APPENDIX

Financial wealth: In the survey, the individual is asked to say in which of the eight predefined available brackets is her family situated. Since we are interested in a continuous measure, we have used the method of simulated residuals (Gouriéroux *et al*. 1987). We have regressed an ordered probit of the financial wealth on some household characteristics. Once we have the estimated financial wealth, 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 true interval. 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. Financial wealth is given in French francs.

Income: For the income of the household, the survey asks which of the 13 predefined available brackets is their household situated. To transform it into a continuous variable, the procedure described in the previous paragraph has also been followed. Income refers to the household's annual income in French francs.

Income risk: Since the new survey has no information about different levels of income risk,[26] we use information from the 'Patrimoine 98' survey to discover the determinants of expected income risk as measured by its standard deviation. In the 'Patrimoine 98' survey, a proxy for the subjective variance of household income was constructed following the methodology carried out by the Bank of Italy in its 'SHIW 1989'. A question asks households to distribute 100 points between different scenarios regarding the evolution of income in the next five years (see Arrondel and Calvo Pardo 2002; Guiso *et al.* 1996). We then use the estimated coefficients to predict each household's income risk, in our DELTA-TNS 2002 sample. Table A1 reports the estimation results.

TABLE A1
THE ESTIMATION OF THE STANDARD DEVIATION OF INCOME (σ)

	Est. (s. e.)	Variable mean (DELTA-TNS 2002)	Variable mean (Patrimoine 98) Ages 35–55	Variable mean (Patrimoine 98) Whole sample
Variables	(1)	(2)	(3)	(4)
Income	0.044 (0.003)	201,847	201,860	169,611
Age	− 389 (109)	45	45	50
Age squared	2.365 (1.084)	2,093	2,064	2,733
Health problems	3004 (1421)	5%	3%	3%
Child (if No. of children > 0)	1623 (813)	44%	85%	76%
Postgraduate studies	1348 (906)	7%	12%	11%
Occupational status				
Trader or craftsman	− 644 (1761)	5%	8%	5%
Profession	− 737 (1642)	15%	22%	15%
Foreman	− 1493 (1559)	27%	23%	15%
Employee	− 3059 (1590)	16%	16%	12%
Blue-collar worker	− 3070 (1553)	27%	21%	15%
Retired	− 4044 (1687)	6%	1%	29%
Inactive	− 4737 (1802)	3%	3%	6%
Personal status				
Cohabitation	2331 (1031)	10%	8%	9%
Single	− 1418 (995)	16%	16%	23%
Divorced	− 2099 (926)	10%	13%	9%
Widow	441 (948)	2%	3%	10%
Constant relative risk aversion (CRRA)				
No answer	− 791 (780)	7%	11%	14%
$1 \leqslant CRRA < 2$	1895 (583)	28%	36%	34%
$2 \leqslant CRRA < 3.76$	3263 (869)	21%	11%	10%
$CRRA \geqslant 3.76$	2423 (1123)	8%	6%	5%
Portfolio risk preference				
Very small	− 307 (1369)	47%	59%	63%
Small	88 (1440)	42%	34%	29%
High	3665 (1791)	4%	5%	4%
Probability of being unemployed in 5 years				
Very small	− 930 (961)	45%	43%	35%
Small	764 (951)	26%	36%	36%
High	1937 (1095)	6%	9%	13%
Very high	1637 (1190)	3%	6%	8%
Region				
Paris Ile-de-France	− 1712 (874)	18%	15%	17%
North	− 835 (1157)	7%	17%	7%

TABLE A1
CONTINUED

Variables	Est. (s. e.) (1)	Variable mean (DELTA-TNS 2002) (2)	Variable mean (Patrimoine 98) Ages 35–55 (3)	Variable mean (Patrimoine 98) Whole sample (4)
East	− 961 (927)	10%	6%	13%
West	− 1540 (924)	14%	13%	14%
South-West	− 13 (1026)	11%	13%	9%
South-East	− 2010 (959)	11%	9%	12%
Mediterranean	− 1632 (923)	12%	13%	14%
Constant	16,137 (3506)			
Number of obs.	**2460**	**2460**	**1043**	**2390**
Adj. *R*-sq	0.2603			
F(35,2355)	25.03			
Prob. > *F*	0.0001			

Source: Patrimoine 98 INSEE survey.
Notes: Standard errors are in brackets.
Reference values are: for occupational status 'Agriculture', for family status 'Married', CRRA $\geqslant$ 3.76, for savings preferences and probability of being unemployed; 'Very high' and for region 'Paris'.

The estimates indicate that high income risk households earn more at work, are younger, more risk averse, have a preference for risk in financial investments, are more often unemployed, have/had health problems, tend to co-habitate rather than marry, and have children. There are eight regional dummies to control for labour supply differences across regions, and eight occupational dummies to capture heterogeneity in professional tastes.

Table A1 also reports sample means of the variables used to impute income risk. The 'Patrimoine 98' (ages 35–55) and DELTA-TNS 2002 variables can be directly compared, showing similar characteristics. The main differences are: a lower proportion of surveyed households with children and education of heal of household to graduate level, and a higher fraction of risk averters with a positive taste for financial risk taking, relative to the 'Patrimoine 98' (ages 35–55) mean variables. This increased preference for stockholding might be explained by the dot.com driven stock market boom that took place between 1998 and 2002 in most OECD economies.

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 agree to give up his present income and 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: 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 2460 households, 172 did not answer, 886 displayed a relative risk aversion lower than 1, 689 between 1 and 2, 517 between 2 and 3.76, and for 195 households relative risk aversion was larger than 3.76.

Absolute risk aversion: The survey asks the following: 'If someone suggests that you make an investment whereby you have one chance out of two win 5000 euros and one chance out of two of losing the capital invested, how much (as a maximum) will you invest?' Guiso and Paiella (2004) show that absolute risk aversion can be computed as: $A_i(w_i) = 2(5000 - Z_i/5000^2 + Z_i^2)$, where A_i is the absolute risk aversion and Z_i is the amount that the individual declares to be willing to invest. Those who declare $Z_i < 5000$ are risk-averse $Z_i = 5000$, are risk neutral and $Z_i > 5000$ are risk loving. For details concerning the validity of the approximation, we direct the reader to their work.

To estimate how risk aversion varies with consumer attributes, we have regressed the measure of absolute risk-aversion on observable characteristics that can proxy for differences in taste. In line with their results, Table 2 shows that risk-aversion decreases with households' financial wealth. This provides further support to temperant risk behaviour that requires decreasing absolute risk-averse houshold preferences. We find that absolute risk-aversion depends on gender, having children and level of education. Being a woman (Schubert *et al*. 1999) and having children increases risk aversion as well as being poorly educated. Surprisingly, the fact that the individual has been unemployed in the past or is likely to be so in the future[27] has no effect on risk aversion. Since residuals are far from being normally distributed, bootstrapped standard errors are provided in Table A2.

Liquidity constraints: Households are asked two questions aimed at measuring their ability to get access to the credit market. These questions are similar to those of the SHIW Italian survey

TABLE A2
ABSOLUTE RISK AVERSION ESTIMATION[1]

Dependent variable	Ln Absolute risk aversion
Ln financial wealth	− 0.021 (0.010)
Paris	− 0.007 (0.042)
Women	0.086 (0.042)
Age	0.002 (0.002)
Child (if children > 0)	0.076 (0.032)
She has been unemployed	− 0.005 (0.028)
Parents own risky assets	10.044 (0.035)
Education level of head of the household	
Primary or secondary level	− 0.094 (0.044)
Baccalaureate	− 0.122 (0.052)
Graduate	− 0.153 (0.054)
Postgraduate	− 0.280 (0.088)
Constant	3.699 (0.156)
Adj. R-squared = 0.0148	No. of obs. = 2088
F (10, 2077) = 3.84	Prob > F = 0.0000

Source: DELTA-TNS 2002 survey and own calculations. The sample only includes households whose head is between 35 and 55 years old.
Note: Standard errors are in brackets. Absolute risk aversion takes value 0 for risk neutrals and 40 for the most risk averse.
[1]Risk lovers are included in the OLS regression; 2088 out of 2460 answered the absolute risk aversion question. The normality test of residuals has been rejected. Therefore bootstrapped standard errors are reported in brackets (based on 200 replications). No diploma is used as the reference group.

(Guiso *et al.* 1996). We classify consumers as being liquidity constrained if they respond positively to at least one of the two following questions. The first indicates whether a consumer is a 'discouraged borrower', the second whether he is a 'turned-down applicant':

> Did you renounce to finance expenditures on durable goods (main residence, cars. . .) or did you renounce to restore your home because you expected that banks or other financial intermediaries will refuse the loan or the mortgage?
> Did you renounce to finance expenditures on durable goods (main residence, cars. . .) or did you renounce to restore your home because banks or other financial intermediaries refused the loan or the mortgage?

In our DELTA-TNS 2002 survey, 481 households are liquidity constrained (20% of the sample), slightly above the average proportion reported by similar studies. The reason is that we only sample households whose head is between 35 and 55 years old (Arrondel and Masson 2003).

Correlation between stock prices and income risk: There is a question in the survey that asks individuals: '*In your opinion, big firms downsize their labour force when*' and the options are: '*when the firm is in financial trouble*' *or* '*when the firm wants to increase the stock market price of its shares*'. If the individual answers '*when the firm is in financial trouble*', a positive correlation is assumed between the exogenous income risk and the endogenous stock market risk ($\rho > 0$), while the correlation is assumed to be negative ($\rho < 0$) if the individual answers '*when the firm wants to increase the stock market price of its shares*'. We assume that there is no correlation ($\rho = 0$) when there is no answer.

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NOTES

1. Pratt and Zeckhauser (1987), Kimball (1993), or Gollier and Pratt (1996) formalized the intuition for different sets of background risks. More recently, Eeckhoudt and Schlesinger (2006: 283) define 'temperance' as a preference for separation of two independent zero-mean background risks, rather than the bundling of both.
2. The increased participation relative to previous studies on French data is due to the restricted age bracket sampled, and not to a real increase in participation as reported by Arrondel and Masson (2003).
3. Assuming that five years ahead expected real income is $y_{t+5} = y_t(1 + \bar{x})$, then the formula of the expected variance of household income is $(y_{t+5}) \equiv \sigma_y^2 = \sigma_x^2 y_t^2$, where y_t is current real income, $\bar{x}$ is the expected growth rate of real income and σ_x^2 its variance. The expectation of earnings uncertainty is significantly positively correlated with current income uncertainty. In the Appendix it can be seen that the structual parameters can be reasonably thought as stable, given that most of the determinants evolve slowly over the relevant time span (e.g. risk preferences, occupational and personal status, region of residence or having had health problems in the past).
4. See Guiso *et al.* (1996) for further details, and Dominitz and Manski (1997) or Manski (2004) for a reassessment of those criticisms.
5. See next subsection for a more thorough discussion.
6. The magnitude of the risk is too large for a second-order Taylor approximation to be accurate (it is claimed to be valid for small risks, i.e. between 1 and 5% of average income). Still, this drawback needs to be traded-off against the inaccuracy of responses if the lottery is small, since expected utility maximizers are risk neutral in the small labour (Rabin 2000).

7. For sampled households, both measures are positively correlated, though less than expected. The reason seems to stem from the different type of lotteries they propose to use to survey respondents: the first relates to lifetime labour income prospects, while the second proposes a financial investment opportunity. See Arrondel and Masson (2007), where 'domain dependent' risk-averse preferences are considered.
8. In Table 2, comparing columns 5 and 6 along the rows reporting the two risk aversion measures, those who are more risk averse perceive riskier incomes (see also Guiso and Paiella 2004).
9. Although the percentage seems strikingly high, it is not among the 35–55 year old households when compared with the INSEE 'Patrimoine 1998' survey (13.25%) or with the figure reported by Guiso *et al.* (1996) for the 1987 SHIW (15.6%).
10. Since those who are more likely to be liquidity constrained are also more likely to face higher income uncertainty, we control for potential endogeneity problems (see next subsection).
11. Arrondel and Masson (2003) show that, although fixed transactions and information costs are the main determinants of stockownership, they do not explain the amount of stocks held.
12. See King and Leape (1998) and simulated results by Cocco *et al.* (2005) or Haliassos and Michaelides (2003).
13. Under this specification, $e_i|\mathbf{x}_i \sim N(0, [\exp(\omega' w_i)]^2)$. Expression (5) becomes:

$$\Pr(y_i = 1|\mathbf{x}_i) = \Phi\left(\frac{\beta'\mathbf{x}_i}{\exp(\omega' w_i)}\right)$$

So that (5) prevails under the null $\mathbf{H}_0$:$\omega = 0$. The reported Likelihood Ratio statistic (LR) is distributed as $\chi^2(1)$. For each different measure of income risk considered, we reject the null. Under the alternative hypothesis, the estimated coefficients have the same sign and are similar in magnitude.
14. Results in Table 3 only refer to direct and indirect stockownership. But the sign and magnitude of the reported estimates are robust to changes in the definition of stockownership (only direct stockholders) and occupational status (subsample of only active households). They are also robust to a semi-log specification in income and financial wealth.
15. To avoid potential endogeneity problems, we instrumented the second-order polynomial in financial wealth by a second-order polynomial in total wealth, region of residence and secondary residence ownership status. The first-stage regressions for the level and the square of total wealth delivered *F*-statistics of 111,55 and 64,23, respectively. Following *Procedure 15.1* in Wooldridge (2002), we obtained significant *t*-statistics for the predicted residuals of the first-stage regressions confirming the endogeneity of financial wealth. Finally, the Sargan test of overidentifying restrictions delivered a NR^2-statistic of 398 and a *p*-value of 0.912 confirming the validity of the instruments. However, since most of the obtained estimates (except for financial wealth and income) kept their signs and magnitudes unchanged, we do not report them for brevity.
16. The positive effect of information on the probability of holding stocks, as proxied by having internet access, has recently been documented by Bogan (2006) for the US.
17. Vissing-Jorgensen (2003) obtains similar results: when parents are stockholders, children have a higher probability of becoming stockholders because informational barriers are smaller.
18. The age coefficients are difficult to interpret also because only individuals between 35 and 55 were interviewed. Although a cohort effect might be present, the nature of the cross-sectional exercise makes identification of both impossible.
19. To avoid a possible endogeneity bias of the liquidity dummy, we expanded the set of instruments reported in footnote 15 to incorporate marital and health status, and a dummy variable for those who have been unemployed in the past. Although the predicted residuals from the first-stage regressions for financial wealth and financial wealth squared appeared individually significant in the augmented regression (*t*-statistics of -2.55 and 2.05, respectively), it was not the case for liquidity constraints (probit *t*-statistic of -0.3) under the null of exogeneity. Instruments for the latter were jointly significant, with an LR(16) statistic of 241.16 and a *p*-value of 0.000. See *Procedure 15.1* in Wooldridge (2002), and Section 15.7.3 for details.
20. Bottazzi *et al.* (1996) use OECD data for 16 countries from 1970 to 1992, and find significant negative covariation between innovations to human wealth and innovations to financial wealth, for all but four countries (Austria, Germany, Norway and US) including France (see Tables 3, 4 and 5). This finding has been subsequently corroborated by Palacios-Huerta (2001), Julliard (2004, Tables 1, 2 and 4) and, more recently, Santos and Veronesi (2005, Tables 1, 2A, 2B, 3 and 4).
21. Those who have graduate-level qualifications (+ 14%) or college-education (+ 11.9%) and work in a big firm (+ 6.2%) tend to report a negative correlation.
22. Yet a third interpretation in terms of the informational content of unemployment news on equity returns is possible: bad unemployment news are interpreted as 'good news' during expansions, but as bad news during recessions (Boyd *et al.* 2005). Still, this interpretation boils down to *state-contingent* redistributive shocks.
23. But in line with previous empirical results for France (Arrondel and Calvo Pardo 2002; Arrondel and Masson 2003) and Alessie *et al.* (2002) for The Netherlands.

24. Although the variance is a partial representation of risk, we considered alternative measures like the probability of being unemployed five years ahead, a dummy for households that assign point estimates to reductions in real earnings, and different dispersion measures of the subjectively assessed individual distributions. For none of them was a coefficient significantly different from zero obtained.
25. Although theoretically feasible, with only a categorical variable for the correlation sign we cannot separately identify the pure risk substitution effect from the hedging effect. See Section I above for more details.
26. There is just a qualitative question about income risk which, in Tables 2 and 3, is labelled 'discrete income risk'. It is a dummy variable constructed from the survey question that takes value one if the household either answers to receive 'irregular income' or 'a mix of both regular and irregular'.
27. We do not include in the results of Table 2 both unemployment variables because the two are highly correlated and multicollinearity problems emerge.

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