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Trusting the Stock Market

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ABSTRACT

We study the effect that a general lack of trust can have on stock market participation. In deciding whether to buy stocks, investors factor in the risk of being cheated. The perception of this risk is a function of the objective characteristics of the stocks and the subjective characteristics of the investor. Less trusting individuals are less likely to buy stock and, conditional on buying stock, they will buy less. In Dutch and Italian micro data, as well as in cross-country data, we find evidence consistent with lack of trust being an important factor in explaining the limited participation puzzle.

THE DECISION TO INVEST IN stocks requires not only an assessment of the risk–return trade-off given the existing data, but also an act of faith (trust) that the data in our possession are reliable and that the overall system is fair. Episodes like the collapse of Enron may change not only the distribution of expected payoffs, but also the fundamental trust in the system that delivers those payoffs. Most of us will not enter a three-card game played on the street, even after observing a lot of rounds (and thus getting an estimate of the "true" distribution of payoffs). The reason is that we do not trust the fairness of the game (and the person playing it). In this paper, we claim that for many people, especially people unfamiliar with finance, the stock market is not intrinsically different from the three-card game. They need to have trust in the fairness of the game and in the reliability of the numbers to invest in it. We focus on trust to explain differences in stock market participation across individuals and across countries.

We define trust as the subjective probability individuals attribute to the possibility of being cheated. This subjective probability is partly based on objective

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characteristics of the financial system (the quality of investor protection, its enforcement, etc.) that determine the likelihood of frauds such as Enron and Parmalat. But trust also reflects the subjective characteristics of the person trusting. Differences in educational background rooted in past history (Guiso, Sapienza, and Zingales (2004)) or in religious upbringing (Guiso, Sapienza, and Zingales (2003)) can create considerable differences in levels of trust across individuals, regions, and countries.

These individual priors play a bigger role when investors are unfamiliar with the stock market or lack data to assess it. But they are unlikely to fade away even with experience and data. Furthermore, when mistrust is deeply rooted, people may be doubtful about any information they obtain and disregard it in revising their priors. For example, data from a 2002 Gallup poll show that roughly 80% of respondents from some Muslim countries (Pakistan, Iran, Indonesia, Turkey, Lebanon, Morocco, Kuwait, Jordan, and Saudi Arabia) do not believe that Arabs committed the September 11 attacks (Gentzkow and Shapiro (2004)).

To assess the explanatory power of a trust-based explanation, we start by modeling the impact of trust on portfolio decisions. Not only does the model provide testable implications, but it also gives us a sense of the economic importance of this phenomenon. In the absence of any cost of participation, a low level of trust can explain why a large fraction of individuals do not invest in the stock market. In addition, the model shows that lack of trust amplifies the effect of costly participation. For example, if an investor thinks that there is a 2% probability that he will be cheated, the threshold level of wealth beyond which he invests in the stock market will increase fivefold.

To test the model's predictions, we use a sample of Dutch households. In the fall of 2003, we asked some specific questions on trust, attitudes toward risk, ambiguity aversion, and optimism of a sample of 1,943 Dutch households as part of the annual Dutch National Bank (DNB) Household Survey. These data were then matched with the 2003 wave of the DNB Household Survey, which has detailed information on households' financial assets, income, and demographics. We measured the level of generalized trust by asking our sample the same question asked in the World Values Survey (a well-established cross-country survey): "Generally speaking, would you say that most people can be trusted or that you have to be very careful in dealing with people?"

We find that trusting individuals are significantly more likely to buy stocks and risky assets and, conditional on investing in stock, they invest a larger share of their wealth in it. This effect is economically very important: Trusting others increases the probability of buying stock by 50% of the average sample probability and raises the share invested in stock by 3.4% points (15.5% of the sample mean).

These results are robust to controlling for differences in risk aversion and ambiguity aversion. We capture these differences by asking people their willingness to pay for a purely risky lottery and an ambiguous lottery. We then use these responses to compute an Arrow–Pratt measure of individual risk aversion and a similar measure of ambiguity aversion.

Since these measures are not statistically significant, however, one may wonder whether trust is not just a better-measured proxy of risk tolerance. To dispel this possibility, we look at the number of stocks people invest in. In the presence of a per-stock cost of investing, our model predicts that the optimal number of stocks is decreasing in individual risk tolerance but increasing in the level of trust. When we look at the Dutch sample, we find that the number of stocks is increasing in trust, suggesting that trust is not just a proxy for low risk aversion.

Trust is also not just a proxy for loss aversion, which in Ang, Bekaert, and Liu's (2005) framework can explain lack of participation (as Barberis, Huang, and Thaler (2006) show, however, loss aversion alone is not sufficient to explain lack of participation). First, more loss-averse people should insure more, but we find that less trusting people insure themselves less. Second, Osili and Paulson (2005) show that immigrants in the United States, facing the same objective distribution of returns, differ in their stock market participation rate as a function of the quality of institutions in their country of origin. This is consistent with the evidence (Guiso, Sapienza, and Zingales (2004, 2006)) that individuals tend to apply the trust of the environment in which they are born to the new environment in which they live. It is not clear why loss aversion should follow this pattern.

We also want to ascertain that trust is not a proxy for other determinants of stock market participation. For example, Puri and Robinson (2005) find that more optimistic individuals (individuals who expect to live longer) invest more in stock, while Dominitz and Manski (2005) find that, consistent with Biais, Bossaerts, and Spatt (2004), an individual's subjective expectations about stock market performance are also an important determinant.

We control for differences in optimism across individuals by using the answers to a general optimism question we borrowed from a standard Life Orientation Test (Scheier, Carver, and Bridges (1994)). We control for differences in expectations thanks to a specific question on this topic that was asked to a subsample of the households. When we insert these controls, the effect of trust is unchanged.

The measure of trust that we elicit in the DNB survey is a measure of generalized trust. But stock market participation can be discouraged not only by general mistrust, but also by a mistrust in the institutions that should facilitate stock market participation (brokerage houses, etc.). To assess the role of this specific trust, we use a customer survey conducted by a large Italian bank, where people were asked their confidence toward the bank as a broker. Also in this case, we find that trust has a positive and large effect on stock market participation as well as on the share invested in stocks.

That lack of trust—either generalized or personalized—reduces the demand for equity implies that companies will find it more difficult to float their stock in countries characterized by low levels of trust. We test this proposition by using cross-country differences in stock participation and ownership concentration. We find that trust has a positive and significant effect on stock market participation and a negative effect on dispersion of ownership. These effects are present even when we control for law enforcement, legal protection, and legal origin. Hence, cultural differences in trust appear to be a new additional explanation for cross-country differences in stock market development.

We are obviously not the first ones to deal with limited stock market participation. Documented in several papers (e.g., Mankiw and Zeldes (1991) and Poterba and Samwick (1995) for the United States, and Guiso, Haliassos, and Jappelli (2001) for various other countries), this phenomenon is generally explained with the presence of fixed participation costs (e.g. Haliassos and Bertaut (1995), Vissing-Jørgensen (2003)). The finding that wealth is highly correlated with participation rates in cross-section data supports this explanation. However, "participation costs are unlikely to be the explanation for nonparticipation among high-wealth households" (Vissing-Jørgensen (2003, p. 188); see also Curcuru et al. (2005)).

A more convincing explanation for lack of participation has been recently proposed by Barberis, Huang, and Thaler (2006). They show that the combination of loss aversion and narrow framing can induce individuals to stay away from any positive payoff gambles, including the stock market, even in the absence of any transaction cost. This explanation is consistent with Dimmock (2005), who finds that a measure of loss aversion is correlated with the probability of investing in stocks.[1]

While independent from fixed costs, our trust-based explanation is not alternative to it. In fact, the two effects compound. The main advantage of the trust-based explanation is that it is able to explain the significant fraction of wealthy people who do not invest in stocks. Accounting for this phenomenon would require unrealistic level of entry costs. By contrast, since mistrust is pervasive even at high levels of wealth (the percentage of people who do not trust others drops only from 66% in the bottom quartile of the wealth distribution to 62% at the top), the trust-based explanation can easily account for lack of participation even among the wealthiest.

Furthermore, as Table I documents, the fraction of wealthy people who do not participate varies across countries. Explaining these differences only with the fixed cost of entry would require even more unrealistic differences in the level of entry costs. By contrast, we show that trust varies widely across countries and is in a way consistent with these differences, especially when we look at the level of trust of the more wealthy people.

Our trust-based explanation is also related to recent theories of limited stock market participation based on ambiguity aversion (e.g., Knox (2003)). When investors are ambiguity averse and have Gilboa-Schmeidler (1989) "max-min" utility, they may not participate even if there are no other market frictions, such as fixed adoption costs (Dow and Werlang (1992) and Routledge and Zin (2001)). The two explanations, however, differ from a theoretical point of view, as can be appreciated from brain experiments (Camerer, Loewenstein, and Prelec (2004),

[1] Dimmock uses the same Dutch survey we use but for a different year. Unfortunately, the questions he uses to construct his measure of loss aversion were not asked in our wave. Hence, we cannot compare the relative power of the two explanations.

Table I
Proportion of Households Investing in Risky Assets, by Asset Quartiles

Panel A shows the proportion of households in each quartile of gross financial wealth that own stock directly. Panel B shows the same proportion when we include also indirect ownership, via mutual funds or pension funds. Data for European countries are computed from the 2004 wave of the Survey for Health, Age, and Retirement in Europe (Share), and refer to year 2003. Data for the U. S. are drawn from the 1998 Survey of Consumer Finances. Data for the U. K. are drawn from the 1997–1998 Financial Research Survey.

	Quartile I	Quartile II	Quartile III	Quartile IV	Top 5%	Average
			Panel A. Direct Stockholding			
U. S.	1.4	6.9	20.6	47.9	70.1	19.2
U. K.	0.0	4.4	28.3	53.6	67.9	21.6
Netherlands	1.5	7.4	20.0	40.3	60.2	17.2
Germany	0.6	4.1	16.1	36.1	50.5	14.0
Italy	0.0	0.8	3.1	12.8	30.8	4.0
Austria	0	1.7	2.8	15.6	25.7	5.0
Sweden	12.9	30.7	46.9	72.8	80.6	40.8
Spain	0	0.3	1.8	13.2	14.4	3.5
France	0.7	9.9	14.6	33.3	44.2	14.4
Denmark	6.3	25.9	36.4	55.6	68.4	31.0
Greece	0	0.7	3.2	17.3	23.5	4.9
Switzerland	2.8	12.2	30.3	54.2	63.2	24.9
			Panel B. Direct and Indirect Stockholding			
U. S.	4.4	38.3	66.0	86.7	93.7	48.9
U. K.	4.9	11.9	37.8	71.1	83.9	31.5
Netherlands	1.7	11.0	31.3	52.8	72.0	24.1
Germany	1.5	11.8	28.7	51.4	61.2	22.9
Italy	0.0	0.8	5.2	27.5	64.8	8.2
Austria	0	1.9	8.1	25.5	33.8	8.8
Sweden	25.8	63.4	82.7	92.9	95.8	66.2
Spain	0	1.1	3.0	19.1	24.6	5.4
France	1.1	17.6	29.9	57.6	67.3	26.2
Denmark	6.6	30.8	44.8	65.7	75.4	37.0
Greece	0	0.7	4.0	22.2	32.9	6.3
Switzerland	2.8	20.0	38.2	63.7	65.8	31.4

McCabe et al. (2001), Rustichini et al. (2002) and Zak, Kurzban, and Matzner (2004)). This evidence shows that when individuals are faced with a standard trust game, the part of the brain that is activated is the "Brodmann area 10," whereas when they have to choose among ambiguous and unambiguous lotteries, the part activated is the "insula cortex." The "Brodmann area 10" is the area of the brain related to the ability of people to make inferences from the actions of others about their underlying preferences and beliefs, and is thus the one that rests on culture. The "insula cortex" is a part of the brain that activates during experiences of negative emotions, like pain or disgust, and is mostly related to instinct. Hence, theories based on ambiguity aversion appeal to the rational part of the decision process, while our theory appeals to the instinctive part.

Finally, our trust-based explanation provides a new way to interpret the growing evidence that familiarity breeds stock market investments. Empirically, there is evidence that investors have a bias to invest in stocks of companies they are more familiar with. For example, Huberman (2001) shows that shareholders of a Regional Bell Operating Company (RBOC) tend to live in the area served by the RBOC. Similarly, Cohen (2005) documents that employees bias the allocation of their 401-K plan in favor of their employer's stock, possibly because they view their employer's stock as safer than a diversified portfolio (Driscoll et al. (1995)). Traditionally, these findings have been interpreted as evidence of Merton's (1987) model of investors with limited information. An alternative interpretation, consistent with our model and several papers in the literature (Coval and Moskowitz (1999, 2001)), is that there is a strong correlation between trust and local knowledge. This correlation can be the result of a causal link flowing in both directions. On the one hand, more knowledge, as we show in this paper, overcomes the barrier created by lack of trust. Hence, mistrust will be less of an obstacle in investing in local stocks. On the other hand, trust facilitates the collection and dissemination of information, as the famous Paul Revere example demonstrates.[2] Accordingly, our model is consistent with Hong, Kubik, and Stein's (2004) findings that more social individuals (who go to church, visit their neighbors, etc.) are more likely to hold stocks, since social individuals exhibit more generalized trust (Guiso, Sapienza, and Zingales (2003)).

The rest of the paper proceeds as follows. Section I shows the implications of introducing a problem of trust in a standard portfolio model. It also derives the different implications trust and risk aversion have when it comes to choosing the optimal number of stocks in a portfolio. Section II describes the various data sources we use and the measures of trust, risk aversion, ambiguity aversion, and optimism in the DNB survey. Section III presents the main results on the effect of generalized trust obtained using the DNB survey. Section IV discriminates between trust and risk aversion, while Section V focuses on the effects of trust toward an intermediary. Cross-country regressions are presented in Section VI. Section VII concludes.

I. The Model

Gambetta (2000) defines trust as "the subjective probability with which an agent assesses that another agent or group of agents will perform a particular

[2] When Paul Revere took the midnight ride in 1775 to inform his fellow citizens that the British were coming, he mounted enough support to defeat them in Concord and begin the Revolutionary War. At the same moment another Bostonian, William Dawes, tried to convey the same message but he was unsuccessful even though he met more people during his nocturnal ride (see Hackett Fisher (1995)). The difference between Paul Revere and William Dawes was that Paul Revere was a well-connected silversmith, known and trusted by all to be highly involved in his community. Thus, people trusted his message and followed him while others ignored Dawes's message (see Gladwell (2000)).

action. (217)" Hence, trust plays a role in all the situations when "others know something about themselves or the world, which the person in question does not, and when what that person ought to do depends on the extent of his ignorance of these matters" (Dasgupta (2002)). In determining whether to invest in a stock an individual has to assess not only what is the "true" distribution of returns, but also what is the possibility the company is just a scam, that the manager steals all the proceeds, or that the broker absconds with the money instead of investing it. For simplicity, we assume that investors know with certainty the "true" distribution of returns, but that they are worried about the probability of these extreme bad events.[3] We refer to all these possible events collectively as "the firm cheats" and we label with p the subjective perceived probability this might occur. Consequently, we identify the complementary probability $(1-p)$ with the degree of trust an investor has in the stock.

To illustrate the role of trust in portfolio choices, we start with a simple two-asset model. The first one is a safe asset, which yields a certain return r_f. The second asset, which we call stock, is risky along two dimensions. First, the money invested in the company has an uncertain "true" return $\tilde{r}$, distributed with mean $\bar{r} > r_f$ and variance σ^2. Second, there is a positive probability p that the value of your investment vanishes. This can occur if the stock becomes worthless. But it can also occur regardless of the behavior of the underlying stock if the broker or the intermediary absconds with the money.

While p is clearly individual-specific, for simplicity in our notation we omit the reference to the individual. Finally, to highlight the role of trust we start by assuming zero costs of participation.

Given an initial level of wealth W, an individual will choose the share α to invest in stocks to maximize his expected utility

$$\operatorname*{Max}_{\alpha}(1-p)EU(\alpha\tilde{r}W+(1-\alpha)r_fW)+pU((1-\alpha)r_fW),$$

where the two terms reflect the investor's utility if, respectively, no cheating or cheating occurs. The first-order condition for this problem is given by

$$(1-p)EU'(\alpha\tilde{r}W+(1-\alpha)r_fW)(\tilde{r}-r_f)\leq pU'((1-\alpha)r_fW)r_f. \qquad (1)$$

The left-hand side (LHS) is the expected marginal utility of investing an extra dollar in the risky asset, which yields an excess return $\tilde{r}-r_f$ with probability $(1-p)$. This must be less than or equal to the cost of losing all the investment if cheating occurs. If at $\alpha=0$ the cost exceeds the benefit, then it is optimal to stay out of the stock market. This will happen if $p>\bar{p}$, where $\bar{p}$, the threshold of p above which an individual does not invest in stocks, is defined as $\bar{p}=(\bar{r}-r_f)/\bar{r}$. It follows that

PROPOSITION 1: *Only investors with high enough trust* $((1-p)>(1-\bar{p}))$ *will invest in the stock market.*

The intuition behind Proposition 1 is very simple. A risk-averse investor will only be willing to hold stocks if the expected return on the risky asset

[3] Adding any level of uncertainty on the true distribution of returns will only make it easier to explain lack of participation.

exceeds the risk-free rate. Since the expected return on stocks is $(1 - p) \times \bar{r} + p \times 0$ he will invest only if $(1 - p) \times \bar{r} > r_f$. Equality between the (subjectively) expected return on stocks and the risk-free rate defines the trust threshold for participation. Sufficient lack of trust can lead the expected return on the risky asset to fall below the risk-free rate, inducing the investor to stay out of the stock market.

Without any cost of participation, equation (1) provides the condition for participation. If we plug the U.S. values of these parameters (the average rate of return on stocks in the post-war period has been about 12% and that on government bonds about 5%), an individual will not participate if his subjective probability of being cheated is greater than $(\bar{r} - r_f)/\bar{r} = (1.12 - 1.05)/1.12$, or about 6.25%.

If the perceived probability of being cheated is above this level, an individual will never invest in stock. Given the long time series of U.S. stock returns, however, one would be tempted to conclude that at least in the United States no rational investor doing Bayesian updating à la Kandel and Stambaugh (1996) would have such a high probability of a total loss. There are, however, several reasons why such high probability is not necessarily irrational.

First, we model the cheating risk as the probability of a total loss just for simplicity. If the fraud consists in skimming part of the profit, to deter an investment the prior of such an event should be higher. Further, the ability to reject a high likelihood of being cheated by looking at past data is much more limited because these events are more frequent and easier to hide. Consider, for instance, the pervasiveness of late trading by mutual funds in the United States (Zitzewitz (2006)).

Second, if we look at the aggregate return, a total loss has not often manifested itself in U.S. history. But until recently individual investors could not easily invest in an index, and now that they can, the problem is still not solved because there is intermediary risk: What is the probability that Vanguard or Fidelity is a fraud? Not only are our time series on this risk much more limited, but the statistics themselves are not so easy to find. Anecdotally, we know of two cases where investors lost everything because the intermediary defaulted or ran away with the cash. But even if we were able to find official statistics about this phenomenon, they would not be unbiased, as only discovered fraud would be reported. A lot of fraud, however, is not discovered and not reported. Dyck, Morse, and Zingales (2007), for example, estimate that more than 50% of corporate fraud goes undetected. This figure is likely to be even higher for other forms of security fraud involving small investors.

Last, but not least, our argument corresponds to priors and there is no way to dismiss a prior as irrational. A high likelihood is irrational only if we consider it as a posterior. But to form a posterior an investor needs to *trust* the data. Mistrusting individuals, however, do not trust the data, as a smart observer of a three card game played on the street does not trust the odds she observes in front of her eyes. That mistrust of the official data is diffuse, even in the United States, is suggested by the fact that a Scripps Howard/Ohio University poll reports that more than a third of Americans think the U.S. government was involved in September 11 (Hargrove (2007)). Why should they trust the official statistics, when many of them are assembled by people who, directly or indirectly, have a vested interest in people investing in the stock market?

An interesting feature of this model is that the necessary condition for stock market participation does not directly depend on wealth. Hence, provided that trust is not highly correlated with wealth (a condition we will verify), this model can explain lack of participation even at high levels of wealth.

Now, suppose that p is below $\bar{p} = (\bar{r} - r_f)/\bar{r}$, then equation (1) will hold in equality and will define the optimal share $\alpha^* > 0$. Lowering trust marginally (i.e., increasing p) will reduce the LHS of equation (1) and increase the right-hand side (RHS). To re-establish optimality, the optimal share invested in stocks should adjust. Since, given concavity of the utility function, the LHS of equation (1) is decreasing in α while the RHS is increasing, α has to decline. Hence, we have

PROPOSITION 2: *The more an investor trusts, the higher his optimal portfolio share invested in stocks conditional on participation.*

This result can be seen more clearly if we assume investors have an exponential utility with coefficient of absolute risk aversion θ and $\tilde{r} \sim N(\bar{r}, \sigma^2)$. In this case, their optimal α would be

$$\alpha^* = \frac{(\bar{r} - r_f)}{\theta W \sigma^2} - \frac{p r_f}{(1-p) A \theta W \sigma^2},$$

where $A = e^{-\theta(\alpha^* \bar{r} W - \theta(\alpha^* W)^2 \sigma^2)}$.

Note that the first term of this equation is the optimal α when there is no fear of being cheated ($p = 0$). Since A is a strictly decreasing function of α^*, as p increases (trust decreases), the optimal level of investment in stock drops.

One objection to interpreting trust as a subjective probability is that mistrust in the stock market may be reflected in the variance of stock returns and thus lead to a higher value of σ^2, rather than a lower mean expected return. If this were the only effect, lack of trust would not in itself be able to generate nonparticipation (though it may still amplify the effect of participation costs). There are at least three answers to this objection. First, in modeling trust as a subjective belief about being cheated by the counterpart in a financial transaction, we are following strictly the trust literature (see Gambetta (2000), Dasgupta (2002), and Berg, Dickhaut, and McCabe (1995)).

Second, any effect of mistrust on variance can be easily eliminated with a frequent observation of the data. As Merton (1980) points out, one can obtain as precise a measure of the variance of returns as desired by sampling at sufficiently fine intervals. By contrast, it takes long stationary time series of data to eliminate the effect of mistrust on expected returns.

Finally, in our modeling approach lack of trust also impacts the variance of the portfolio return though not that of stock returns.

A. Inserting Participation Costs

The previous section shows that lack of trust can theoretically explain the lack of stock market participation of many investors even without participation costs. The combination of trust and fixed cost of participation, however, can do even better and add realism to the model.

To assess the impact of combining the two explanations, we introduce trust in a fixed cost of participation model à la Vissing-Jørgensen (2003). Hence, we assume that if an individual wants to invest in stocks, he has to pay a fixed cost f and allocate between the two assets only the remaining wealth $W - f$. If p exceeds $\bar{p} = (\bar{r} - r_f)/\bar{r}$, the investor will not participate, whatever the value of the participation cost. Now, investing in stocks becomes relatively less attractive; as f increases the level of trust required to participate is higher ($\bar{p}$ is lower) because it corresponds to the higher participation costs.

PROPOSITION 3: *Adding a fixed cost of participating lowers the threshold value of p that triggers nonparticipation.*

Proof: See the Appendix.

On the other hand, introducing limited trust in a model with participation costs changes the wealth threshold for investing too. The perceived risk of being cheated decreases the return on the stock investment, making participation less attractive. To see this effect, suppose $0 < p < \bar{p}$ and let α^* be the optimal share invested in stocks if the investor decides to pay the fixed cost. It is worthwhile for an investor to pay f and invest in stock if participation yields a higher expected utility than staying out of the stock market and investing the whole wealth in the safe asset, that is, if

$$(1-p)EU(\alpha^*\tilde{r}(W-f)+(1-\alpha^*)r_f(W-f))+pU((1-\alpha^*)r_f(W-f)) > U(r_f W).$$

Let α_p^* denote the optimal portfolio share if the investor participates when the probability of being cheated is $p \in [0, 1]$ and $\widehat{r_p}$ denote the certainty equivalent return on equity defined implicitly by $EU(\alpha_p^*\tilde{r}(W-f)+(1-\alpha_p^*)r_f(W-f)) = U(\alpha_p^*\widehat{r_p}(W-f)+(1-\alpha_p^*)r_f(W-f))$. We then have:

PROPOSITION 4: *For any probability of being cheated p, there exists a wealth threshold $\bar{W}_p$ that triggers participation and $\bar{W}_p$ is increasing in p.*

Proof: See the Appendix.

The intuition behind Proposition 4 is very simple. When an investor perceives a probability of being cheated, the effect of a fixed cost increases because he has to pay the participation cost in advance, but expects a positive return only with probability $1 - p$. Hence, the actual participation cost becomes inflated by $\frac{1}{1-p}$.

Thus, introducing trust amplifies the effect of participation costs, and introducing a participation cost lowers the amount of mistrust required to stay out of the stock market. But how sensitive are the trust and wealth thresholds

Table II

Limited Trust and Participation Costs

This table shows the result of a calibration exercise of the optimal portfolio choice for different levels of trust (expressed as the perceived probability p that an investor will be cheated). The first column reports these perceived probabilities, varying between zero and the maximum value above which no participation takes place. Column 2 reports the wealth threshold beyond which people invest in the stock market expressed as a ratio of the level of wealth that will trigger investment in the absence of trust considerations. Column 3 reports the optimal portfolio share invested in the stock market, conditional on investing. The calculations assume the investor has CRRA utility; relative risk aversion is three; the level of initial wealth is one; participation cost is 1.6% of the wealth threshold that leads to nonparticipation when the probability of being cheated is equal to zero; and the return on equity and the risk-free rate are 1.12 and 1.05, respectively, while the variance of stock returns is 0.05.

Probability of Being Cheated and Wealth Participation Threshold		
Probability of Being Cheated in the Stock Market	Wealth Participation Thresholds/Wealth Threshold When Trust Is Full ($p = 0$)	Optimal Share Invested in Stocks if Participation Occurs
0	1.000	0.519
0.001	1.096	0.463
0.005	1.458	0.356
0.01	1.980	0.285
0.0125	2.294	0.258
0.0150	2.657	0.235
0.0175	3.585	0.195
0.020	4.920	0.152
0.0225	6.942	0.133
0.03		0.000

to the insertion of (small) participation costs and (small) deviations from the full trust hypothesis? To answer this question, in Table II we report how much the threshold level of wealth has to increase when the perceived probability of being cheated changes. The calculations are made assuming the investor has constant relative risk aversion (CRRA) utility with relative risk aversion equal to three, a participation cost of 1.6% of the wealth threshold that leads to nonparticipation when the probability of being cheated is equal to zero, and $\bar{r} = 1.12, r_f = 1.05$, and $\text{var}(\tilde{r}) = 0.05$.

Even a perceived probability of being cheated as small as 0.5% raises the wealth threshold by 45% of its value when trust is full. If the perceived probability of being cheated is 1% or 2%, the wealth threshold for participating is two times and five times, respectively, larger than if individuals perceived no risk of being cheated.

The table also shows that inserting a small cost of participating lowers the threshold probability of being cheated that triggers nonparticipation from 6.25% (the level in the absence of participation costs) to 3%.

In summary, lack of trust always reduces stock market participation, but the strength of this effect depends upon the presence of participation costs. In the absence of any participation cost, lack of trust discourages stock investments only because it reduces their expected return. When participation is costly, lack of trust reduces the return on equity investments in two additional ways: It lowers the optimal share invested in stock conditional on participation and it lowers the expected utility from participating because it reduces the expected return of stock investments. Thus, paying the fixed costs to enjoy the equity premium becomes less rewarding in the presence of mistrust.

B. Diversification, Trust, and Risk Aversion

Given the difficulties in obtaining a reliable measure of individual risk aversion, it will be important to establish in the empirical analysis that trust is not just a proxy for risk tolerance. To do so, we need to devise some theoretical implications where the effect of trust differs from the effect of risk aversion. This is the case for the optimal number of stocks held.

B.1. The Two-Stock Case

Suppose there are just two risky stocks (1 and 2) in the economy (hence, in this example, for simplicity we assume away the risk-free asset), which are equally and independently distributed with returns $\tilde{r}_1 \sim N(\bar{r}, \sigma^2)$ and $\tilde{r}_2 \sim N(\bar{r}, \sigma^2)$. Each stock also has a probability p of "cheating" and yielding a zero return. The probability of "cheating" is equal for the two stocks but independent of each other.

To make the problem interesting, we assume that there is a cost *c per stock* that investors have to incur.[4] If an investor puts all his money in the first stock, his expected utility will be

$$(1-p)EU(\tilde{W}_1) + pU(0) - c. \tag{2}$$

Since there is another stock, he can diversify by investing part of the money also in the second stock. Given that the two stocks are identically distributed, if he invests in both, the optimal allocation is half of his wealth in each. The investor's expected utility from investing in both assets is

$$(1-p)^2 EU\left(\frac{1}{2}\tilde{W}_1 + \frac{1}{2}\tilde{W}_2\right) + p^2 U(0) + p(1-p)EU\left(\frac{1}{2}\tilde{W}_1\right) + p(1-p)EU\left(\frac{1}{2}\tilde{W}_2\right) - 2c. \tag{3}$$

Subtracting (2) from (3), the investor will buy the second stock if

$$(1-p)[D + pV] > c, \tag{4}$$

[4] As Curcuru et al. (2005) argues, the lack of diversification remains a puzzle. One way to explain this puzzle is to posit some per-stock cost of diversification.

where

$$D = EU\left(\frac{1}{2}\tilde{W}_1 + \frac{1}{2}\tilde{W}_2\right) - EU(\tilde{W}_1)$$

$$V = \left[EU\left(\frac{1}{2}\tilde{W}_1\right) + EU\left(\frac{1}{2}\tilde{W}_2\right)\right] - \left[EU\left(\frac{1}{2}\tilde{W}_1 + \frac{1}{2}\tilde{W}_2\right) + U(0)\right].$$

The term D measures the standard benefit of diversifying the idiosyncratic risk, which materializes regardless of any possibility of cheating. For a risk-averse investor, this term is strictly positive and increasing with his degree of risk aversion. By contrast, the term V can be thought of as the benefit of diversifying away the risk of being cheated. Notice that in equation (4) V is multiplied by the probability of being cheated. Hence, V is the benefit of having invested in two stocks rather than one if cheating in at least one stock (but not both) occurs. The first term in brackets is the payoff an investor receives if he has diversified the risk of cheating across the two stocks. If cheating occurs only in stock 1, he gets $EU(\frac{1}{2}\tilde{W}_1)$; while if it occurs only in stock 2, he gets $EU(\frac{1}{2}\tilde{W}_2)$. By contrast, if an investor is diversified with respect to the idiosyncratic risk but not with respect to the risk of cheating (this could occur if the investor buys a mutual fund that is diversified and the risk of cheating is at the mutual fund level), then he gets $EU(\frac{1}{2}\tilde{W}_1 + \frac{1}{2}\tilde{W}_2)$ half of the time and $U(0)$ the remaining half.[5]

The investor will diversify into the second stock if the LHS of equation (4) exceeds the cost of buying the second stock (assuming that he has already invested in the first, so that equation (1) is positive). It is easy to see that an increase in risk aversion increases the terms D and V, and thus makes it more likely that the investor buys the second stock.

But we are also interested in how a change in trust affects the decision. Since $(1 - p)(D + pV)$ represents the total expected benefits from diversification, when trust increases (the probability of being cheated p decreases), we have two effects. First, the importance of the total benefits from diversification increases (since all the benefits are multiplied by $(1 - p)$), but the benefit of diversifying the risk of being cheated (V) becomes less important (because it is multiplied by p). Hence, we have:

PROPOSITION 5: *Diversification will always be nondecreasing in trust if $D > V$.*

Proof: The derivative of the LHS of equation (4) is $-D + (1 - 2p)V$, which is always negative for $D > V$.

The intuition is straightforward. When we increase p (decrease trust), we lose some benefits of diversification (pD) and gain others ($(1 - p)pV$). If $D > V$, the benefits of diversification are always decreasing in p and hence higher trust will always lead to more diversification.

Taking a second-order approximation around $W = 0$, it is easy to show that $D \simeq -\frac{U''(0)\sigma^2}{4} > 0$ (from concavity of $U(\cdot)$) and $V \simeq 0$. Hence, while it is possible,

[5] In the event both stocks cheat, the payoff is $U(0)$ regardless of the diversification strategy.

in extreme situations, that diversification may decrease in trust, in general a higher level of trust makes it more likely to invest in the second stock. Q.E.D.

Another sufficient condition for diversification being always increasing in trust is that the benefits from standard diversification are greater than the costs.

PROPOSITION 6: *The incentives to diversify will always be nondecreasing in trust if an investor would have diversified in the absence of any trust issue (i.e., $D > c$).*

Proof: If $D > c$, the LHS of equation (4) will be greater than c at $p = 0$. Since the LHS of equation (4) is a concave function, if it starts above c at $p = 0$, it will cross c at most once as p increases. Hence, the investor will go from diversifying (for low values of p) to not diversifying (for high values of p). Q.E.D.

B.2. The General Case

We can now extend this line of reasoning to the case in which there are n stocks. Suppose utility is exponential as before. Each of the n stocks an investor can pick yields the same return, which is *i.i.d.* with $\tilde{r}_i \sim N(\bar{r}, \sigma^2)$. As before, there is a diversification cost: adding one stock costs c in utility terms, so that if an investor buys n stocks he pays a total diversification cost of nc.

Each stock will pay out only with probability $(1 - p)$, where p is equal across stocks and independent from stock to stock. If the investor decides to invest in n stocks, he will put $1/n$ of his wealth W in each stock and solve the problem:

$$\operatorname*{Max}_{n} \sum_{g=0}^{n} C_n^g p^g (1-p)^{n-p} E\left[-e^{-\theta(W/n)\sum\limits_{i=1}^{g}\tilde{r}_i}\right] - cn, \tag{5}$$

where g is the number of stocks in which he has invested that paid out and $C_n^g = \frac{n!}{g!(n-g)!}$ is the probability that g stocks pay out (where we adopt the convention that $\sum_{i=1}^{n-g}\tilde{r}_i = 0$ when $g = n$). The above expression already reflects the fact that if an investor is cheated on stock j, he loses all the money invested in that stock.

Since $\tilde{r}$ is normally distributed, the above problem can be written as

$$\operatorname*{Max}_{n} \sum_{g=0}^{n} C_n^g p^g (1-p)^{n-p} \left[-e^{g\theta(W/n)\bar{r}+\frac{1}{2}g^2\theta^2(W/n)^2\sigma^2}\right] - cn.$$

The coefficient multiplying the square bracket term is the coefficient of a binomial term raised to the n power. Hence, we can rewrite this expression as

$$\operatorname*{Max}_{n} - \left[p + (1-p)e^{-\theta(W/n)\bar{r}+\frac{1}{2}\theta^2(W/n)^2\sigma^2}\right]^n - cn.$$

Let $Z = [p + (1-p)e^{-\theta(W/n)\bar{r}+\frac{1}{2}\theta^2(W/n)^2\sigma^2}]$, then the first-order condition for equation (5) can be written as

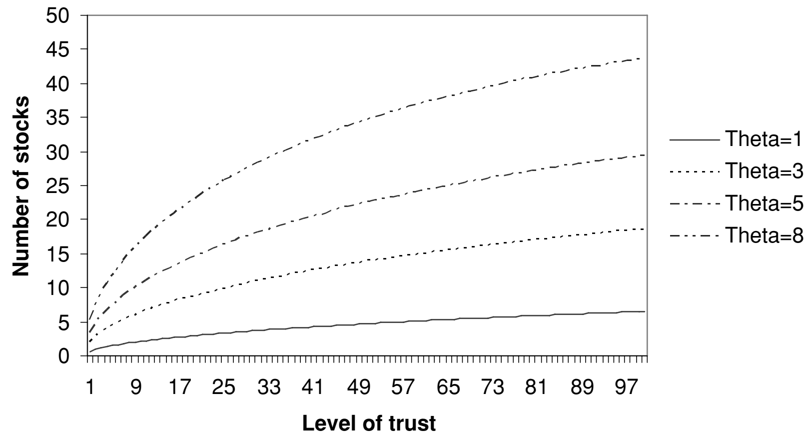

Figure 1. Trust and the number of stocks. This figure reports the optimal number of stocks an investor should hold for different levels of risk aversion and different levels of trust. Trust is the percentage probability of being cheated. Theta is the coefficient of absolute risk aversion of an exponential utility function.

$$-Z^n\left[\log Z + \frac{Z-p}{Z}\left(\theta\frac{W}{n}\bar{r} - \theta^2\left(\frac{W}{n}\right)^2\sigma^2\right)\right] = c.$$

As we show in Appendix A, the limit of the LHS tends to ∞ as $n \longrightarrow 0$ and tends to zero as $n \longrightarrow \infty$. Since the function is continuous, the intermediate value theorem ensures that the first-order condition has at least one interior solution.

Unfortunately, this condition is sufficiently complex that it is not easy to do comparative statics analytically. However, we can resolve it numerically for different values of the parameters and plot the solution. This is what we do in Figure 1. The graph plots the optimal number of stocks as a function of the level of trust, measured by $1 - p$, for different values of the risk aversion parameter. Not surprisingly, the optimal number of stocks increases as the degree of risk aversion increases. More importantly, the optimal number of stocks also increases with trust. Trust and risk tolerance, therefore, have opposite predictions in terms of number of stocks, and thus, we can try to distinguish them empirically.

II. The Main Data

Our main data source is the 2003 wave of the DNB Household Survey, which collects information on a sample of 1,943 Dutch households (about 4,000 individuals). The survey, sponsored by the DNB, is administered and run by CentER at Tilburg University. The purpose of this survey is to collect household-level data to study the economic and psychological determinants of household savings behavior.[6] All members of the households who are at least 16 years old are interviewed. Appendix B provides details about the survey design and contents, while Table III illustrates the main summary statistics.

The survey is particularly useful for our purpose as it has a rich description of the households' assets (real and financial), including investment in stocks. In particular, the survey distinguishes between stocks of listed and unlisted companies and stocks held directly or indirectly through mutual funds or investment accounts.

A. Measuring Trust

In the fall of 2003, we had the opportunity to submit to the DBN panel a short questionnaire specifically designed to obtain individual measures of trust, attitudes toward risk and ambiguity, as well as optimism. This questionnaire was submitted to about half the DNB panel and thus information is available for 1,990 individuals belonging to 1,444 households.

To elicit information about trust, we use a question routinely asked in the World Values Survey questionnaires:

> "Generally speaking, would you say that most people can be trusted or that you have to be very careful in dealing with people?"

Individuals could answer in one of three ways: (1) most people can be trusted; (2) one has to be very careful with other people; (3) I don't know.[7] In our analysis we define trust as a dummy variable equal to one if individuals choose option (1). On average, 37.7% of the respondents choose option (1).

For trust to account for the puzzling lack of participation at high levels of wealth, it must be the case that it does not increase too much with wealth. Table III, Panel D shows the average level of the two measures of trust by quartile of financial assets. While trust increases with wealth, consistent with findings in other surveys (Guiso, Sapienza, and Zingales (2003) and Alesina and La Ferrara (2002)), the change is mild: In the bottom quartile, two-thirds of the individuals stated that one has to be very careful when dealing with people, while in the top quartile this fraction drops to 61%. Thus, even among the wealthy a substantial fraction has a low level of trust.

[6] Interviews are done via computer through the internet. If a household does not own a computer or does not have access to the internet, CentER provides a set-top box and if necessary a television set that can be used to fill in questionnaires. This feature allows CentER to interview the panel occasionally after the main survey has been conducted and collect additional data on topics of interest. In the main survey, participants are given seven questionnaires covering different areas: general information on household demographics; home and market work; housing and mortgages; health conditions and income; financial assets and liabilities; economic and psychological attitudes; and work and home.

[7] To avoid the answers to this question being driven by the order with which the possible answers are presented, half of the sample was randomly presented a reverse ordering (i.e., option (2) was offered first and option (1) second). The average answers of the two samples are very similar, suggesting that there is no response order bias.

Table III
Summary Statistics

The table shows summary statistics of the variables used. Panels A–E use data from the Dutch National Bank survey. Financial wealth, income, and health insurance premiums are in thousand euros. Trust is a dummy equal to one if a person answers "most people can be trusted" to the question: "Generally speaking, would you say that most people can be trusted or that you have to be very careful in dealing with people?" The price for the lotteries is obtained by asking people how much they are willing to pay to participate in a lottery. In the unambiguous lottery the interviewee is given the exact number of balls in the urn. In the ambiguous one this number is uncertain, but the interviewee is given the probability distribution. The coefficient of risk aversion is obtained fitting a CARA utility. Optimism is an index of agreement (from 1 to 5) to the statement "I expect more good things to happen to me than bad things." "Expect stock market to go up" is a dummy equal to one if the interviewee answers "increase" to the question "do you expect market stock prices to increase, remain constant or decrease in the next two years?" Panel F is from a survey of bank customers of a large Italian commercial bank. In this sample high trust is a dummy equal to one when a bank customer responds "a lot" or "enough" to the question: "How much do you trust your bank official or broker as financial advisor for your investment decisions?" Medium trust is a dummy variable equal to one if s/he answers "so so" or "not much" (the omitted category is "not at all"). Panel G is from an international data set combining data from Giannetti and Koskinen (2005), La Porta et al. (1998), and the World Values Survey (data on trust).

	Mean	Median	*SD*	Min	Max
Panel A. Stock Holdings, Financial Assets and Income: DNB (N = 1,444)					
Direct stockholders	0.135	0.0	0.342	0	1
Risky assets holders	0.422	0.0	0.449	0	1
Portfolio share in stocks	0.033	0	0.119	0	1
Portfolio share in stocks among stockholders	0.203	0.118	0.229	0.0001	0.926
Portfolio share in risky assets	0.124	0	0.230	0	1
Portfolio share in risky assets among holders of risky assets	0.295	0.195	0.274	0.001	1
Number of stocks	0.532	0	2.873	0	97
Number of stocks among stockholders	3.90	3	6.952	1	97
Holders of health insurance	0.269	0	0.444	0	1
Health insurance premium ('000 of euros)	0.178	0	1.148	0	44.411
Household financial wealth ('000 of euros)	031.230	10.140	66.804	0	838.041
Gross household income ('000 of euros)	28.128	22.362	68.930	0	2,197.032
Number of observations					
Panel B. Trust, Risk Aversion, Ambiguity Aversion, and Optimism: DNB (N = 1,444)					
Trust WVS	0.332	0.0	0.471	0	1
Absolute risk aversion	0.107	0.028	0.186	0	0.693
Ambiguity aversion	4.155	7.1077	4.275	−2.389	41.692
Price to participate in risky lottery ('000 of euros)	0.123	0.001	0.421	0	5
Price to partic. in ambiguous lottery ('000 of euros)	0.090	0.001	0.341	0	3
Individual optimism	3.127	4	1.532	0	5
Expect stock market to go up	0.596	1	0.458	0	1

(*continued*)

Table III—*Continued*

Panel C. Correlation Matrix between Trust, Risk Aversion, Ambiguity Aversion, and Optimism: DNB (N = 1,444)

	Trust WVS	Absolute risk Aversion	Ambiguity Aversion	Optimism
Trust WVS	1			
Absolute risk aversion	0.017	1		
Ambiguity aversion	0.014	0.072	1	
Optimism	0.310	0.172	0.013	1

Panel D. Trust and Wealth: DNB

	Financial Wealth					
	Quartile I	Quartile II	Quartile III	Quartile IV	Top 5%	Average
Trust WVS	0.342	0.373	0.409	0.396	0.365	0.382

	Mean	Median	*SD*	Min	Max
Panel E. Household Head and Household Demographics: DNB					
Male	0.466	0	0.499	0	1
Age	30.184	34	27.011	0	90
High education	0.178	0	0.382	0	1
Medium education	0.292	0	0.455	0	1
Employee	0.369	0	0.483	0	1
N. of household members	2.442	2	1.281	1	8
N. of children in the household	0.711	0	1.070	0	6
Panel F. Summary Statistics for the Bank Customer Dataset (N = 1,834)					
Share holding risky assets	0.638	1	0.481	0	1
Portfolio share of risky assets	0.223	0.110	0.269	0	1
High trust in bank official	0.665	1	0.472	0	1
Medium trust in bank official	0.135	0	0.342	0	1
Averse to risk	0.709	1	0.454	0	1
Financial assets ('000, euros)	109.185	25	270.810	0	3,760
Male	0.711	1	0.453	0	1
Age	54.698	56	14.366	21	85
Years of education	11.974	13	4.412	0	21
Panel G. Summary Statistics for the International Data (N = 33)					
% of stock market cap. closely held	44.03	42.43	18.38	7.94	77.48
% population participating in the stock market	0.16	0.15	0.10	0.01	0.40
Average trust	0.34	0.36	0.17	0.03	0.67
Legal enforcement	0.54	0.50	0.24	0.17	1.00
Common law	0.32	0.00	0.47	0.00	1.00

B. Measuring Risk and Ambiguity Aversion

To obtain a measure of risk and ambiguity aversion, we ask individuals to report their willingness to pay for a lottery. First, we offer them the following unambiguous lottery:

> Risky lottery: "Consider the following hypothetical lottery. Imagine a large urn containing 100 balls. In this urn, there are exactly 50 red balls and the remaining 50 balls are black. One ball is randomly drawn from the urn. If the ball is red, you win 5,000 euros; otherwise, you win nothing. What is the maximum price you are willing to pay for a ticket that allows you to participate in this lottery?"

Clearly, risk aversion implies that the price they are willing to pay for the first lottery is lower than the expected value of the lottery, that is, 2,500 euros. The good news is that only four individuals report a price higher than 2,500 euros. The bad news is that the sample average is extremely low (112 euros). While extreme, this low willingness to pay is not unusual. It is a well-known phenomenon in experimental economics: individuals asked to price hypothetical lotteries (or risky assets) tend to offer very low prices (Kagel and Roth (1995, p. 68–86)). Given this downward bias in the reported willingness to pay, our risk aversion measures are likely to be biased upward. We have found no reference on whether the magnitude of the bias is correlated with observable individual characteristics. If the bias is constant across individuals, measured risk aversion is just a scaled up version of the true level of risk aversion. A second caveat is that the risky lottery involves only gains and thus may only proxy imperfectly for the risk aversion to lotteries that involve both gains and losses, such as stock market gambles.

To map these prices into a risk aversion measure we assume that individuals have a CARA utility with risk aversion parameter θ and infer the coefficient of risk aversion from the indifference condition between the price offered and the risky lottery.

To measure ambiguity aversion we also offer the following lottery:

> Ambiguous lottery: "Consider now a case where there are two urns, A and B. As before, each one has 100 balls, but urn A contains 20 red balls and 80 blacks, while urn B contains 80 reds and 20 blacks. One ball is drawn either from urn A or from urn B (the two events are equally likely). As before, if the ball is red you win 5,000 euros; otherwise, you win nothing. What is the maximum price you are willing to pay for a ticket that allows you to participate in this lottery?"

This lottery has the same expected value and variance as the previous one. The only difference is that it requires some compounding of probability. Hence, it can be used to assess the extent of aversion to compounding, which is a form of ambiguity aversion.

To obtain a measure of aversion to compounded lotteries from the answer to this question, we use an approach similar to the one used to measure risk aversion based on the utility function developed by Maccheroni, Marinacci, and Rustichini (2005). The details of these calculations are contained in Appendix C.

In some preference representations, ambiguity aversion and pessimism are, to some extent, intertwined.[8] To disentangle the two effects on portfolio

[8] We also computed an alternative measure of ambiguity aversion based on the preference specification of Ghirardato, Maccheroni, and Marinacci (2004), who develop a general version of what

decisions as well as distinguish trust from optimism, we also introduce in the questionnaire a qualitative question meant to capture an individual's degree of optimism. In doing so, we follow the standard Life Orientation Test, very common in psychology (Scheier, Carver, and Bridges (1994)), and ask individuals the following question: "We now present you with the following statement." "I expect more good things to happen to me than bad things." Individuals have to rate their level of agreement/disagreement with the content of the statement, where one means they strongly disagree and five strongly agree.

Table III, Panel C shows the cross correlation between trust, risk aversion, ambiguity aversion, and optimism.

III. Results

A. *The Effect of Generalized Trust on Stock Market Participation*

We start by analyzing the impact of trust on the decision to invest in stock. Since portfolio decisions are likely to involve the entire household, we look at the effect of trust on households' portfolio decisions. It is not obvious, however, how to aggregate individual measures of risk aversion and trust into a single household measure. In the reported estimates, we use the attitudes reported by the household head as the attitude of the entire household. The results using household averages or using all individual-level data are very similar.

Table IV reports the probit estimates obtained using the DNB survey. The LHS variable is a dummy equal to one if a household invests directly (i.e., not through a mutual fund) in stocks of listed or unlisted companies and zero otherwise. Here and in the subsequent definitions, investment in stock does not include investment in equity of one's own business for those who have one.[9] In this as well as the subsequent regressions, we control for a number of variables. First, since the literature on fixed costs emphasizes the importance of wealth, we include both the value of household financial wealth and income. Then, we include various demographic characteristics to account for possible differences

is commonly called the Hurwicz (1953) α-maxmin criterion which mainly consists of weighting extreme pessimism and extreme optimism when making decisions under ambiguity. The general preference representation is of the form

$$v(x) = a(x)\min_{\pi\in\Pi} E_\pi u(x) + (1 - a(x))\max_{\pi\in\Pi} E_\pi u(x),$$

where $E_\pi u(x)$ is the expected utility of x under the probability distribution π. The expression $a(x)$ is what Ghirardato, Maccheroni, and Marinacci (2004) call the index of ambiguity aversion, which they allow to depend on the choice variable x. Utility $v(x)$ is a weighted average of the utility derived by a purely ambiguity-averse agent ($\min_{\pi\in\Pi} E_\pi u(x)$) and that of a purely ambiguity-loving agent ($\max_{\pi\in\Pi} E_\pi u(x)$), the weights being $a(x)$ and $(1 - a(x))$. Ambiguity aversion depicted by ($\min_{\pi\in\Pi} E_\pi u(x)$) reflects extreme pessimism, where the agent acts according to the worst-case probability measure π in Π. Likewise, ($\max_{\pi\in\Pi} E_\pi u(x)$) reflects extreme optimism. This is why, as Hurwicz (1954) himself describes it, the index $a(x)$ is closer in terms of interpretation to an index of pessimism than ambiguity aversion. But to the extent that pessimism and ambiguity aversion are intertwined, it may also be interpreted as an index of ambiguity aversion.

[9] Trust issues should obviously be irrelevant for equity investment in an individual's own business.

Table IV

The Effect of Trust on Direct Stock Market Participation

The dependent variable is a dummy equal to one if the household directly owns shares in a company (be it listed or not) except in his own company. The table reports the probit estimates, calculated as the effect on the LHS of a marginal change in the RHS variable computed at the average value of the RHS variables. All household characteristics, which are defined in Table I, are assumed to be those of the household head. Standard errors are reported in parentheses. *** indicates the coefficient is different from zero at the 1% level, ** at the 5% level, and * at the 10% level.

	Whole Sample				Above-median Wealth
	(1)	(2)	(3)	(4)	(5)
Trust	0.065***	0.059***	0.057***	0.064	0.072**
	(0.023)	(0.022)	(0.022)	(0.051)	(0.036)
Risk aversion	0.055	0.061	0.061	0.012	0.113
	(0.052)	(0.047)	(0.047)	(0.122)	(0.085)
Ambiguity aversion		−0.002	−0.002	−0.001	−0.003
		(0.002)	(0.002)	(0.004)	(0.003)
Optimism			0.005	0.047*	0.023
			(0.010)	(0.025)	(0.019)
Stock market expected to go up				−0.020	
				(0.043)	
Financial wealth	0.001***	0.001***	0.001***	0.001**	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Income	0.994	0.837	0.824	−7.001	3.831
	(1.325)	(1.190)	(1.189)	(20.720)	(3.662)
Male	0.039	0.036	0.036	0.025	0.047
	(0.027)	(0.024)	(0.024)	(0.069)	(0.045)
Age	−0.005**	−0.004*	−0.005*	−0.010*	−0.006
	(0.002)	(0.002)	(0.002)	(0.005)	(0.004)
Age squared	0.000**	0.000**	0.000**	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Household size	−0.015	−0.014	−0.014	0.041	−0.075*
	(0.026)	(0.023)	(0.023)	(0.060)	(0.045)
Number of children	0.040	0.037	0.037	0.009	0.121**
	(0.030)	(0.028)	(0.028)	(0.065)	(0.054)
College education	0.072**	0.066**	0.063*	0.357***	0.072
	(0.036)	(0.033)	(0.033)	(0.133)	(0.053)
High school education	0.041	0.038	0.036	0.169*	0.055
	(0.029)	(0.027)	(0.027)	(0.091)	(0.047)
Employee	−0.002	−0.000	−0.002	−0.139**	−0.058
	(0.030)	(0.027)	(0.027)	(0.067)	(0.053)
Observations	1156	1156	1156	255	618

in participation costs. We insert a male dummy, the number of adults and the number of children in the household, two dummies for middle and high education, and a dummy for being an employee. We also control for the household head's age (both linear and linear squared) to capture changes over the life cycle. These variables may also capture differences across individuals that affect their attitude toward investment in stocks, such as variation in exposure to uninsurable risks (Kimball (1993)), or that act as a barrier to participation in the stock market regardless of any participation cost, such as lack of awareness that a stock is an asset (Guiso and Jappelli (2005)).

The first column reports the estimates of the basic specification, where we insert both trust and risk aversion. While risk aversion turns out to have little predictive power, the effect of trust is positive and highly statistically significant.[10]

Trusting others increases the probability of direct participation in the stock market by 6.5 percentage points. This is a remarkable effect as it corresponds to a 50% increase in the unconditional probability of participation.

The second column includes the measure of ambiguity aversion. Ambiguity aversion has the expected sign, but it is not statistically significant. In spite of the fact that ambiguity aversion and trust are (as shown in Table III) negatively correlated, the coefficient on trust is hardly affected.

Of course, we cannot conclude from these regressions that trust is more economically important in explaining stock market participation than risk or ambiguity aversion. In fact, it is likely that trust is measured with less noise than both risk and ambiguity aversion and thus its coefficient estimates suffer less of the standard attenuation bias. What we can say, however, is that if we want to predict the level of stock market participation, using measures of trust seems more effective than using measures of risk and ambiguity aversion.

An alternative interpretation of our finding is that trust reflects not the fear of being cheated, but rather optimism. Optimistic investors may be induced to participate by their inflated expectations of returns. This possibility is strengthened by the results of Puri and Robinson (2005), who find that people who overestimate their life expectancy (and thus are optimistic) invest more in stock.

We address this concern in two ways. First, in column (3) we insert a dummy variable equal to one for all those individuals who answer that they normally expect more good things to happen to them than bad things (a measure of optimism). Consistent with Puri and Robinson (2005), this variable has a positive effect on stock market participation, albeit this effect is not statistically significant. More importantly from our point of view, controlling for optimism leaves the effect of trust nearly unchanged.

Second, in column (4) we control for the household head's expectations about the stock market for the following year. The question addressed to 495 individuals is whether they expect the stock market to go up the following year. If all individuals had the same expectations about the underlying distribution of returns, then this measure should absorb the effect of trust. In reality, however, this is unlikely to be the case. Hence, per a given level of trust, we may interpret

[10] It is not surprising that risk aversion has limited power in explaining stock market participation in our regressions. In a standard model without participation costs, risk aversion should have no effect. When one takes into account costs of participation, risk aversion should have a negative effect on participation. However, given the costs are small (Vissing-Jørgensen (2003)), the effect is likely to be trivial.

their answer as a measure of their optimism about the underlying distribution of returns.[11]

Unfortunately, this question was addressed to only 495 individuals and when we merge them with our sample we are left with only 255 observations. Not surprisingly, the effect of trust loses precision. It is interesting to note, however, that it has the same magnitude (in fact, slightly bigger) as before, suggesting our results on trust are not driven by different expectations about the future performance of the stock market.

Finally, in the last column we show that the effect of trust does not fade away with wealth. When we restrict the sample to individuals with above median financial assets, the effect of trust is of the same order of magnitude and actually somewhat larger than in the overall sample. This implies that trust has a chance to explain why even the rich may choose to keep themselves out of the stock market, even if they can afford to pay the fixed participation cost.

Though it is reasonable to expect the effect of trust to be particularly important for direct participation in the stock market, it is not limited to direct participation or to equity investment. An investor needs some trust even when he buys a stock indirectly, through a mutual fund, a broker, or a bank. While the presence of an intermediary reduces the need for information (and thus for trust), it also increases exposure to opportunistic behavior of the intermediary.[12]

Hence, the effect of trust should generalize to investments in all risky assets, which we define as the sum of directly and indirectly owned stocks, corporate bonds, and put and call options. Table V shows this to be the case. The pattern of the estimates is very similar to that in Table IV. While risk and ambiguity aversion have little predictive power for participation in risky assets, trust has a positive and significant effect: People who trust others have a probability of investing in risky assets that is 8.5 percentage points higher, or about 20% of the sample mean. All the other results are the same.

B. The Effect of Generalized Trust on the Portfolio Share Invested in Stocks

According to the model in Section 1, not only does trust increase the likelihood that an individual invests in stock, but it also increases the share of wealth invested in stocks, conditional on investing in them. We test this prediction in Table VI. Panel A presents the Tobit estimates when the dependent variable is the portfolio share invested in stock, computed as the value of stocks

[11] More formally, in our notation the subjective expected stock market return for respondent i is $(1 - p_i) \times \bar{r}_i$. If all respondents had the same expectation of stock market return $\bar{r}_i$, including both measures would generate perfect collinearity. If $\bar{r}_i$ differs across investors, then one can identify the effect of trust separately.

[12] In Italy, for instance, there is anecdotal evidence that banks tend to rebalance their portfolio by advising customers to buy the securities they want to unload. After the summer of 2001, FIAT, the Italian car maker, experienced distress. When FIAT's distress was still unknown to the public, one of the authors was strongly advised by his bank to buy FIAT bonds, on the grounds that FIAT was the largest and most solid Italian firm.

Table V

The Effect of Trust on Participation in Risky Assets

The dependent variable is a dummy equal to one if the household directly owns any risky asset (shares, mutual funds, corporate bonds, put and call options) except equity in one's own company. The table reports the probit estimates, calculated as the effect on the LHS of a marginal change in the RHS variable computed at the average value of the RHS variables. All household characteristics, which are defined in Table I, are assumed to be those of the household head. Standard errors are reported in parentheses. *** indicates the coefficient is different from zero at the 1% level, ** at the 5% level, and * at the 10% level.

	Whole Sample				Above-median Wealth
	(1)	(2)	(3)	(4)	(5)
Trust	0.085**	0.084**	0.082**	0.053	0.084*
	(0.037)	(0.037)	(0.037)	(0.079)	(0.044)
Risk aversion	−0.100	−0.107	−0.106	−0.039	0.019
	(0.091)	(0.092)	(0.092)	(0.197)	(0.115)
Ambiguity aversion		0.000	0.000	0.001	0.000
		(0.000)	(0.000)	(0.006)	(0.000)
Optimism			0.007	−0.009	0.042*
			(0.019)	(0.040)	(0.023)
Stock market exp. to go up				−0.028	
				(0.077)	
Financial wealth	0.003***	0.003***	0.003***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Income	−1.951	−1.979	−2.006	−53.158	−4.451
	(3.271)	(3.290)	(3.295)	(33.834)	(5.356)
Male	0.109**	0.109**	0.109**	0.153	0.096
	(0.048)	(0.048)	(0.048)	(0.116)	(0.062)
Age	−0.007	−0.006	−0.007	−0.009	−0.011*
	(0.004)	(0.004)	(0.005)	(0.009)	(0.006)
Age squared	0.000*	0.000*	0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Household size	0.165***	0.165***	0.164***	0.083	0.119**
	(0.044)	(0.044)	(0.044)	(0.096)	(0.056)
Number of children	−0.109**	−0.109**	−0.108**	0.023	−0.051
	(0.052)	(0.052)	(0.052)	(0.108)	(0.066)
College education	0.016	0.016	0.013	0.136	−0.029
	(0.050)	(0.050)	(0.051)	(0.111)	(0.061)
High school education	0.020	0.019	0.017	0.083	0.011
	(0.045)	(0.045)	(0.045)	(0.094)	(0.057)
Employee	0.183***	0.183***	0.181***	0.203*	0.109*
	(0.050)	(0.050)	(0.050)	(0.107)	(0.066)
Observations	1,007	1,007	1,007	237	618

held directly divided by the value of financial assets. We control for the same variables as in the probit estimates reported in Table V.

As in the participation estimates, the effect of risk is poorly measured, while trust always has a positive and statistically significant effect. Individuals who trust have a 3.4 percentage points higher share in stocks, or about 15.5% of the sample mean. Ambiguity aversion has a negative effect on the share in stocks, while optimism has a positive effect, but neither coefficient is statistically significant. Adding these controls leaves the effect of trust unchanged. Estimated effects and conclusions are similar if instead of the share directly invested in stocks we look at the share invested in all risky assets (Panel B).

In summary, the evidence thus far suggests that our measures of risk and ambiguity aversion have little predictive power, while generalized trust has

Table VI

The Effect of Trust on the Portfolio Share in Stocks and Risky Assets

The table reports Tobit estimates for the portfolio share invested in stocks (Panel A) and in risky assets (Panel B), except equity in one's own company. The share in stocks is the value of household holdings of listed and unlisted stocks divided by total household financial assets; the share in risky assets is the value in stocks, stock mutual funds, corporate bonds, and put and call options divided by total family financial wealth. All characteristics are those of the household head. Standard errors are reported in parentheses. *** indicates the coefficient is different from zero at the 1% level, ** at the 5% level, and * at the 10% level.

Panel A. Share of Household in Financial Assets Invested in Stocks				
Trust	0.131***	0.133***	0.130***	0.145
	(0.047)	(0.047)	(0.048)	(0.119)
Risk aversion	0.064	0.085	0.085	−0.048
	(0.116)	(0.118)	(0.118)	(0.332)
Ambiguity aversion		−0.003	−0.003	0.003
		(0.003)	(0.003)	(0.010)
Optimism			0.012	0.088
			(0.026)	(0.068)
Stock market expected to go up				−0.039
				(0.119)
Financial wealth	0.002***	0.002***	0.002***	0.001
	(0.000)	(0.000)	(0.000)	(0.001)
Income	0.873	0.781	0.754	−19.128
	(3.293)	(3.274)	(3.274)	(53.827)
Male	0.129*	0.132*	0.132*	0.161
	(0.067)	(0.067)	(0.067)	(0.211)
Age	−0.011**	−0.011**	−0.012**	−0.028**
	(0.005)	(0.005)	(0.006)	(0.014)
Age squared	0.000**	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Household size	−0.066	−0.067	−0.067	0.071
	(0.058)	(0.058)	(0.058)	(0.166)
Number of children	0.139**	0.141**	0.141**	0.141
	(0.068)	(0.068)	(0.068)	(0.179)
College education	0.169**	0.171**	0.166**	0.724***
	(0.067)	(0.067)	(0.068)	(0.232)
High school education	0.087	0.089	0.086	0.400*
	(0.063)	(0.063)	(0.064)	(0.217)
Employee	−0.012	−0.010	−0.014	−0.348**
	(0.067)	(0.067)	(0.067)	(0.170)
Observations	999	999	999	234

(*continued*)

Table VI—*Continued*

Panel B. Share of Household Financial Assets Invested in Risky Financial Assets				
Trust	0.096***	0.096***	0.095***	0.022
	(0.034)	(0.034)	(0.035)	(0.071)
Risk aversion	−0.093	−0.095	−0.095	−0.068
	(0.086)	(0.087)	(0.087)	(0.181)
Ambiguity aversion		0.000	0.000	0.004
		(0.000)	(0.000)	(0.005)
Optimism			0.004	−0.003
			(0.018)	(0.035)
Stock market expected to go up				−0.030
				(0.070)
Financial wealth	0.002***	0.002***	0.002***	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
Income	−2.152	−2.164	−2.180	−32.009
	(3.295)	(3.301)	(3.304)	(30.996)
Male	0.125***	0.124***	0.125***	0.231**
	(0.048)	(0.048)	(0.048)	(0.117)
Age	−0.009**	−0.009**	−0.010**	−0.014*
	(0.004)	(0.004)	(0.004)	(0.008)
Age squared	0.000**	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Household size	0.066	0.066	0.065	−0.034
	(0.043)	(0.043)	(0.043)	(0.095)
Number of children	−0.007	−0.007	−0.007	0.169
	(0.049)	(0.049)	(0.049)	(0.104)
College education	0.028	0.028	0.027	0.159
	(0.047)	(0.047)	(0.048)	(0.101)
High school education	0.017	0.017	0.015	0.009
	(0.042)	(0.042)	(0.043)	(0.086)
Employee	0.120**	0.120**	0.119**	0.096
	(0.049)	(0.049)	(0.049)	(0.101)
Observations	999	999	999	234

considerable explanatory power both for direct and overall stockholding as well as the fraction of the portfolio invested in stocks and risky assets.

C. Education, Market Knowledge, and the Effect of Trust

If trust reflects individuals' priors, then more educated individuals should be less affected by these priors because they possess more reliable information. This is consistent with Guiso, Sapienza, and Zingales (2007), who find that the trusting decision of more educated individuals is less affected by cultural stereotypes. Hence, a direct implication of the trust-based model is that the effect of trust on the stockholding decision should decrease with an investor's level of education and with his knowledge of the market.

Table VIII tests this implication by splitting the sample according to educational attainments (people with less than a secondary school degree and people with more). The results show a clear pattern: The effect of trust is stronger

Table VII

Trust and Education

In this table we re-estimate the regressions in Table IV (first two columns), Table V (second two columns), and Table VI (last four columns) splitting the sample by level of education. In the first two columns the left-hand side variable is a dummy equal to one if the household holds equity directly. In the second two columns is a dummy equal to one if the household holds stocks directly or indirectly and/or invests in corporate bonds and put and call options. In the remaining columns the left hand side variable is the share of household financial assets invested directly in equity (columns 5 and 6) and in risky assets (last two columns), respectively; the share in risky assets is the value in stocks, stock mutual funds, corporate bonds, and put and call options divided by total family financial wealth. In all cases, investment in stock does not include equity in one's own company. As in Tables IV and V, the first four columns are probit estimates, calculated as the effect on the LHS of a marginal change in the RHS variable computed at the average value of the RHS variables. The last four columns are Tobit estimates. High education includes all those with a high school degree or a university degree. Low education includes all those with less than high school education. Education is that of the head of the household. All characteristics are those of the household head. Standard errors are reported in parentheses. *** indicates the coefficient is different from zero at the 1% level, ** at the 5% level, and * at the 10% level.

	Ownership of Stock		Ownership of Risky Assets		Share of Stocks		Share of Risky Assets	
	Low Educ	High Educ	Low Educ	High Educ	Low Educ	High Educ	Low Educ	High Educ
Trust	0.059**	0.014	0.095**	0.056	0.155***	0.071	0.119***	0.052
	(0.025)	(0.046)	(0.045)	(0.068)	(0.052)	(0.095)	(0.040)	(0.063)
Risk	0.018	0.229*	−0.094	−0.201	−0.004	0.288	−0.102	−0.174
aversion	(0.038)	(0.118)	(0.105)	(0.195)	(0.126)	(0.250)	(0.097)	(0.186)
Ambiguity	−0.003***	−0.001	0.000	0.001	−0.007	−0.002	0.000	0.001
aversion	(0.001)	(0.002)	(0.000)	(0.002)	(0.005)	(0.003)	(0.000)	(0.001)
Optimism	−0.000	0.032	−0.001	0.021	−0.003	0.066	−0.006	0.021
	(0.008)	(0.029)	(0.022)	(0.040)	(0.026)	(0.061)	(0.020)	(0.037)
Financial	0.001***	0.002***	0.002***	0.003***	0.002***	0.002***	0.002***	0.002***
wealth	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
Income	−0.127	3.785	−3.118	−0.618	−0.278	2.700	−3.006	−1.194
	(1.136)	(3.355)	(5.310)	(5.426)	(3.653)	(7.012)	(4.860)	(5.336)
Male	0.022	0.068	0.141**	0.021	0.089	0.216*	0.132**	0.069
	(0.022)	(0.050)	(0.061)	(0.080)	(0.080)	(0.122)	(0.061)	(0.076)
Age	−0.002	−0.009	−0.005	−0.035*	−0.004	−0.025	−0.003	−0.049***
	(0.002)	(0.011)	(0.005)	(0.018)	(0.006)	(0.023)	(0.005)	(0.016)
Age squared	0.000	0.000	0.000	0.000**	0.000	0.000	0.000	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Household	−0.013	0.003	0.182***	0.114	−0.049	−0.094	0.121**	−0.087
size	(0.020)	(0.054)	(0.054)	(0.080)	(0.065)	(0.114)	(0.052)	(0.076)
Number of	0.030	0.012	−0.118*	−0.082	0.098	0.211	−0.080	0.206**
children	(0.024)	(0.068)	(0.062)	(0.102)	(0.074)	(0.143)	(0.058)	(0.095)
Employee	−0.005	0.030	0.174***	0.226**	−0.035	0.046	0.081	0.225**
	(0.021)	(0.067)	(0.058)	(0.102)	(0.070)	(0.144)	(0.055)	(0.100)
Observations	858	298	748	259	740	259	740	259

for people with less education. In fact, the coefficient for more highly educated individuals is never statistically different from zero. For instance, trust raises direct stockholding by six percentage points in the low education group and only by 1.4 percentage points in the high education sample. Similarly, the impact on the share invested in stocks or in risky financial assets is twice as large among the less educated.

IV. Is Trust a Proxy for Risk Tolerance?

Given the noisiness of our measure of risk aversion, an obvious criticism of our results is that trust may just be a proxy for (poorly measured) attitude to risk. All the effects of trust we have seen so far are consistent with this interpretation: If trust were simply a proxy for risk tolerance, we would expect higher trust (risk tolerance) to be associated with a higher portfolio share invested in stocks and, in the presence of some fixed participation costs, with a higher probability of participating in the stock market.

To address this concern, we exploit the differential implications of trust and risk tolerance on the number of stocks. As shown in Section I, while the number of stocks unambiguously decreases with the investor's risk tolerance, it may increase with his degree of trust. Thus, if we find that trust has a positive effect on the number of stocks, we can reject it as just a proxy for (poorly measured) risk aversion.[13]

Table VIII, Panel A, shows the results of a Poisson count model estimate. The dependent variable is the number of stocks in a household's portfolio. The first four columns report Poisson count model regressions for the whole sample.

Besides the male dummy and age, the only two variables that have predictive power for the number of stocks are the level of wealth and generalized trust: Individuals who trust invest on average in 0.6 more stocks than those who do not trust. This is a nonnegligible effect, given that the median number of stocks among stockholders is three. In order to obtain a similar effect, we should move a household's wealth from its median value to about the 80th percentile. All the other controls, including measured risk aversion, ambiguity aversion, and optimism, have the expected signs but lack statistical significance. To take into account the possibility that one can achieve diversification by investing in a mutual fund instead of buying single stocks, in column 4 we include a dummy for whether the investor owns a stock mutual fund; the results are unchanged.

The last column restricts the sample to the equity holders (162 observations). Even in this very limited sample trust has a positive and statistically significant effect, which is very similar in magnitude to the one estimated in the whole sample. The only puzzling aspect is that our measure of risk aversion has a negative impact on the number of stocks held.

An alternative way to separate trust from risk aversion is to look at insurance data. On the one hand, more risk tolerant individuals should buy less insurance, at least as long as insurance contracts are not actuarially fair (as generally they are not). On the other hand, more trusting individuals should buy more insurance because insurance is just another financial contract with delayed and uncertain repayment, where trust can play a role. An individual who is less confident that the insurance promise will not be kept, that is, has less trust, will be less likely to insure himself.

Panel B uses data on holdings of private health insurance to distinguish between these alternative predictions. Inconsistent with trust being a proxy for risk tolerance, trust has a positive effect on the decision to buy private health insurance (first three columns), as well as on the amount purchased (last two columns), albeit these effects are very imprecisely estimated.[14]

[13] Since the optimal number of stocks does not necessarily have to increase with trust (see Section I) this test can only reject the hypothesis that trust is a proxy for risk tolerance if the empirical relationship between number of stocks and trust is positive.

[14] These results also suggest that trust is not a proxy for loss aversion. Loss aversion should make people buy more insurance, while the regression evidence, albeit weak, is consistent with the trust interpretation.

In sum, there is no evidence that trust is a proxy for risk tolerance, while the evidence is consistent with mistrust creating a wedge between the demand and the supply of financial contracts.

Table VIII

Is Trust a Proxy for Risk Aversion?

The table shows regressions for the effect of trust on the number of stocks (Panel A) and on demand for health insurance (Panel B). The first panel reports Poisson count regressions for the number of different stocks in which the household invests, excluding equity in one's own company. The left-hand side variable is an integer varying between zero (no directly held stocks) and n (the household invests in n directly held stocks of different companies). In the last column the sample includes only households with strictly positive stockholdings. In Panel B the left-hand side is a dummy equal to one if the household has a private insurance. The reported figures are probit estimates calculated as the effect on the LHS of a marginal change in the RHS variable computed at the average value of the RHS variables. The last column shows Tobit estimates for the amount of health insurance purchased (i.e., the value of the premium paid). All characteristics are those of the household head. Standard errors are reported in parentheses. *** indicates the coefficient is different from zero at the 1% level, ** at the 5% level, and * at the 10% level.

Panel A. Trust and the Number of Stocks					
Trust	0.857***	0.863***	0.854***	0.754***	0.297***
	(0.086)	(0.086)	(0.086)	(0.087)	(0.095)
Risk aversion	−0.013	0.071	0.060	−0.100	−0.171
	(0.193)	(0.195)	(0.195)	(0.198)	(0.217)
Ambiguity aversion		−0.022**	−0.022**	−0.018**	−0.024*
		(0.009)	(0.009)	(0.008)	(0.014)
Optimism			0.052	0.058	−0.064
			(0.046)	(0.046)	(0.065)
Own mutual funds				0.786***	
				(0.086)	
Financial wealth	0.006***	0.006***	0.006***	0.005***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Income	−0.015	−0.016	−0.016	−0.025	−0.056**
	(0.012)	(0.012)	(0.012)	(0.017)	(0.028)
Male	1.002***	1.012***	1.017***	0.978***	0.965***
	(0.141)	(0.142)	(0.141)	(0.141)	(0.161)
Age	−0.043***	−0.040***	−0.045***	−0.038***	0.005
	(0.009)	(0.009)	(0.010)	(0.010)	(0.012)
Age squared	0.001***	0.001***	0.001***	0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Household size	−1.015***	−1.025***	−1.031***	−1.085***	−0.934***
	(0.098)	(0.099)	(0.099)	(0.101)	(0.105)
Number of children	1.479***	1.494***	1.503***	1.555***	1.178***
	(0.117)	(0.117)	(0.118)	(0.120)	(0.122)
High school education	−0.672***	−0.648***	−0.666***	−0.629***	−0.890***
	(0.104)	(0.104)	(0.105)	(0.106)	(0.109)
College education	−0.406***	−0.431***	−0.475***	−0.706***	−0.402***
	(0.109)	(0.109)	(0.111)	(0.114)	(0.116)
Employee	0.257**	0.268**	0.255**	0.227*	0.178
	(0.128)	(0.128)	(0.129)	(0.128)	(0.140)
Observations	1156	1156	1156	1156	162

(*continued*)

Table VIII—*Continued*

Panel B. Trust and the Demand for Health Insurance				
Trust	0.050	0.048	0.043	179.759
	(0.031)	(0.031)	(0.031)	(223.050)
Risk aversion	−0.126	−0.137*	−0.135*	−773.808
	(0.079)	(0.080)	(0.080)	(591.815)
Ambiguity aversion		0.000	0.000	0.188
		(0.000)	(0.000)	(0.284)
Optimism			0.019	178.813
			(0.016)	(115.943)
Financial wealth	0.001***	0.001***	0.001***	5.767***
	(0.000)	(0.000)	(0.000)	(1.411)
Income	1.867	1.852	1.797	6,931.391
	(2.111)	(2.116)	(2.118)	(17,158.756)
Male	0.115***	0.115***	0.116***	750.441**
	(0.038)	(0.038)	(0.038)	(305.882)
Age	−0.011***	−0.011***	−0.013***	−34.931
	(0.003)	(0.003)	(0.004)	(28.967)
Age squared	0.000***	0.000***	0.000***	0.578*
	(0.000)	(0.000)	(0.000)	(0.334)
Household size	0.005	0.005	0.003	144.074
	(0.037)	(0.037)	(0.037)	(269.719)
Number of children	0.002	0.002	0.005	−31.349
	(0.044)	(0.044)	(0.044)	(320.463)
High school education	0.157***	0.156***	0.151***	451.967
	(0.040)	(0.040)	(0.041)	(294.534)
College education	0.249***	0.249***	0.241***	986.477***
	(0.046)	(0.046)	(0.047)	(318.290)
Employee	0.126***	0.126***	0.122***	71.651
	(0.042)	(0.042)	(0.042)	(313.147)
Observations	1156	1156	1156	1156

V. Is It Generalized or Personalized Trust That Matters?

The degree of trust a person has toward another or toward a company depends both on his general trusting attitude and on the perceived trustworthiness of the counterpart. The nature of the Dutch sample allowed us to capture only the first effect. We now move to our second data set, the Italian Bank customers survey, where we are able to capture the second effect.

A. Bank Customers' Data

This survey contains detailed information on portfolio composition and demographic characteristics for a sample of 1,834 customers. For all the customers in the sample, the survey collects information on all the asset holdings that customers have either with the bank or with other intermediaries.[15] For our

[15] Most of the households in the sample (57%) have a relation only with the bank that sponsored the survey; 25% have two banks. Banks are the main avenue through which investors buy stocks. Indeed, only 6% of the sample has a relation with a nonbank intermediary.

purpose, we will be looking at their total stockholdings. The survey also asks participants to report how much they trust their banker:

> "How much do you trust your bank official or broker as financial advisor for your investment decisions?"

We create a dummy equal to one when a customer answers that he trusts the banker a lot and a second dummy equal to one if instead he says he trusts the banker enough. The complements are those customers who trust the banker little or very little. Since the people interviewed are already customers of the bank, their average level of trust is high: 30% report that they trust their banker a lot, while 45% report that they trust him or her "enough." We use these dummies as a measure of personalized trust, that is, of trust toward a well-identified entity, in contrast to the measure of generalized trust.

This bank survey also tries to elicit attitudes toward risk by asking individuals to report whether they view risk predominantly as (1) an uncertain event from which one can profit, or (2) an uncertain event one should protect himself from. Hence, we are able to control for this indicator of risk preferences. Summary statistics for this sample are shown in Table III, Panel F.

B. Results

Table IX reports the estimates of both the participation and the portfolio share decisions. As the first column shows, those who perceive risk as something to avoid rather than as an opportunity—the risk averse—are less likely to be stockholders. In contrast to what we find in the DNB data, this measure of risk aversion has predictive power, perhaps because eliciting attitudes toward risk this way is less subject to measurement error. The effect is also economically important: Being risk averse reduces the likelihood of investing in risky financial assets by 5 percentage points (7.8% of the sample mean).

More importantly for our purposes, trust in the bank officer also has a positive and statistically significant effect on the choice to invest in equity, and the impact is sizeable. Compared to those who do not trust, investors who trust their banker a lot are 16 percentage points more likely to invest in stocks (25% of the sample mean).

The second column reports Tobit estimates for the share of financial wealth in stocks, while the third column reports estimates for the conditional share. In both cases, trust has a positive effect on the investment in stocks, albeit in the conditional share equation this effect is poorly estimated.

Overall, these results confirm those obtained by using a measure of generalized trust. That lack of trust toward one's *own* bank affects financial investment in risky assets testifies to the pervasiveness of the effects of trust on portfolio allocation. That the effect is present even when we have a better measure of risk further strengthens the conviction that trust is not a proxy for risk tolerance.

Table IX
The Role of Personalized Trust

The table shows the effect of personalized trust on the participation in risky assets and the share invested in risky assets. Personalized trust is the trust a person has towards his bank official. In the first column the left-hand side variable is a dummy equal to one if the person invests in risky assets (directly held stocks, stock mutual funds, corporate bonds, derivatives); in the second and third is the share of financial wealth invested in these assets. "Risk averse" is a dummy variable equal to one if the interviewee answered (2) "Risk is an uncertain event from which one should seek protection" instead of (1) "Risk is an uncertain event from which one can extract a profit." All characteristics are those of the respondent. Standard errors are reported in parentheses. *** indicates the coefficient is different from zero at the 1% level, ** at the 5% level, and * at the 10% level.

	Probit for Ownership of Risky Assets	Share Invested in Risky Assets (Tobit Regression)	Conditional Share (Second Stage Heckman)
High personalized trust	0.1610***	0.0653***	0.0156
	(0.000)	(0.002)	(0.280)
Medium personalized trust	0.0580	0.0226	0.0011
	(0.121)	(0.431)	(0.955)
Averse to risk	−0.04*	−0.0883***	−0.0730***
	(0.025)	(0.000)	(0.000)
Financial wealth	0.0010***	0.0001***	0.00002***
	(0.000)	(0.000)	(0.000)
Male	0.1050***	0.0753***	-
Age	0.0219***	0.0144***	0.0073***
Age squared	−0.0002***	−0.0001***	−0.00006***
Education	0.0221***	0.0138***	
Observations	1,834	1,834	1,834

VI. The Effect of Trust on Stock Market Participation Across Countries

Thus far, we have only analyzed the effect of differences in trust across individuals. But what are the aggregate implications of a low *average* level of trust in a country? When the average level of trust is low, for any given level of return, investors are more reluctant to invest. Hence, to attract them, price-earnings ratios should fall. If they do, entrepreneurs will be less interested in floating their companies or even in selling pieces of them to private investors (see Giannetti and Koskinen (2005)). We will test this implication across countries.

To test this prediction we assemble information from three sources. We get stock market participation across countries (fraction of individuals who directly own stocks) from Giannetti and Koskinen (2005).[16] These data show remarkable variation: The fraction of direct stockholders is only 1.2% in Turkey (the lowest value in the sample) and 40% in Australia (the highest value). The

[16] Since individuals can also participate through mutual funds, pension funds, and managed investment accounts, these figures represent a lower bound. But a very relevant one, since trust should be most important for direct investment.

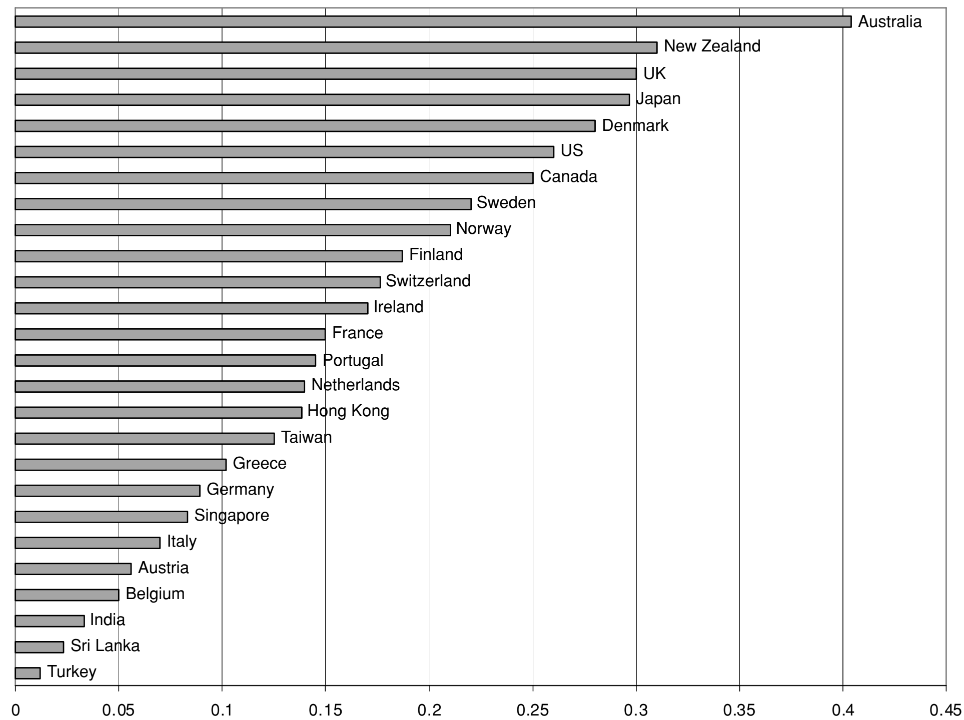

Figure 2. Stock market participation across countries. The figure shows the fraction of individuals that invest directly in stocks across countries. The data come from Giannetti and Koskinen (2005).

fraction of stock market capitalization that is closely held is obtained from La Porta et al. (1998). From the same source, we obtain an index of legal enforcement, and the country's legal origin. Finally, average trust in each country is obtained from the World Values Survey. It is computed as the fraction of individuals in each country who reply that most people can be trusted.

A. Cross-country Results

If entrepreneurs are reluctant to float their companies and investors are reluctant to invest, countries with low levels of trust should exhibit low levels of stock market participation. To test this implication we look at the proportion of the population that invests in the stock market. As Figure 2 shows, this proportion varies widely across countries. Stockholders are as low as 2% in Turkey and as high as 40% in Australia.

While entry costs might differ across countries, it is hard to believe that they are much lower in Australia and New Zealand (the countries with the highest participation) than in Switzerland (with a participation rate of 18%) or Belgium (where only 6% buy equity).

Table X

Trust, Stock Market Participation, and Ownership Concentration around the World

Panel A shows the effect of trust on the share of stock market capitalization that is closely held and on the percent of the population that participates directly in the stock market in a cross-section of countries. Information on the fraction of stockholders across countries is obtained from Giannetti and Koskinen (2005), data on trust from the World Values Survey, and the remaining data from La Porta et al. (1998). Standard errors are reported in parentheses. *** indicates the coefficient is different from zero at the 1% level, ** at the 5% level, and * at the 10% level. Panel B shows the average participation rate when we divide the sample into four groups depending on whether the country was fully occupied during WWII and whether its level of trust is above or below the median (0.37).

Panel A:

	% Population Participating in the Stock Market			% Stock Market Capitalization Closely Held		
	(1)	(2)	(3)	(4)	(5)	(6)
Trust (WVS)	0.272**	0.399***	0.390***	−42.65**	−46.80***	−46.84***
	(0.041)	(0.001)	(0.000)	(0.023)	(0.01)	(0.01)
Legal enforcement		0.246***	0.143*		−23.95*	−21.68
		(0.003)	(0.08)		(0.074)	(0.20)
Common law			0.091**			−1.92
			(0.02)			(0.82)
Observations	24	23	23	33	33	33
R-squared	0.18	0.50	0.62	0.15	0.24	0.25

Panel B: Level of Stock Market Participation

	Country Occupied during WWII	Country Not Occupied during WWII
High trust (N)	0.19	0.19
	(6)	(7)
Low trust (N)	0.09	0.19
	(6)	(7)

It would also be hard to explain this variation just with differences in risk or ambiguity aversion. In so far as these preference parameters reflect innate traits, their distribution should be similar across different populations.

By contrast, since generalized trust is affected by culture and history, it can potentially differ considerably across communities, as indeed it does. In our sample, the share of individuals that trust varies between a low of 3% in Brazil and a high of 67% in Denmark.

Table X, Panel A reports the results. The first three columns formally test this relation by regressing the share of stockholders in each country on the World Values Survey measure of trust. As predicted, trust has a positive effect on stock ownership and this effect is statistically significant. This result is unchanged if we control for the quality of legal enforcement (column 5) and for the fact a country has a common law system (6). In all these cases, the effect is very economically significant. If Turkey had the same level of trust

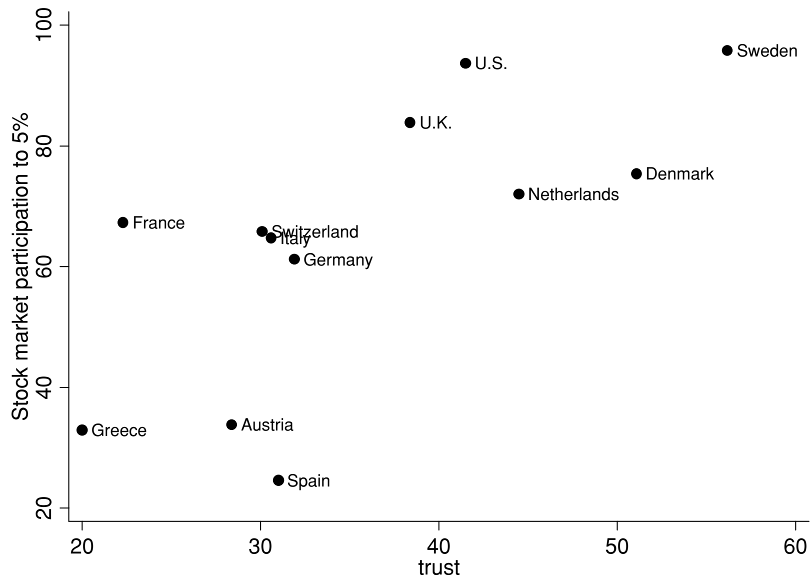

Figure 3. Trust and stock market participation of the wealthy. The figure plots stock market participation (direct and through mutual funds) for individuals in the top 5% of the wealth distribution in the countries in Table 1 against the average level of trust in that country (from the World Values Survey). The participation data are those shown in the second panel of Table 1, column "Top 5%" data. The data on trust are from the World Values Survey.

as Ireland (the median country) the share of stockholders would increase to 8 percentage points, more than a six-fold increase in the level of participation in that country.[17]

The advantage of a trust-based explanation is that it can explain lack of participation even among wealthy individuals. Unfortunately, we have data on stock market participation by wealth level only for the subset of 12 countries in Table I. Figure 3 plots the relation between the level of participation of the top 5% of the wealth distribution and the prevailing level of trust in the country. It shows a remarkable positive correlation that is statistically significant at the 2% level in spite of the paucity of observations. Trust alone can explain half of the cross country variation.

In the second three columns of Table X, Panel A, the dependent variable is the percentage of the stock market capitalization that is closely held. As expected, trust has a negative effect on this variable and the effect is both statistically and economically significant. If Turkey had the same level of trust as Belgium (the median country), the fraction of the stock market closely held would be 11 percentage points lower.

[17] The results (not reported) are substantially the same when, as a measure of trust, we use the fraction of people who do not have any confidence in major corporations.

When we control (column 2) for legal enforcement as done by Giannetti and Koskinen (2005), the coefficient on trust becomes even larger in absolute value. Further controlling for common law origin leaves the effect of trust positive and significant and its coefficient unchanged, suggesting that trust plays an independent and additive role with respect to the quality of formal institutions in explaining worldwide differences in ownership concentration.

In our model, the effect of mistrust on participation fades away when investors have a sufficiently long stationary time series of stock returns. As a proxy for the length of the stock market time series, we use whether the country was occupied during World War II. A foreign military occupation (with the constitutional changes this generally leads to) creates a very strong structural break that makes untenable the stationarity in the time series of returns. If this assumption is correct, our model predicts that countries with low trust that were invaded during WWII should have much lower levels of participation than invaded countries with high trust. By contrast, trust should not matter for countries that have not been invaded. Table X, Panel B shows this to be the case. Moving from below-median to above-median levels of trust doubles the level of stock market participation (from 9% to 19%) in countries that have been invaded. The same change in trust, however, has no effect on participation for countries that have not been invaded and thus enjoy a longer reliable time series of returns.

VII. Conclusions

After the recent corporate scandals, many politicians and business commentators argued that investors were deserting the stock market because they had lost their confidence in corporate America. In spite of the popularity of this interpretation, the finance literature has thus far ignored the role of trust in explaining stock market participation and portfolio choices.

This paper tries to fill this gap. First we show that, in theory, lack of trust can explain why individuals do not participate in the stock market even in the absence of any other friction. We also show that, in practice, differences in trust across individuals and countries help explain why some invest in stocks, while others do not. Our simulations also suggest that this problem can be sufficiently severe to explain the percentage of wealthy people who do not invest in the stock market in the United States and the wide variation in this percentage across countries.

Another outstanding puzzle regarding stock market participation is why some demographic factors, such as race, have so much impact on the decision to invest in stock, even after controlling for wealth and education (e.g., Chiteji and Stafford (2000)). That the race effect disappears when Chiteji and Stafford (2000) control for whether parents owned stock points to a cultural explanation of the phenomenon. Since trust is very much linked to family background (Banfield (1958), Guiso, Sapienza, and Zingales (2004)), our trust-based model has the potential to address even this puzzle.

If it is a policy goal to promote wider stock ownership, then this paper has two implications. First, better education about the stock market can reduce the negative effect of lack of trust. Second, it becomes crucial to understand the determinants of investors' (possibly biased) perception of the trustworthiness of the stock market. This is the next item on our research agenda.

Appendix A. Proofs

Proof of Proposition 3: Without participation costs it must be that at $p = \bar{p}$ the investor is indifferent between participating and not participating, that is, $(1-\bar{p})EU(\alpha\tilde{r}W + (1-\alpha)r_f W) + \bar{p}U((1-\alpha)r_f W) = U(r_f W)$. Inserting a fixed participation cost f lowers wealth in the LHS of the expression to $W - f$ but not in the RHS. Since U is decreasing in W, it follows that $(1-\bar{p})EU(\alpha\tilde{r}(W-f) + (1-\alpha)r_f(W-f)) + \bar{p}U((1-\alpha)r_f(W-f)) = EU(\alpha\tilde{r}(W-f) + (1-\alpha)r_f(W-f)) - \bar{p}[EU(\alpha\tilde{r}(W-f) + (1-\alpha)r_f(W-f)) - U((1-\alpha)r_f(W-f))] < U(r_f W)$. Since $EU(\alpha\tilde{r}(W-f) + (1-\alpha)r_f(W-f)) - U((1-\alpha)r_f(W-f)) > 0$, in order for the investor to be indifferent between not participating and participating when the latter is costly $\bar{p}$ must decrease. Hence, inserting a fixed participation cost lowers the required level of mistrust to stay out. Q.E.D.

Proof of Proposition 4: First notice that $EU(\alpha_0^*\tilde{r}(W-f) + (1-\alpha_0^*)r_f(W-f)) = U(\alpha_0^*\widehat{r_0}(W-f) + (1-\alpha_0^*)r_f(W-f)) > EU(\alpha_p^*\tilde{r}(W-f) + (1-\alpha_p^*)r_f(W-f)) = U(\alpha_p^*\widehat{r_p}(W-f) + (1-\alpha_p^*)r_f(W-f))$, since α_0^* maximizes the first expression above and $U(\cdot)$ is increasing in final wealth. It follows that $\alpha_0^*\widehat{r_0} > \alpha_p^*\widehat{r_p}$. We can now show that if $W = \bar{W}_0 = f\frac{\alpha_0^*\widehat{r_0} + (1-\alpha_0^*)r_f}{\alpha_0^*(\widehat{r_0} - r_f)}$ (the wealth threshold for participation when trust is full) and $p > 0$ the investor will not participate, that is, $(1-p)U(\alpha_p^*\widehat{r_p}(\bar{W}_0 - f) + (1-\alpha_p^*)r_f(\bar{W}_0 - f)) + pU((1-\alpha_p^*)r_f(\bar{W}_0 - f)) < U(r_f\bar{W}_0)$. Since $(1-\alpha_p^*)r_f(\bar{W}_0 - f) < r_f\bar{W}_0$, it is enough to show that $\alpha_p^*\widehat{r_p}(\bar{W}_0 - f) + (1-\alpha_p^*)r_f(\bar{W}_0 - f) < r_f\bar{W}_0$. Substituting the expression for $\bar{W}_0$, the above inequality always holds since $\alpha_0^*\widehat{r_0} > \alpha_p^*\widehat{r_p}$. Thus, with partial trust, the wealth threshold required to enter the stock market is larger than when there is full trust.

Existence of a solution for the optimal number of stocks: The first order condition for the problem

$$\operatorname*{Max}_n - \left[p + (1-p)e^{-\theta(W/n)\bar{r} + \frac{1}{2}\theta^2(W/n)^2\sigma^2}\right]^n - cn$$

is

$$FOC: -Z^n\left[\log Z + \frac{Z-p}{Z}\left(\theta\frac{W}{n}\bar{r} - \theta^2\left(\frac{W}{n}\right)^2\sigma^2\right)\right] = c,$$

where $Z = [p + (1-p)e^{-\theta(W/n)\bar{r} + \frac{1}{2}\theta^2(W/n)^2\sigma^2}]$.

To show that the first-order condition has at least one solution, we take limits of the LHS of the first-order condition for $n \to +\infty$ and $n \to 0$.

- Limit of the LHS when $n \to +\infty$

  In this case, $\lim_{n\to+\infty} Z = 1$, $\lim_{n\to+\infty} Z^n = e^{-(1-p)\theta\bar{r}w}$, and LHS $\to 0$.
  To see why $\lim_{n\to+\infty} Z^n = e^{-(1-p)\theta\bar{r}w}$, we write the following approximations:

  1) $\log(Z) \approx \log(1 + Z - 1) \approx Z - 1$.

  2) $$Z - 1 = (1-p)\left(e^{-\theta(W/n)\bar{r}+\frac{1}{2}\theta^2(W/n)^2\sigma^2} - 1\right)$$
  $$\approx (1-p)\left(-\theta(W/n)\bar{r} + \tfrac{1}{2}\theta^2(W/n)^2\sigma^2\right).$$

  3) $Z^n = e^{n\log(Z)} \approx (1-p)(-\theta(W)\bar{r})$.

- Limit of the LHS when $n \to 0$:

  1) Now $\lim_{n\to 0} Z = +\infty$ and $\lim_{n\to 0} Z^n = +\infty$.

  2) $$\frac{Z-p}{Z} = \frac{(1-p)e^{-\theta(W/n)\bar{r}+\frac{1}{2}\theta^2(W/n)^2\sigma^2}}{p + (1-p)e^{-\theta(W/n)\bar{r}+\frac{1}{2}\theta^2(W/n)^2\sigma^2}}$$
  $$= \frac{1-p}{1 - p + pe^{\theta(W/n)\bar{r}-\frac{1}{2}\theta^2(W/n)^2\sigma^2}},$$

     so that $\lim_{n\to 0}\frac{Z-p}{Z} = 1$.

  3) Let $K = \theta(W/n)\bar{r} - \frac{1}{2}\theta^2(W/n)^2\sigma^2$.

  We can write the following approximations:

$$\frac{Z-p}{Z} = \frac{(1-p)e^{-K}}{(1-p)e^{-K} + p}$$
$$= \frac{1}{1 + \frac{p}{1-p}e^K}$$
$$\approx 1 - \frac{p}{1-p}e^K$$
$$\log(Z) = \log\left(\frac{p}{1-p}e^K + 1\right) + \log(1-p)e^{-K}$$
$$= \log\left(\frac{p}{1-p}e^K + 1\right) + \log(1-p) - K,$$

so that

$$\log Z + \frac{Z-p}{Z}(\theta(W/n)\bar{r} - \theta^2(W/n)^2\sigma^2)$$
$$\approx \log\left(\frac{p}{1-p}e^K + 1\right) + \log(1-p) - K + \left(1 - \frac{p}{1-p}e^K\right)$$
$$\times(\theta(W/n)\bar{r} - \theta^2(W/n)^2\sigma^2) \underset{n\to 0}{\sim} -\frac{1}{2}\theta^2(W/n)^2\sigma^2.$$

This means that $(\log Z + \frac{Z-p}{Z}(\theta(W/n)\bar{r} - \theta^2(W/n)^2\sigma) \to -\infty$ as $n \to 0$ and that the LHS goes to $+\infty$.

Since $c > 0$, according to the intermediate value theorem, the first-order conditions have a solution.

Appendix B. The DNB Survey and the Bank Customers Survey

A. The DNB Survey

We rely on the 2003 wave of the DNB Household Survey. The DNB survey collects information on a sample of about 1,943 Dutch households (about 4,000 individuals). The survey, sponsored by the DNB, is administered and run by CentER at Tilburg University. The purpose of the survey is to collect household-level data to study the economic and psychological determinants of household savings behavior. Interviews are done via computer through the internet. If a household has no computer or access to the net, CentER provides a set-top box and if necessary a television set that can be used to fill in questionnaires. This feature allows CentER to interview the panel occasionally after the main survey has been conducted and collect additional data on topics of interest. On the main survey, participants are given seven questionnaires each covering a different feature of the household: general information on household demographics; home and market work; housing and mortgages; health conditions and income; financial assets and liabilities; economic and psychological attitudes; and work and home. All individuals in the households of age above 16 are interviewed but the general information is collected for all household members.

B. The Bank Customers Survey

The bank customer survey (BCS) draws on a sample of one of the largest Italian banking groups, with over 4 million accounts. The survey was conducted in the fall of 2003 and elicits detailed financial and demographic information on a sample of 1,834 individuals with a checking account in one of the banks that are part of the group. The sample is representative of the eligible population of customers, excluding customers aged less than 20 and more than 80, and those who hold accounts of less than 1,000 euros or more than 2.5 million euros. Account holders are stratified according to three criteria (geographical area, city size, and financial wealth), and the sample explicitly oversamples rich individuals.

The goal of the survey is to understand customers' behavior and expectations. The questionnaire was constructed with the help of field experts and academic researchers. It has different sections, dealing with household demographic structure, occupation, propensity to save, propensity to take risk and invest, individual and household financial wealth and liabilities, real estate and entrepreneurial activities, income and expectations, and needs for insurance and pension products.

Appendix C. Measuring Risk and Ambiguity Aversion

A. The Coefficient of Risk Aversion

Since survey participants are reporting the price that makes them indifferent between participating in the lottery and paying the reported price q and not participating, it must be that

$$-e^{\theta W} = \frac{1}{2}\big(-e^{\theta(W+X-q)}\big) + \frac{1}{2}\big(-e^{\theta(W-q)}\big),$$

where X is the lottery prize (5,000 euros in the survey). Using this indifference condition we compute for each individual in the sample his/her absolute risk aversion parameter θ. A measure of relative risk aversion can be obtained by multiplying θ by the individual endowment (income, wealth, or the sum of the two).[18]

B. The Coefficient of Ambiguity Aversion

To get a measure of ambiguity aversion from the answers to our questions, we rely on the utility model recently developed by Maccheroni, Marinacci, and Rustichini (2005). Consider an individual who must make a decision prior to the realization of an unknown state of nature s. There is a finite set S of possible states and a typical choice will be a vector $(x_1, \ldots, x_S)$ among a choice set X. The environment is ambiguous in the sense that the decision maker cannot precisely evaluate his subjective probability distribution for the states of nature but he has a set of subjective probability distributions Π.

In this framework, ambiguity-averse preferences for two-state lotteries can be written as

$$v(x) = E_\pi u(x) \text{ if there is no ambiguity}$$

$$v(x) = \min_{\pi \in \{\pi_A, \pi_B\}} \left\{ E_\pi u(x) + \omega \left(\pi \log \frac{\pi}{\pi^*} + (1-\pi) \log \left(\frac{1-\pi}{1-\pi^*} \right) \right) \right\},$$

where π^* is a reference probability measure for the distribution $(\pi,\ 1-\pi)$. The term $(\pi \log \frac{\pi}{\pi^*} + (1-\pi)\log(\frac{1-\pi}{1-\pi^*}))$ is a measure of entropy and the extent of aversion to ambiguity is measured by the parameter ω. Letting q_A denote the willingness to pay for the ambiguous lottery and X the prize of the lottery (5,000 euros), the index of ambiguity aversion can be computed as:

$$\omega = \frac{u(W) - \pi_A u(W - q_A) - (1-\pi_A) u(W + X - q_A)}{\left(\pi_A \log \dfrac{\pi_A}{\pi^*} + (1-\pi_A) \log \left(\dfrac{1-\pi_A}{1-\pi^*} \right) \right)},$$

where W is the person's wealth and the risk aversion of the utility function $u(W)$ is obtained from the answers to the purely risky lottery. In our case, the reference measure $(\pi^*, 1-\pi^*)$ can be taken to be (1/2, 1/2).

[18] The assumption about the shape of the utility function to obtain the risk aversion parameter is not important. Assuming that individuals have CRRA preferences and backing the relative risk aversion parameter under this assumption gives essentially the same estimates of absolute risk aversion as using CARA preferences.

We can further develop this formula to separate the effect of pure risk aversion on the ambiguity index a from the effect of ambiguity and write it as

$$\omega = \frac{u(W) - 1/2u(W-P) - 1/2u(W+X-P)}{\left(\pi_A \log\frac{\pi_A}{\pi^*} + (1-\pi_A)\log\left(\frac{1-\pi_A}{1-\pi^*}\right)\right)} + \frac{1/2u(W-P) + 1/2u(W+X-P) - \pi_A u(W-P) - (1-\pi_A)u(W+X-P)}{\left(\pi_A \log\frac{\pi_A}{\pi^*} + (1-\pi_A)\log\left(\frac{1-\pi_A}{1-\pi^*}\right)\right)}.$$

The first term reflects the pure effect of risk aversion and is equal to zero if the participant is risk neutral; the second term reflects the effect of ambiguity, that is, the effect of distorting the perceived probability from (1/2, 1/2) to $(\pi_B, 1-\pi_B)$. Here the distortion of the perceived probability distribution is made in favor of the "worst-case model" $(\pi_A, 1-\pi_A)$. Another way to refine the index is to consider the second term only as the index of ambiguity aversion.

Note that in this model, there will be a nonzero ambiguity aversion index even if the willingness to pay is the same for both the purely risky lottery and the ambiguous lottery. This is due to the fact that ambiguity (the sole fact of not knowing the probabilities) has this effect of distorting the perceived probabilities for the decision maker, which should be taken into account.

In practice, for *CARA* utility, we have that

$$u(x) = -\frac{1}{\theta}e^{-\theta x}$$

$$\omega = -\frac{1}{\theta}e^{-\theta W}\frac{1-\pi_A e^{\theta q_A} - (1-\pi_A)e^{-\theta(X-q_A)}}{\left(\pi_A \log\frac{\pi_A}{\pi^*} + (1-\pi_A)\log\left(\frac{1-\pi_A}{1-\pi^*}\right)\right)}$$

$$= u(W)\frac{1-\pi_A e^{\theta q_A} - (1-\pi_A)e^{-\theta(X-q_A)}}{\left(\pi_A \log\frac{\pi_A}{\pi^*} + (1-\pi_A)\log\left(\frac{1-\pi_A}{1-\pi^*}\right)\right)},$$

and for CRRA utility, we have that

$$u(x) = \frac{x^{1-\gamma}}{1-\gamma}$$

$$\omega = \frac{W^{1-\gamma}}{1-\gamma}\frac{1-\pi_A\left(1-\frac{q_A}{W}\right)^{1-\gamma} - (1-\pi_A)\left(1+\frac{X-q_A}{W}\right)^{1-\gamma}}{\left(\pi_A \log\frac{\pi_A}{\pi^*} + (1-\pi_A)\log\left(\frac{1-\pi_A}{1-\pi^*}\right)\right)}$$

$$= u(W)\frac{1-\pi_A\left(1-\frac{q_A}{W}\right)^{1-\gamma} - (1-\pi_A)\left(1+\frac{X-q_A}{W}\right)^{1-\gamma}}{\left(\pi_A \log\frac{\pi_A}{\pi^*} + (1-\pi_A)\log\left(\frac{1-\pi_A}{1-\pi^*}\right)\right)}.$$

As already noticed by Maenhout (2004), the Hansen-Sargent static multiplier preferences, of which the Maccheroni, Marinacci, and Rustichini (2005) preferences are a generalization, are not homogeneous in wealth even if the utility function u is homogeneous in wealth. This is the reason why the ambiguity aversion index ω is proportional to $u(W)$ when u is homogeneous in wealth. In the numerical calculations, we report only $\frac{\omega}{u(W)}$, as $u(W)$ is extremely small (in the order of 10^{-10}).

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