Testing Portfolio Choice with a Correlated Background Risk¤

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Abstract

Recent empirical evidence has tested the theoretical prediction of risk substitution theory: households faced with undiversi…able sources of risk on their income tend to participate less in the stockmarket and to hold less stocks than those with a more stable income. One of the most important sources of undiversi…able income is human capital. Previous empirical work measuring the importance of earnings risk have been successful though unsatisfactory. This paper tests whether the correlation between human capital and …nancial capital shocks leads to more satisfactory empirical results. Using a recent survey of French data, we are able to show that households reporting a negative correlation between both, tend to participate more in the stock market. We o¤er a candidate explanation for rejecting risk substitution behaviour in previous country-speci…c empirical studies.

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1 Introduction

The theory of risk substitution formalizes[1] the intuition that households exposed to risks beyond their control -termed exogenous or background- should, ceteris paribus, compensate the total riskiness they endure by decreasing their exposure to those risks under their control termed endogenous. Recent empirical evidence starting from Guiso et al. (1996), have tested this prediction with relative but yet unsatisfactory success. Given the strong implications for improving the understanding of several puzzles in the economics and …nance literatures, the question is hotly debated. Motivated by the results of Heaton and Lucas (2000), Davis and Willen (2000), Viceira (2001), or Vissing-Jorgensen (2002), emphasizing the role of the correlation between the exogenous and the endogenous risks, we have conducted a new survey among French households to test the importance of the correlation in the explanation of the positive e¤ect of earnings variance on stock market participation detected by Arrondel and Masson (1996) and by Arrondel and Calvo (2002).

The paper is organized as follows: in section 2 we compare the predictions of the theory of risk substitution with an independent background risk with those obtained when a dependent background risk is considered instead. So doing, we characterize the main hypothesis to be tested empirically. In section 3, we describe the data and we present the results of the quantitative estimations. Section 4 summarizes the …ndings and concludes.

2 Risk substitution theory revised

Consider the standard static optimal portfolio composition approximation model for small risks of a household in a complete markets framework[2]. The problem she 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 $\mathbf{e}$ and a riskless asset promising the delivery of a sure return r: Her individual objective function is a continuous di¤erentiable representation of

[1] See Pratt and Zeckhauser (1987), Kimball (1993) or Gollier and Pratt (1996). These works are summarized and completed with more recent advances in the excellent book by C. Gollier (2001).

[2] We borrow notation from the excellent recent book by Gollier (2001) all along the theoretical exposition.

his preferences that admit an expected utility form over …nal wealth w_f: Denoting by α the amount of initial wealth that is invested in the risky asset, by $z \equiv \varepsilon - r$ the excess return of the risky asset over the riskless asset, and by $w \equiv w_0(1+r)$ the …nal wealth had she invested all her current wealth w_0 in the riskless asset, we can write the solution α^* to her individual optimization problem under the small risk approximation as:

$$\alpha^* = \frac{Ez}{\sigma_z^2 A_u(w)} \in \arg\max_{\alpha} Eu(w + \alpha z)$$

Its extension to the presence of an independent small background risk y (incomplete markets) has been performed by Pratt and Zeckhauser (1987), Kimball (1993) and Gollier and Pratt (1996) under di¤erent assumptions on the class of preferences and background risks considered so as to observe substitution between risks:

$$\beta = \frac{Ez}{\sigma_z^2 A_v(w)} \in \arg\max_{\alpha} Eu(w + \alpha z + y)$$

Where substitution between risks means conditions under which the change in preferences from $u(:)$ to $v(:)$[3] : $v(t) \equiv E_y(t+y)$ leads households to be more risk averse in the presence of the exogenous small risk on income y, resulting in decreased stockholdings:

$$A_v(w) \geq A_u(w) \Rightarrow \alpha^* \geq \beta \tag{1}$$

Specializing to the assumptions of Kimball (1993), in Arrondel and Calvo (2002) the results of this literature were extended to the case of a small dependent background risk of the form used by Elmendorf and Kimball (2000). Theoretically they showed how the sign and magnitude of the correlation modulates the theoretical predictions of the literature of risk substitution. Elmendorf and Kimball (2000) de…ned income risk as $y = \bar{y} + \hat{\varepsilon} + \bar{\gamma}\varepsilon = \hat{\eta} + \bar{\gamma}\varepsilon$: A coe¢cient $\bar{\gamma} \neq 0$ captures a non-zero correlation[4] between a part of the exogenous income risk $y - \hat{\eta}$ and the endogenous stock market risk ε. The program of the agent is modi…ed accordingly, to become:

$$\beta \in \arg\max_{\mu} Eu[w + \mu z + \hat{\eta}]$$

[3] Kihlstrom et al. (1981) introduced this indirect utility function to perform their comparative statics analysis.

[4] Davis and Willen (2000) show that the $\bar{\gamma}$ coe¢cient can be interpreted as the standard OLS estimate obtained from regressing earnings y on a broad measure of aggregate stock market returns ε.

Observe that now $\beta^* \gtrless \theta + \bar{\rho} : \theta \Rightarrow \alpha^* \gtrless 0$; satisfying that whenever the correlation is zero, $\bar{\rho} = 0$; the household's optimal choice coincides: $\beta^* \gtrless \theta \Rightarrow \alpha^* \gtrless 0$.

Introducing a partially negatively correlated loss-aggravating background risk[5] $\tilde{y} = \tilde{h} + \bar{\rho}\tilde{e}$ can lead households to rationally increase stockownership and/or participation. Taking a …rst order Taylor expansion of the …rst order condition of the above program evaluated at the solution of the standard portfolio choice problem α^* evidentiates it:

$$\begin{aligned} E_z\{\tilde{e}v'[w + \alpha^*\tilde{e} + \bar{\rho}\tilde{e}]\} &= E_z\{\tilde{e}v'[w + \alpha^*\tilde{e}]\} + \bar{\rho}E_z\{[\tilde{e}]^2 v''[w + \alpha^*\tilde{e}]\} \\ &= \underbrace{E_{z;h}\{\tilde{e}u'[w + \alpha^*\tilde{e} + \tilde{h}]\}}_{\text{Standard Risk Substitution Condition } (<0)} + \\ &\quad + \underbrace{\bar{\rho}}_{\text{Correlation } (\gtrless 0)} \underbrace{E_{z;h}\{[\tilde{e}]^2 u''[w + \alpha^*\tilde{e} + \tilde{h}]\}}_{\text{SOC } (<0)} \end{aligned}$$

Rational households will therefore increase their stockownership if both risks are negatively correlated. Intuitively, this can be interpreted as an uncontrollable implicit liability in risky assets that individuals tend to compensate by directly modifying their portfolio risk exposure in the sense of increasing it[6]. The purpose of the next section is to test empirically whether the correlation has an e¤ect on households' stock market participation when they face a non-diversi…able earnings risk.

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[5] A risk $\tilde{y}$ is loss-aggravating when starting from initial wealth w if and only if it satis…es $Eu'(w + \tilde{y}) \geq u'(w)$: Observe that this is equivalent to $E\tilde{y} \cdot \pi^a : \pi^a$ is the precautionary premium as de…ned by Kimball (1990). The set of risks that satisfy this property for preferences u(:) and initial wealth w are called expected-marginal-utility-increasing risks. In intuitive terms, they are risks that make the agent willing to pay a bigger amount than its expected value in order to keep as optimal the decision prevailing before the risk introduced. Finally observe that if preferences are DARA, every undesirable risk is loss-aggravating.

[6] Davis and Willen (2000) present a similar result, although they only capture the 'mechanic' e¤ect of the correlation, i.e. if the correlation is zero, agents do not modify their stockholdings decision when an undiversi…able income risk is introduced in their optimization program. This is because they characterize agents' preferences by a CARA function, a standard result known since Merton's classical dynamic treatment.

3 Empirical tests with a correlated background risk

Guiso et al. (1996) pioneered the analysis of the empirical validation of risk substitution theory using data on Italian households. The empirical tests for other European countries following an homogeneous methodology are collected in the book edited by Guiso et al. (2003). Following the results by Heaton and Lucas (2000), Davis and Willen (2000) or Vissing-Jorgensen (2002) highlighting the importance of the correlation between risks, Arrondel and Calvo (2002) showed that empirical tests preceding the aforementioned works, were misspeci…ed since they did not control for the correlation. Consequently, conclusions on risk substitution behavior in households were likely to be misguided. In this section we test empirically whether subjective correlations determine non-participation using data on French households. When we include the correlation variable, we e¤ectively correct the impact of non-diversi…able earnings risk on portfolio choice in the direction predicted by risk substitutability.

3.1 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', hereafter) on a sample of 4000 French individuals between 35 and 55 years old. A question to proxy for the correlation as subjectively perceived by individuals is for the …rst time available. Only 2518 households answered, of which 2460 could be exploited. There are questions that try to capture the degree of individual exposure and aversion to risk.

To construct a proxy for the subjective variance the available data is scarce, as we show below. Therefore we use a prediction of the subjective income variance from the previous wealth INSEE survey 'Patrimoine 97', assuming that the relevant determinants are the same[7]. This procedure facilitates as well the comparison with previous results obtained in Guiso et al. (1996) or Arrondel and Calvo (2002) for participation.

The survey allows us to distinguish between direct stockholders (households who hold equities directly) from indirect stockholders (households holding equities through mutual funds). Table 1 summarizes the characteristics

[7] See the appendix for details.

of the sample[8]. Participation is low (21% for direct stockholders and 33% for direct and indirect stockholders), but is slightly bigger than in 'Patrimoine 97' (15% and 23.5% respectively) and in accordance with the …gures for other European countries studied in Guiso et al. (2003). The increased participation relative to previous studies using French data is due to a sample selection bias[9] and not to a real increase in participation as shown in Arrondel (2003).

Moreover, there is one question[10] in the survey that can be used as a proxy for the subjective correlation between income risk and stock market risk (½). It asks about the reasons guiding big …rms decisions to …re out part of their personnel: bankruptcy problems (a positive correlation is assumed, ½ > 0) or expected own stock market price impact (negative correlation, ½ < 0). 62% of the sample believes that there is a negative correlation, while 34% thinks that the correlation is positive. The remaining 4% are non-respondents[11]. This is one of the novelties of this paper. For the …rst time, subjective correlations are considered rather than the objective measures used in previous studies[12] which are at least di¢cult to de…ne and at best di¢cult to compare.

To capture risk aversion (°), two methodologies were adopted. The …rst is based on Barsky et al. (1997) and asks individuals to choose sequentially between their willingness to accept di¤erent contracts in the form of lotteries (A, B or C corresponding to one chance over two to double their lifetime income versus one chance over two to reduce it by one third, by one half and by one …fth respectively). Assuming that preferences are strictly risk averse and that utility is of the CRRA type, we can dispose of a discrete measure of relative risk aversion with four di¤erent corresponding values ranked between 0 (risk neutral) and 4 (the more risk averse). 8% of the sample has a CRRA lower than 1, 20% has a CRRA between 1 and 2, 28% has a CRRA between 2

[8] Risk lovers (54 out of 2460) are dropped o¤ our sample.

[9] Recall that 'DELTA - TNS 2002' has only surveyed individuals with ages between 35 and 55, i.e. when they are more likely to participate. If we look at the data repoted by the INSEE for people between those ages, the rates are almost the sames (32.4% for direct and indirect stockholders and 21.6 for direct stockholders only).

[10] In fact, there is another variable to measure the subjective correlation in the sample. It asks the individual about the correlation between the stockmarket risk and the unemployment rate. But it does not work well and it has been dopped of the …nal results.

[11] A detailed description of the information contained in the survey is in the appendix.

[12] Davis and Willen (2000) or Vissing-Jorgensen (2002).

and 3.76 and 37% has a risk aversion coe¢cient greater than 3.76. The second risk aversion measure is based on Guiso and Paiella (2001) who construct a measure of the coe¢cient of absolute risk aversion. It asks individuals their maximum willingness to pay to enter a lottery representing a relatively large risk (around 16% of average annual income). We use the …rst to obtain estimates of the subjective income variance because in 'Patrimoine 97' it was the only variable available. We use the second to estimate the probability of participation, since this variable has more explanatory power (despite of the fact that both variables are correlated) and it is continuous.

Another of the novelties of the present work is the utilization of the variable proposed by Guiso and Paiella (2001) to measure risk aversion on French households without assuming that individuals are risk averse (in contrast to what happened with the CRRA variable)[13]. To estimate how risk aversion varies with consumers attributes, we have regressed the measure of absolute risk aversion on observable characteristics that can proxy for di¤erences in tastes following Guiso and Paiella (2001) paper[14]. In line with their results, table 2 shows that risk aversion decreases with households' …nancial wealth[15]. Contrary to the results of Guiso and Paiella (2001) for Italy, no signi…cant di¤erences between living in di¤erent regions[16] or having di¤erent ages are obtained. Instead, we …nd that absolute risk aversion depends on gender,

[13] A possible caveat of this measure of absolute risk aversion that also applies to the work of Guiso and Paiella (2001) is that to empirically capture risk aversion behaviour a substantial income risk (around 16% of average annual income) must be proposed in the lottery. But to be a useful measure of absolute risk aversion, the methodology of taking a second order Taylor approximation is not accurate, given that it is only valid for small risks (between 1% and 5%). With this caveat in mind, we still use it since we consider that the improved accuracy of using a continuous variable more than compensates the approximation error we are accepting.

[14] The results included in table 2 replicate the one developed by Guiso and Paiella (2001) with the exception of father's characteristics, information which is not available in our survey.

[15] This is the second caveat of assuming a CARA preference speci…cation which is empirically rejected in favour of a DARA speci…cation. The third and last caveat is that under this type of preferences there is no substitution between risks in the static portfolio choice model with background risk, as we discussed in reference to Davis and Willen's (2000) work above.

[16] In table 3 we use a dummy for living in Paris which is not statistically signi…cant. But we also included a dummy variable for each 'département' and they were not jointly signi…cant (results reported upon request).

having children and level of education. Being a woman[17] 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[18] has no e¤ect on risk aversion. Since residuals are far from being normally distributed, bootstrapped standard errors are provided in table 2.

3.2 Econometric results

We posit the following relation for the share of risky assets in …nancial wealth to estimate the e¤ect of the subjective correlation on:

$$\frac{A}{F} = g(¾^2; cl; °; ½; X) + e \qquad (2)$$

where $A \geq 0$ is the demand for risky assets and F is total …nancial wealth. cl is a proxy for being liquidity constrained in the future, $¾^2$ is the subjective earnings variance, $°$ is the coe¢cient of absolute risk aversion, $½$ is an interaction term proxying for the subjective individual correlation between …nancial and income risks, and X is a vector of other variables which theoretically in‡uence the demand for risky investments. e is the error term.

In speci…cation (2) income risk is assumed to be exogenous. Since in the survey we do not have a quantitative variable for the actual amount invested in the stock market (directly or indirectly), we consider only the probability of participation in the stock market as a dependent variable. Doing so does not signi…cantly change the treatment of the question given that the determinants of the amount invested and the participation decision are the same, excepting the set of information variables[19]. Therefore we estimate a probit model including as regressors the above mentioned variables plus those contained in the X vector according to the predictions of previous theoretical work. If capital markets are imperfect (transaction or informational costs) households' income and wealth in‡uences portfolio choice[20]. The stock of

[17] Schubert et al. (1999) …nd empirical evidence of women being more risk averse.

[18] We do not include in the results of table 2 both unemployment variables because the two are highly correlated and multicollinearity problems emerge.

[19] Arrondel and Masson (1990, 1996) show that …xed transactions and information costs are the main determinant of the ownership decision but that they do not in‡uence the amount of stocks held.

[20] See King and Leape (1987, 1998).

…nancial information that we proxied by age, whether parents hold stocks, whether individuals have an Internet access and a dummy for living in the Parisian agglomeration[21], should determine participation in the stock market but not the level of stockholdings. Demographic factors give also an approximation of potential future sources of income risk, the exclusion of which can lead to misspeci…cation problems according to Burgess et al. (2000). As so, we include marital status[22] and a dummy to control whether they have children or not. We also include in X a dummy for inheritance and inter vivos transfers received including gifts. Despite of the fact that we control for …nancial wealth and income, we consider them separately because individuals could inherit stocks and decide to keep them even if they had not bought them directly. Finally, we include a dummy for gender to obtaining that women are more temperant, in line with the empirical results obtained in the literature on health risks.

Table 3 displays the results of the probit estimation of stock market participation for either direct and indirect stockownership (column 1) or just for direct stockholders (column 2). We include the correlation variable available in the survey to show their impact on the probability of participation.

The variables have the expected sign. Financial wealth has a positive e¤ect on participation and is signi…cant at the 1% level. An increase in …nancial wealth from the …rst decile (6,500 euros) to the ninth decile (410,000 euros) increases the probability of participation by 29%. Income also increases the probability of participation in the stock market, moving from the …rst to the ninth decile increases by 11% the probability. House ownership is used as a proxy for total wealth and for detecting di¤erences in stockholding behavior between owners and renters (See Brueckner, 1997). It has a positive and signi…cative e¤ect. Being a house owner increases the probability of participation by 5%. Heaton and Lucas (2000) rationalize this …nding by means of the negative correlation detected between housing and …nancial risks, i.e. owning a house serves as a hedge against …nancial ‡uctuations.

Previous studies …nd that education increases the probability of participation, but does not explain the level of stokholdings. We have not included

[21] It might be that the variable 'Living in Paris' does not only capture an information asymmetry. For example, people who live in Paris may have an easier access to a stock broker, while for people living in the countryside it may be more di¢cult.

[22] We decided to drop marital status from our …nal estimations since it was systematically non signi…cant.

education as a dependent variable because it was highly correlated with the set of information variables. More information (proxied by Internet[23], if parents own risky assets[24] and living in Paris) implies a greater probability of participation. The information variables are always very signi…cant. Having Internet at home raises the probability of participation by 10% and if parents hold risky assets, the probability increases to 16% (13.5% in column 2). People who live in Paris are 12% more likely to hold risky assets. The age variables indicate that the probability of owning risky assets is lower for younger households, although concave with a maximum in 46 years old. This was obtained in previous studies like Arrondel and Calvo (2002) or Arrondel and Masson (1990). Younger individuals are less informed and participate less, but the reduction in the probability to participate after 46 is di¢cult to explain by life cycle motives alone[25].

More risk averse individuals have a lower probability of participation. We have tested the two proxies we described above to capture risk aversion. We have chosen the continuous variable based on Guiso and Paiella (2001), since it seems to have more explanatory power. Surprisingly, once we control for risk aversion, being a woman always reduces the probability of being a stockholder (by a 7%) thus con…rming that women risk behavior is not completely captured by the risk aversion variable. Households with children are 5.5% less likely to invest in the stock market. Having received an inheritance or an inter vivos transfers (or a gift) increases the probability of participation (6% and 3% respectively) but inter vivos transfers is not statistically signi…cant.

Households who have been liquidity constrained or who think that they will be so in the future are less likely to participate (around 12.5%). The e¤ect of liquidity constraints reinforces the risk substitution e¤ect[26], in line with the empirical results obtained by Guiso et al. (1996). Since we suspected the liquidity proxy to su¤er from an endogeneity bias, a Hausman test has been conducted. The instruments used in the auxiliary instrumental variables regression are: squared log of income, education, marital status, health status, a dummy variable for those individuals who have asked for a credit and labor status. As well, we have run a test for the validity of

[23] Moreover, having internet may be interpreted as a reduction of the transaction and infromation costs.

[24] It can capture habits as well.

[25] The age coe¢cients are di¢cult to interpret accurately because there is a sample selection bias (just individuals between 35 and 55 are interviewed).

[26] See Koo (1995), Haliassos and Michaelides (2003) or Gollier (2001).

the instruments following the procedure explained in Robin (2000). The null hypothesis of exogeneity of the regressors cannot be rejected[27].

The income risk increases the probability of participation, contrary to the standard risk substitution theory. Having a mix of regular and irregular income or an irregular income increases the probability of participation relative to having a regular income. But this discrete measure do not allow to distinguish between several degrees of income risk. For this reason we use another variable in table 4, which facilitates comparison with the results in Guiso et al. (1996) or Arrondel and Calvo (2002). The role of the correlation is the following: if the individual believes that ½ < 0, the individual is 8% more likely to participate (at 1% level of signi…cance and 5% level of signi…cance for direct and indirect stock holders and direct stockholders only respectively).

As it was mentioned, column 2 contains the probit estimates for direct stockholders. The signs we observe in column 1 remain, but some variables become non-signi…cant due to the fact that only 21% of the sample hold stocks directly. That is the case for the age variables, house ownership or inheritance. Some information proxies (Internet, living in Paris and if parents own risky assets) are still very signi…cant.

In table 4 we try to …nd out why risk substitution theory seems not to hold in some previous works[28], taking into account the correlations between income risk and …nancial risk and using a continuous measure of income risk. Table 4 displays the probit estimation of risky assets demand for direct or indirect stockownership (columns 1 and 2) and for just the direct one (columns 3 and 4). Columns 1 and 3 consider income risk (see the appendix to see how it has been constructed) without controlling for the correlations, while in columns 2 and 4 the correlation between earnings risk and …nancial risk is controlled for.

In column 1, the earnings risk variable has a positive signi…cant e¤ect (at 6% level). Arrondel and Calvo (2002) obtain the same result using data from the 'Patrimoine 97' survey. It countervails the risk substitutability prediction. In that work it was claimed that without controlling for the correlation, the empirical tests of columns 1 and 3 could be misspeci…ed. Actually, with

[27] These results are available from the authors upon request.

[28] See Arrondel and Masson (2002) for France, or Alessie and Hochguertel (2002) for Netherlands included in the book edited by Guiso et al. (2003).

the data available in the new survey we have been able to control for it[29]. In column 2, we decompose the e¤ect of income risk using the individual subjective correlation to separate those who perceive a positive correlation ($\rho > 0$) from those who perceive a negative one ($\rho < 0$) and from those who perceive no correlation at all ($\rho = 0$). In line with the theoretical results of section 2, we expect that once we control for the correlation those who believe it to be negative should tend to participate more, given that they tend to use the stock market as a hedge against ‡uctuations in their earnings. This is precisely what is obtained in our regression: a positive and signi…cant sign is obtained. As well, for those who believe that both risks are not correlated, the theory predicts a negative impact of earnings risk on the probability to participate in the stock market. This negative impact should still be larger in absolute value for those who believe in a positive correlation, since their earnings are implicitly constituted in a fraction $\bar{}$ (correlation) by shares of a CAPM market portfolio type. However, we obtain a positive non-signi…cant sign as we do for those who think that there is a negative correlation after controlling for it. Therefore, when controlling for the correlation we do not …nd evidence of a negative impact of a positive earnings variance on the probability of participation as the theory of risk substitution would predict.

In column 3 and 4 the empirical results for direct stockholders are shown. The signs of the variables remain unaltered, denoting robustness. The signi-…cativity and values of the parameters change slightly with the exception of age, house ownership and inheritance variables which become non-signi…cant, as it happened in the previous table. The income risk variables (column 3) or the correlation e¤ect (column 4) become, as well, not signi…cant, a fact that might be explained by the low participation rate.

4 Conclusions

There has been a resurgent interest on the implications of incomplete markets for portfolio choice theory motivated by the number of portfolio puzzles identi…ed in the literature. One of the most active research areas has concentrated on the study of the determinants of stock market participation and stockholdings. Then heterogeneity becomes a crucial assumption which has been con…rmed empirically. This heterogeneity also a¤ects the statistical re-

[29] See appendix for details concerning the proxy that captures the individual subjective correlation between earnings and …nancial risks.

lationship between risks, as Heaton and Lucas (2000) or Davis and Willen (2000) have shown using di¤erent decomposition criteria of non-diversi…able income. In particular, the correlation between earnings and …nancial risks seems to be conditioned by the type of labor market institutions, as the study of Botazzi et al. (1996) argues. Following these observations, Arrondel and Calvo (2002) extended the theory of risk substitution to incorporate a dependent exogenous risk to show that empirical tests of risk substitution theory which did not control for the correlation could not disentangle the e¤ect of the correlation from the proper risk substitution e¤ect, given that the theoretical predictions are conditional to the independence between risks. This is what is succinctly shown in section two. Vissing-Jorgensen (2002) is a recent empirical attempt to test whether US households substitute between risks controlling for the correlation. In section three we have performed a similar study using a cross-section of French households to identify the determinants of the probability of participation in the stockmarket. The essential di¤erence is that we have used a subjective proxy of the correlation between earnings and …nancial risk, which seems to us more relevant to describe households stockmarket participation. We obtain that households who think that there is a negative correlation between both risks tend to participate more than those who think that it is either positive or zero. 62 % of the interviewees think that in the aggregate, redistributive shocks (negative correlation) dominate over the cycle (positive correlation).

Furthermore, once we control for the correlation, the e¤ect of undiversi…able income risk on stock market participation is not positive and signi…cant as it was shown to be for French households in Arrondel and Calvo (2002). Yet, we are not able to con…rm the theory of substitution between risks which predicts a negative impact of earnings variance on participation whenever the correlation is positive or zero[30]. Still, the quality of the data and the nature of the problem would call for a further theoretical development of a proper choice of participation in both the labor and the stockmarket which is beyond the scope of the current work, but very promising.

[30] A possible explanation is that the choice of occupation also depends on the household's tolerance for risk, so that measures like the regional average rate of unemployment should be better proxies for income risk than self-assessed measures. Then, we would have an endogeneity problem. We have performed an exogeneity test described in Robin (2000), and we cannot reject the hypothesis of exogeneity although the instruments are poor. These results are available upon request.

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Appendix

Financial wealth: in the survey the individual is asked to say in which of the 8 prede…ned available brackets is her family. Since we are interested in a continuous measure we have used the simulated residual method (Gouriéroux et al., 1987). We have regressed an ordered probit of the …nancial wealth on some household characteristics. Once we have the estimated …nancial 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. The …nancial wealth is given in francs.

Income: for the income of the household the survey has a discrete variable of 13 brackets. The procedure described in the last paragraph to transform it into a continuous variable has been used too. Income refers to the household's annual income in French francs.

Income risk: since the new survey has no information about income risk[31] and our aim is to focus on background risk, an equation with the 'Patrimoine 97' survey is run to discover the variables that have an in‡uence on income risk. Then, the coe¢cients of the regressions are used to predict income risk in our sample. See table A1 for the details. In the 'Patrimoine 97' survey a proxy for the subjective variance of households' income was constructed, following the methodology carried out by the Bank of Italy in 'SHIW 1989'. It asks households to distribute 100 points between di¤erent scenarios regarding the evolution of income in the next …ve years (see Guiso et al., (1992,1996) or Arrondel and Calvo (2002)). The results of the OLS regression run with 'Patrimoine 97' survey are shown in table A1.

Absolute risk aversion: the survey asks the following: 'if someone proposes you to invest in a place where you have one chance out of two to 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 (2001) show that absolute risk aversion can be computed as: $A_i(w_i) = 2\frac{5000 - Z_i}{5000^2 + Z_i^2}$, where A_i is the absolute risk aversion and Z_i is the amount that the individual

[31] There is just a qualitative question about income risk which in table 3 is labelled 'proxy for income risk'. The survey asks if the individual perceives a regular income, an irregular income or a mix of both.

declares to be willing to invest. For details concerning the validity of the approximation, we address the reader to their work.

Liquidity constraints: we use as a proxy for being liquidity constrained in the future a dummy variable that takes the value of one if she has been liquidity constrained in the past or if she thinks that she is not going to get a credit today if she asks for it. For more details see Arrondel and Calvo (2002).

Correlation between stock prices and income risk: there is a question in the survey that asks directly to individuals: 'In your opinion, big …rms …re employers when' and the options are: 'when the …rm is in …nancial trouble' or 'when the …rm wants to increase its stock market price'. If the individual responds, 'when the …rm is in …nancial trouble', a positive correlation is assumed between the exogenous income risk and the endogenous stock market risk ($\rho > 0$); the correlation is negative ($\rho < 0$) if the individual answers 'when the …rm wants to increase its stock market price' and there is no correlation ($\rho = 0$) when there is no answer.

Table 1: Sample characteristics [1]

Continuous variables	**Mean**	**Std. Dev.**
Financial wealth [2] [3]	192,695	1,504,920
Income [2] [4]	202,067	256,637
Income risk [2] [5]	0.0637	0.0350
Age (of the head of the household) [6]	45	7.431
Absolute risk aversion (10^{-5})[2]	29.323	14.219
Discrete variables	**% of the sample**	
Direct and indirect stockholders	33%	
Direct stockholders	21%	
Individuals who answer absolute risk aversion question	87%	
Inheritance	19%	
Inter vivos transfers and gift received	52%	
Paris	16%	
Parents own risky assets	24%	
Internet	33%	
Women	15%	
Homeownership	67%	
Child (if n° of children > 0)	44%	
Liquidity constraints [2]	20%	
She has been unemployed	52%	
Relative risk aversion (CRRA):		
Non respondents	7%	
CRRA < 1	8%	
1 ≤ CRRA < 2	20%	
2 ≤ CRRA < 3.76	28%	
CRRA ≥ 3.76	37%	
Correlation between income risk and market risk: [2]		
ρ > 0 (people who believe that there is a positive correlation)	34%	
ρ < 0 (negative correlation)	62%	
ρ = 0 (no correlation)	5%	
Correlation between stocks and unemployment:		
Positive	13%	
Negative	11%	
No correlation	25%	
I do not know	51%	
Education level of head of the household:		
No diploma or primary level	6%	
Primary or secondary level	41%	
Baccalaureate	21%	
Graduate studies	25%	
Post-graduate studies	7%	
Number of households	**2406**	

Source: "DELTA - TNS 2002"

(1) The 54 households who are risk lovers (with negative absolute risk aversion) are dropped off the sample.

(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: standard deviation of expected income per unit of income estimated from "Patrimoine 97" using household characteristics of "DELTA - TNS 2002". Income is in French francs.

(6) Age: age of the head of the household.

Direct stockholders: the household holds equities directly (includes national and foreign stocks).

Indirect stockholders: the household holds equities indirectly (through mutual funds).

Table 2: Absolute risk aversion [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	-0.044 (0.035)
Education level of head of the household:	
Primary or secondary level	-0.094 (0.044)
Baccalaureate	-0.122 (0.052)
Graduate studies	-0.153 (0.054)
Post-graduate studies	-0.280 (0.088)
Constant	3.699 (0.156)
Adj R-squared = 0.0148	Number of obs = 2088
F (10, 2077) = 3.84	Prob > F = 0.0000

Source: "DELTA - TNS 2002" survey and own calculations

(1) Risk lovers are included in the regression. 2088 out of 2460 answer the absolute risk aversion question.

Note: an OLS regression has been used. 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.

Table 3: Probit estimation of the demand for risky assets: (1)

Dependent variable	direct or indirect stockholders (1)	direct stockholders only (2)
Ln financial wealth (2)	0.195 (0.021)	0.165 (0.023)
Ln income (3)	0.264 (0.064)	0.197 (0.068)
Proxy for income risk:		
Irregular income	0.178 (0.076)	0.220 (0.081)
Correlation between income risk and stock market risk: (4)		
$\rho < 0$ (negative correlation)	0.244 (0.063)	0.160 (0.069)
$\rho = 0$ (no correlation)	-0.237 (0.162)	-0.163 (0.173)
Age (5)	0.104 (0.039)	0.054 (0.041)
Age squared (10E-3)	-0.001 (0.000)	-0.001 (0.000)
Inheritance	0.155 (0.073)	0.121 (0.078)
Inter vivos transfers	0.085 (0.060)	0.057 (0.065)
Internet	0.264 (0.063)	0.203 (0.067)
Parents own risky assets	0.460 (0.069)	0.475 (0.073)
Paris	0.352 (0.081)	0.383 (0.083)
Absolute risk aversion	-0.020 (0.003)	-0.018 (0.003)
Whether the individual answers the risk aversion question	0.921 (0.147)	0.829 (0.154)
Woman	-0.204 (0.095)	-0.246 (0.106)
Child (if n° of children > 0)	-0.138 (0.071)	-0.135 (0.077)
Homeownership	0.165 (0.069)	0.126 (0.075)
Liquidity constraints	-0.393 (0.088)	-0.460 (0.102)
	-8.824 (1.165)	-6.901 (1.212)
Pseudo R2	0.187	0.164
Number of observations	2406	2406

Source: "DELTA - TNS 2002" survey and own calculations.
Reference groups are: Perceiving a regular income, Positive correlation between income risk and stock market risk, Positive correlation between stock market risk and unemployment.

(1) Households who are risk lovers (with Zi > 5000) are dropped off the sample.
(2) Logarithm of household's total financial wealth in French francs.
(3) Logarithm of household's annual income in French francs.
(4) The parameter ρ tries to measure the correlation between income risk and stock market risk. A different coefficient for income risk is computed depending on the sign of the correlation. See the appendix to know how we obtain the correlation variable.
(5) Age: age of the head of the household.

Direct stockholders: the household holds equities directly (includes national and foreign stocks).
Indirect stockholders: the household holds equities indirectly (through mutual funds).

Table 4: Probit estimation of the demand for risky assets: (1)

Dependent variable	direct or indirect stockholders (1)	direct or indirect stockholders (2)	direct stockholders only (3)	direct stockholders only (4)
Ln financial wealth (2)	0.194 (0.021)	0.193 (0.021)	0.163 (0.023)	0.162 (0.023)
Ln income (3)	0.300 (0.068)	0.295 (0.068)	0.250 (0.072)	0.246 (0.072)
Income risk (4)	2.333 (1.078)		3.009 (1.123)	
Income risk effect: (5)				
For individuals with $\rho > 0$		-0.873 (1.353)		0.972 (1.434)
For individuals with $\rho < 0$		2.932 (1.072)		3.354 (1.123)
For individuals with $\rho = 0$		-0.897 (2.903)		1.891 (3.017)
Age (6)	0.115 (0.039)	0.110 (0.039)	0.065 (0.041)	0.061 (0.041)
Age squared (10E-3)	-1.199 (0.407)	-1.157 (0.407)	-0.616 (0.421)	-0.589 (0.421)
Inheritance	0.160 (0.073)	0.162 (0.073)	0.127 (0.078)	0.128 (0.078)
Inter vivos transfers	0.080 (0.060)	0.081 (0.060)	0.052 (0.065)	0.050 (0.065)
Internet	0.269 (0.062)	0.266 (0.062)	0.204 (0.067)	0.202 (0.067)
Parents own risky assets	0.454 (0.069)	0.451 (0.069)	0.465 (0.072)	0.463 (0.072)
Paris	0.311 (0.081)	0.322 (0.082)	0.333 (0.084)	0.341 (0.084)
Absolute risk aversion	-0.019 (0.003)	-0.019 (0.003)	-0.018 (0.003)	-0.018 (0.003)
Whether the individual answers the risk aversion question	0.972 (0.144)	0.947 (0.146)	0.852 (0.151)	0.844 (0.154)
Woman	-0.174 (0.095)	-0.172 (0.096)	-0.207 (0.107)	-0.203 (0.107)
Child (if n° of children > 0)	-0.165 (0.071)	-0.151 (0.071)	-0.163 (0.077)	-0.156 (0.077)
Homeownership	0.150 (0.069)	0.157 (0.069)	0.110 (0.075)	0.114 (0.075)
Liquidity constraints	-0.373 (0.087)	-0.380 (0.087)	-0.448 (0.102)	-0.449 (0.102)
Constant	-9.605 (1.222)	-9.306 (1.224)	-7.932 (1.279)	-7.728 (1.280)
Pseudo R2	0.180	0.185	0.161	0.163
Number of observations	2406	2406	2406	2406

Source: "DELTA - TNS 2002" survey and own calculations

(1) Households who are risk lovers (with Zi > 5000) are dropped off the sample.

(2) Logarithm of household's total financial wealth in French francs.

(3) Logarithm of household's annual income in French francs.

(4) Income risk: standard deviation of expected income per unit of income estimated from "Patrimoine 97" using household characteristics of "DELTA - TNS 2002". See the appendix and table A1 for details. Income in French francs.

(5) The parameter ρ tries to measure the correlation between income risk and stock market risk. A different coefficient for income risk is computed depending on the sign of the correlation. See the appendix to know how we obtain the correlation variable.

(6) Age: age of the head of the household.

Direct stockholders: the household holds equities directly (includes national and foreign stocks).

Indirect stockholders: the household holds equities indirectly (through mutual funds).

Table A1: The income risk estimation

Dependent variable	Income risk
Income	0.044 (0.003)
Age	-389 (109)
Age squared	2.365 (1.084)
Health problems	3,004 (1,421)
Child (if n° of children > 0)	1,623 (813)
Post-graduate studies	1,348 (906)
Occupational status:	
Trader or craftsman	-644 (1,761)
Profession	-737 (1,642)
Foreman	-1,493 (1,559)
Employee	-3,059 (1,590)
Blue collar worker	-3,070 (1,553)
Retired	-4,044 (1,687)
Inactive	-4,737 (1,802)
Personal Status:	
Cohabitation	2,331 (1,031)
Single	-1,418 (995)
Divorced	-2,099 (926)
Widow	441 (948)
Constant relative risk aversion (CRRA):	
No answer	-791 (780)
$2 \leq CRRA < 3.76$	1,895 (583)
$1 \leq CRRA < 2$	3,263 (869)
$CRRA < 1$	2,423 (1,123)
Portfolio risk preference:	
Very small	-307 (1,369)
Small	88 (1,440)
High	3,665 (1,791)
Probability to be unemployed in 5 years:	
Very small	-930 (961)
Small	764 (951)
High	1,937 (1,095)
Very high	1,637 (1,190)
Region:	
Paris Ile-de-France	-1,712 (874)
Nord	-835 (1,157)
East	-961 (927)
West	-1,540 (924)
Sud-West	-13 (1,026)
Sud-East	-2,010 (959)
Mediterranean	-1,632 (923)
Constant	16,137 (3,506)
Adj R-sq 0.2603	Number of obs = 2390
F (35, 2355) = 25.035	Prob > F = 0.0001

Source: "Patrimoine 97" INSEE survey
Reference values are: for occupational status "Agriculture", for familiar status "Married", CRRA ≥ 3.76, for savings preferences and probability to be unemployed "Very high" and for region "Paris".