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Institutional Quality, Trust and Stock-Market Participation: Learning to Forget

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Abstract

We explore the relation between institutional quality, trust and stock-market participation. In our theoretical model, agents update their beliefs in a Bayesian manner based on observations on frauds and choose whether to invest in the stock market. The corresponding empirical model shows that institutional quality affects trust and that the part of trust that is explained by institutional quality influences stock-market participation. For immigrants, we consider learning factors, such as education and duration of stay, and we find that the impact of the institutional quality of the country of residence, relative to that of the home country, tends to increase with education.

Keywords: institutional quality; learning, trust; stock-market participation

JEL Codes: C13, G11

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"Man […] cannot learn to forget, but hangs on the past: however far or fast he runs, that chain runs with him."

Friedrich Nietzsche, *The Use and Abuse of History*

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1 Introduction

The ability to protect property rights is paramount to the development of financial markets and also to promoting economic growth in a market economy. If people trust that financial contracts are being enforced and that the cost of fraudulent behavior is sufficiently high, they are, presumably, also more likely to invest. In an environment of low institutional quality, where property rights are not being protected and there is no substantial punishment for fraudulent behavior, people become distrustful and less willing to engage in any type of financial contract that involves a counterparty to whom they have no personal ties. In such environments, social control becomes more important and may in some cases partially (at least locally) replace the punishing role of institutions. However, social control can never entirely replace the role of institutions because social control applies only locally, whereas institutions have a much broader impact on attitudes and behavior. In well-functioning market economies with good institutions, people tend to trust each other and so are more willing to enter financial contracts with counterparties with whom they have no previous ties.[1]

In this paper, we analyze the effects of institutional quality on stock-market participation, both theoretically and empirically. We develop a theoretical model in which agents are Bayesian updaters who, from time to time, observe frauds; this forms their level of trust. According to the model, higher institutional quality leads to a higher level of trust, and, for a sufficiently high level of trust, agents want to invest in the stock market.

An interesting aspect resides in the fact that people may migrate to other countries and thus experience a dramatic change in institutional quality. Over time, they should adopt a level of trust that is consistent with the institutional quality of their new country of residence and the degree of fraud in their country of origin should play a less important role in their decision making. However, many factors may affect an individual's degree of adaptation to a new country of residence. In our theoretical model, we make the behavioral assumption that immigrants use a weighted average of fraud probabilities in their home country and in their new country of residence. To the best of our knowledge, this is the first study on the effect of

[1] See Bohnet and Steffen (2004) for evidence that better institutions lead to higher levels of trust.

institutional quality on the degree of stock market participation that accounts for learning aspect in individuals' behavioral response to institutional quality.

In accordance with our theoretical motivation, we build an empirical model that investigates to what extent institutional quality affects trust and how trust related to institutional quality affects individual investors' stock-market participation. In the case of immigrants, we analyze to what degree their level of trust is affected by the institutional quality of their home country relative to that of their new country of residence. Furthermore, we study if immigrants' degree of adaptation in this regard is related to learning factors such as education and the duration of stay in the new country.

The findings support our hypotheses: Institutional quality significantly affects trust and the level of trust that is related to institutional quality has in turn a significant effect on the probability of stock-market participation. According to our results, cross-country differences in institutional quality lead to a considerable variation in predicted probabilities of stock-market participation. For example, the estimated participation probability is 1.2% for a typical native residing in the country with the lowest institutional quality among the countries included in the survey, Poland. In contrast, the probability is 17.3% if he or she resides in the country with the highest institutional quality, Denmark. Similarly, the predicted probability of participation for a typical immigrant is 0.9% if he or she immigrates to Poland, whereas the probability is 5.8% if he or she immigrates to Denmark. Further, we find that immigrants' education is an important factor determining the relative impact of the institutional quality of the country of residence relative to that of the home country: The more time the immigrant households have spent on education, the larger is the impact of the institutional quality of the country of residence. Our interpretation is that highly educated immigrants learn the institutional quality of their new country of residence more easily and thereby adapt their economic behavior to it to a larger extent, whereas poorly educated immigrants are more heavily influenced by the institutional quality of their home countries.

Our study is based on European survey data (the SHARE data set), covering more than 30,000 individuals in fourteen European countries. We first employ an ordered probit model to investigate the relation between trust and institutional quality, in which the relative weights assigned by immigrants to the institutional quality of the country of residence and the country of origin are determined endogenously within the model and are allowed to be a function of a learning factor: education or duration of stay. In the second step, we perform a standard logit analysis of the relationship between stock-market participation and trust related to institutional quality.

Our study is related to the literature on the "limited-participation puzzle."[2] Theoretical explanations put forward for this phenomenon include both rational—based on, for example, transaction costs and liquidity needs (Allen and Gale, 1994; Williamson, 1994), ambiguity aversion (Dow and Werlang, 2002; Cao, Wang and Zhang, 2005; Epstein and Schneider, 2007), disappointment aversion (Ang, Bekaert and Liu, 2005)—and behavioral—based on, for example, loss aversion (Gomes, 2005), influence of social interaction (Hong, Kubik, and Stein, 2004; Brown, Ivković, Smith, and Weisbenner, 2008). More specifically, our paper is related to Osili and Paulson (2008a,b), Guiso, Sapienza, and Zingales (2008) and Giannetti and Wang (2014), who, among others, relate institutional environment, corporate fraud and social capital to stock-market participation.[3] Osili and Paulson (2008a,b) use data on immigrants to the US to investigate the impact of institutions on households' participation in financial markets. They find that the institutional quality of the country of origin has a large impact on a broad range of financial-market behaviors, and that the effect of home-country institutions is absorbed early in life. Guiso, Sapienza, and Zingales (2008) investigate the effect of trust on stock-market participation, treating trust as an exogenous variable. Using Dutch and Italian micro data, as well as macro data for several countries, they show that lack of trust is an important factor in explaining the stock-market–participation puzzle. Giannetti and Wang (2014) find that corporate fraud revelations decrease the probability of stock-market participation and show that this is due to a loss of trust in the market.

Our contribution to the literature is two-fold. First, instead of treating trust as exogenous, we analyze the formation of trust through learning in a repeated-interaction model and investigate the impact of institutional quality on trust. To our knowledge, this is the first study on stock-market participation that, both theoretically and empirically, analyses the joint impact of institutional quality and learning on individuals' behavioral response. Among other things, our modeling allows us to assess the importance of education on the formation of trust, and hence how the effect of institutions on stock-market participation varies with educational background. Second, because our data set spans immigrants and natives in different countries,

[2] In short, the puzzle is that if the expected return on a stock exceeds the risk free rate, then, absent any frictions, everyone should participate in the stock market, albeit to varying degrees. However, we know that not all real-world investors participate in the stock market.
[3] The literature in this area also includes, e.g., Guiso, Paola, and Zingales (2004), Georgarakos and Pasini (2011), Christelis, Georgarakos, and Haliassos (2013).

we are able to investigate the importance of the country of origin's institutional quality, relative to that of the country of residence.

The remainder of our paper is organized as follows. Section 2 presents our theory, which models how institutional quality affects trust through learning and how trust in turn affects stock-market participation. Section 3 presents our empirical model. Section 4 describes the data, and we present our empirical results in Section 5. Finally, Section 6 concludes the paper.

2 Theoretical motivation

Drawing on Guiso, Sapienza, and Zingales (2008), we develop a framework for analyzing how trust is formed and how it affects stock-market participation. The main difference between our model and the one proposed by Guiso, Sapienza, and Zingales (2008) is that we specifically consider the formation of trust through learning.

We consider a partial-equilibrium model where returns on assets are exogenously given. There are two assets available for investment: one stock and one short-term bond. The short-term gross interest rate is R_f, where $R_f \geq 1$. If there is fraud, then the stock's gross return is ε, where $\varepsilon > 0$ is close to zero, and certainly less than one. In the absence of fraud, the stock delivers a gross return $\tilde{R}_t^+ > \varepsilon$.[4] We also assume that $E_t[\tilde{R}_{t+1}^+] > R_f$. Fraud occurs independently across periods. The probability of fraud (p) can either be high ($p = p_h$) or low ($p = p_l$), where $p_h > p_l$, but this probability does not change over time.

Agents maximize their expected utility of final wealth by choosing the relative allocation of their wealth to the stock (α_t). They have a short-selling constraint, meaning that $\alpha_t \geq 0$. For simplicity, we assume that agents have logarithmic utility.[5] However, our main results regarding stock-market participation also hold for myopic risk-averse investors in general (given standard assumptions on the elementary utility function), as shown in Appendix A.2. Agents know the risk-free rate, the stock return if there is fraud and the distribution of the stock return if there is no fraud, but they do not know the probability of fraud. They update their probability of being in the state with a high probability of fraud using their historical observations on fraud in a Bayesian manner. Each agent has a prior regarding the probability of fraud: the prior is that the probability of fraud is high with probability θ_0. For ease of

[4] In Guiso, Sapienza, and Zingales (2008), ε is equal to zero. Because we assume logarithmic utility, we need to let ε be greater than zero.
[5] It is well known that logarithmic utility induces myopic behavior (e.g., Mossin 1968; Hakansson 1971). This is important in this setting, because agents are learning about the probability of fraud, and thus, in general, the perceived investment opportunity set will change over time.

exposition, we suppress an index indicating what agent this prior belongs to. Let D_t denote the number of frauds at time t.[6] By Bayes' theorem, agents' posterior probability of being in the state with a high probability of fraud is given by

$$\begin{aligned}\text{Prob}(p = p_h|D_t = k) &= \frac{\theta_0\text{Prob}(D_t = k|p = p_h)}{\theta_0\text{Prob}(D_t = k|p = p_h) + (1-\theta_0)\text{Prob}(D_t = k|p = p_l)} \\ &= \frac{\theta_0 \binom{t}{k} p_h^k (1-p_h)^{t-k}}{\theta_0 \binom{t}{k} p_h^k (1-p_h)^{t-k} + (1-\theta_0)\binom{t}{k} p_l^k (1-p_l)^{t-k}} \\ &= \frac{\theta_0 p_h^k (1-p_h)^{t-k}}{\theta_0 p_h^k (1-p_h)^{t-k} + (1-\theta_0) p_l^k (1-p_l)^{t-k}}. \qquad (1)\end{aligned}$$

In Appendix A.1, we derive the condition for stock-market participation:

$$\xi_t \equiv \frac{E_t[\tilde{R}_{t+1}^{+} - R_f]}{R_f - \varepsilon} > \frac{\text{Prob}(\tilde{R}_{t+1} = \varepsilon|D_t)}{1 - \text{Prob}(\tilde{R}_{t+1} = \varepsilon|D_t)}, t = 1, 2, \dots, (T-1). \qquad (2)$$

We call ξ_t the stock's *normalized conditional risk premium* at time *t*. The above condition can also be written as

$$\text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t\right) < \frac{\xi_t}{1+\xi_t}. \qquad (3)$$

In fact, as shown in Appendix A.2, the condition for stock-market participation in equation (2) holds for any *myopic* investor with a strictly increasing, strictly concave and twice-continuously differentiable elementary utility function u satisfying $\lim_{W\to 0} u'(W) = +\infty$.

We can use the law of total probability to calculate the probability of fraud:[7]

$$\begin{aligned}\text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t = k\right) &= \text{Prob}(p = p_h|D_t = k) \cdot \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t = k, p = p_h\right) \\ &\quad + \text{Prob}(p = p_l|D_t = k) \cdot \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t = k, p = p_l\right) \\ &= \frac{\theta_0 p_h^{k+1}(1-p_h)^{t-k} + (1-\theta_0)p_l^{k+1}(1-p_l)^{t-k}}{\theta_0 p_h^k (1-p_h)^{t-k} + (1-\theta_0) p_l^k (1-p_l)^{t-k}} \qquad (4)\end{aligned}$$

We note that this probability is between p_l and p_h. By the above equation, the condition for stock-market participation in equation (2) can be rewritten as

[6] Our assumption that $\tilde{R}_t^{+} > \varepsilon$ ensures that investors can identify frauds *ex post* by looking at returns.
[7] Notice that $\text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t = k, p = p_h\right) = p_h$ and $\text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t = k, p = p_l\right) = p_l$.

$$\xi_t > \frac{\theta_0 p_h^{k+1}(1-p_h)^{t-k} + (1-\theta_0)p_l^{k+1}(1-p_l)^{t-k}}{\theta_0 p_h^{k}(1-p_h)^{t-k+1} + (1-\theta_0)p_l^{k}(1-p_l)^{t-k+1}}. \quad (5)$$

The boundary for the normalized risk premium to be participation inducing is increasing in the prior θ_0 because, if we divide both the numerator and the denominator of the right-hand side of equation (5) by θ_0, and take the derivative with respect to $1/\theta_0$, we get

$$\frac{p_l^k(1-p_l)^{t-k}p_h^k(1-p_h)^{t-k}(p_l-p_h)}{\left(p_h^k(1-p_h)^{t-k+1} - p_l^k(1-p_l)^{t-k+1} + \frac{1}{\theta_0}p_l^k(1-p_l)^{t-k+1}\right)^2} < 0\,. \quad (6)$$

Thus, if the prior probability of the state with high probability of fraud increases, the expected return on the stock in the absence of fraud needs to be higher for the agent to participate in the stock market. As summarized in the following lemma, we can also show that, if the normalized risk premium (ξ_t) lies between $p_l/(1-p_l)$ and $p_h/(1-p_h)$, then the prior probability required to induce stock-market participation is lower for greater numbers of observed frauds (k). The interpretation of the bounds on the normalized risk premium is, in order for it to be possible to satisfy equation (5) with a lower prior, ξ_t has to be greater than $p_l/(1-p_l)$, which is the lowest possible value on the right-hand side limit in equation (5). Moreover, if $\xi_t > p_h/(1-p_h)$, then all priors $\theta_0 \in [0,1]$ will induce participation, because $p_h/(1-p_h)$ is the highest possible value on the right-hand side limit in equation (5).[8]

Lemma 1: Suppose $\frac{p_l}{1-p_l} < \xi_t < \frac{p_h}{1-p_h}$. Then, the prior probability (θ_0) required for stock-market participation is decreasing in the number of observed frauds (k).

The proof is in Appendix A.3.

Now, consider two countries: country H and country L. Country H is a country with high institutional quality, and so in that country, the true probability of fraud is $p^{\mathrm{H}} = p_{\mathrm{l}}$ (but this is unknown to the investors) whereas country L is a country with low institutional quality and the true probability of fraud is $p^{\mathrm{L}} = p_{\mathrm{h}}$. Each country has a continuum of investors with a positive mass and with identical distributions of priors in the interval [0,1], and with positive support for the entire interval. Investors can only invest through an intermediary in their country of residence, which may from time to time engage in fraudulent behavior. Through the local intermediary, they can invest in the same risky asset ("a world market index") with gross returns $\tilde{R}_t^+$. The short-term gross interest rate is the same in both countries (R_{f}).

[8] If $\xi_t = p_h/(1-p_h)$, then all priors except $\theta_0 = 1$ will induce participation.

Provided that $\xi_t > p_l/(1-p_l)$ and $\xi_t < p_h/(1-p_h)$—so that, if agents learn the true probability of fraud, no one in country L will invest in the stock, whereas everyone in country H will invest in the stock—we generally expect to see a higher degree of stock-market participation in country H than in country L. In fact, as *t* increases, the probability that the citizens of country L have experienced more frauds than the citizens of country H increases as well. For large *t*, the number of frauds, which follows a binomial distribution, can be approximated by a normal distribution:

$$(D_t^H | p^H = p_l) \sim N(tp_l, tp_l(1-p_l)) \tag{7}$$

$$(D_t^L | p^L = p_h) \sim N(tp_h, tp_h(1-p_h)) \tag{8}$$

Hence, provided that the number of frauds in country H and the number of frauds in country L are independent, then, for large *t*, the probability that the citizens of country L have experienced more frauds than the citizens of country H is given by

$$\text{Prob}(D_t^L > D_t^H | p^L = p_h, p^H = p_l) = \Phi\left(\frac{(p_h - p_l)\sqrt{t}}{\sqrt{p_h(1-p_h) + p_l(1-p_l)}}\right), \tag{9}$$

where $\Phi(.)$ is the standard normal cdf. Since $p_h > p_l$, the above probability will approach one as *t* gets larger. By Lemma 1, this means that the participation-inducing value of the prior probability of the state with a high probability of fraud is lower in country L than in country H with that same probability. In turn, this implies that, as *t* gets larger, the probability that the fraction participating in the stock market is higher in country H than in country L also approaches one. Guided by the above reasoning, we formulate the following hypothesis.

Hypothesis 1: *In countries with better institutional quality, people tend to have a higher level of trust, which in turn induces a higher degree of stock-market participation in those countries.*

Next, we compare the stock-market participation between immigrants emigrating from country L to country H and natives in country H. Here, we make the behavioral assumption that immigrants use a weighted average of beliefs. This modeling of beliefs is consistent with Norman Anderson's psychological studies how beliefs are formed in response to stimuli (see Anderson, 1974, and the references therein). Formally, we model immigrants' beliefs as

$$\text{Prob}^I\left(\tilde{R}_{t+1} = \varepsilon | D_t^L, D_t^H\right) = w(\Lambda)\text{Prob}\left(\tilde{R}_{t+1} = \varepsilon | D_t^H\right) + \left(1 - w(\Lambda)\right)\text{Prob}\left(\tilde{R}_{t+1} = \varepsilon | D_t^L\right), \tag{10}$$

where Λ is a learning factor.[9] For expositional reasons, we assume that a higher value of Λ is associated with better learning so that the higher the value of Λ, the higher the weight assigned to the belief that is relevant for the new country of residence. The weighting of beliefs is thought to capture the phenomenon that immigrants' beliefs are affected by what happens and has happened in their home country, and more so if the value of the learning factor is lower. For example, we would think that a well-educated immigrant forms beliefs based on the history of events for the new country of residence to a larger extent. Of course, we need to ensure that the weight $w(\Lambda)$ is between zero and one. We let $w'(\Lambda) > 0$ for $0 \leq \Lambda < \Lambda_{\max}$, $w(0) = 0$, $w(\Lambda_{\max}) = 1$, where $\Lambda_{\max}$ is the maximum Λ value.

As t increases in equation (9), the probability that $D_t^L > D_t^H$ approaches one. Therefore, we assume that $D_t^L > D_t^H$ in the following. It then follows that the probability that our conclusions will hold approaches one as t increases.

If we compare immigrants with a Λ value lower than its maximum level, $\Lambda_{\max}$, to natives and assume that the two groups have identical distributions of priors with positive support on [0,1], we can conclude that a higher fraction of natives will invest in the stock market (provided that $p_l/(1-p_l) < \xi_t < p_h/(1-p_h)$).

Next, consider the effect of the learning factor on immigrants' stock-market participation. Using a reasoning similar to that in Lemma 1, we can establish that the highest participation-inducing prior belief is decreasing in Λ (again provided that $p_l/(1-p_l) < \xi_t < p_h/(1-p_h)$).

Lemma 2: The rational probability of fraud given the number of observed frauds, see equation (4), is increasing in the number of observed frauds.

We provide a proof of this lemma in Appendix A.4.

Lemma 3: Suppose $D_t^L > D_t^H$. Then, the prior probability (θ_0) required in order to reach a certain probability of fraud is increasing in the learning factor Λ.

The proof of this lemma is in Appendix A.5.

The interpretation of Lemma 3 is that as the value of the learning factor Λ increases, a higher prior (θ_0) is needed to reach the lowest probability of fraud required for nonparticipation in the stock market. Now, consider a continuum of immigrants having a certain distribution of priors with positive support on [0,1] and suppose that $p_l/(1-p_l) < \xi_t < p_h/(1-p_h)$). If

[9] For ease of exposition, we let Λ be a scalar, but we could easily extend the analysis to the case when Λ is a multidimensional vector.

we increase the value on the learning factor, Λ, while holding everything else constant (including the distribution of priors), the prior needed to induce nonparticipation increases. That is, the higher the value of immigrants' learning factor, the higher the fraction of immigrants participating in the stock market. This leads us to formulate a hypothesis.

Hypothesis 2: *Immigrants who emigrate from a country of lower institutional quality tend to have lower trust, which in turn means that they tend to be less prone to participate in the stock market. This effect is more pronounced for immigrants with a lower learning factor, and from countries with a lower institutional quality.*

In Appendix A.6, we consider the effect of adding a fixed participation cost. This introduces interactions between wealth and trust. First, given that the investor would invest if there were no participation costs, there is a threshold level of wealth below which the investor would not participate. Second, this threshold level of wealth is increasing in the prior probability of fraud. Third, adding a participation cost lowers the prior probability of fraud that triggers nonparticipation.

3 Institutional quality, learning and participation

Based on our theoretical hypotheses, we construct an empirical model that investigates the degree to which stock-market participation is affected by households' level of trust related to institutional quality. Our empirical model has two sequential parts. In the first part, we examine how institutional quality affects trust; in the second part, we investigate the degree to which the level of trust explained by institutional quality affects stock-market participation.

The first part of the empirical model defines

$$T_i^* = \text{func}(X_i) + \varepsilon_i, \tag{11}$$

where T_i^* is the latent level of trust for individual i, X_i is the level of institutional quality experienced by individual i, and ε_i is an error term.

Since immigrants may have been exposed to completely different institutional conditions in their country of origin compared to the country of residence, we allow immigrants' level of trust to depend on a weighted average of institutional qualities in their country of residence and country of origin. In our baseline model, equation (11) is specified as

$$T_i^* = b_N D_{N,i} X_i^{res} + b_I D_{I,i}\left(w X_i^{\text{res}} + (1-w) X_i^{\text{ori}}\right) + \varepsilon_i, \tag{12}$$

where X_i^{res} is the institutional quality of the country of residence for individual i, X_i^{ori} is the institutional quality of the country of origin for immigrant i, $D_{N,i}$ is a dummy variable for natives, and $D_{I,i}$ is a dummy variable for immigrants. Further, $w \in [0,1]$ is the weight of the institutional quality of the immigrants' country of residence. In the baseline model, w is assumed to be constant. T^* is an unobservable continuous latent variable. What we can observe is a discrete ordinal variable of trust, T, extracted from the survey data SHARE. We use ordered probit to estimate (12).

As hypothesized in Section 2, immigrants' degree of adaptation to the new institutional environment is related to their level of education. It seems plausible that immigrants with a higher level of education would learn the institutional quality of their new country of residence more quickly. To capture this learning process, we extend the model above and define the weight w for each immigrant as a (logistic) function of the learning factor, Λ:

$$T_i^* = b_N D_{N,i} X_i^{\text{res}} + b_I D_{I,i}\left(w_i X_i^{\text{res}} + (1 - w_i) X_i^{\text{ori}}\right) + \varepsilon_i, \tag{13}$$

$$w_i = \frac{1}{1 + \exp\left(-\gamma(\Lambda_i - c)\right)},$$

where c is the inflection point of the curve and γ determines the shape of the curve (a small value corresponds to relatively smooth changes in function values). Such specification for w ensures that the value of w is in the interval [0, 1].

We use the estimated parameters obtained from the ordered probit estimation of equation (13) to decompose trust for individual i into two parts: one that is explained by institutional quality and one that is not explained by institutional quality and may depend on other social factors or individual attributes.

$$T_i^{\text{expl}} = E[T_i | \boldsymbol{X}_i^T] = \sum_{j=1}^{J} \text{Prob}[T_i = j | \boldsymbol{X}_i^T] \times j, \tag{14}$$

$$T_i^{\text{unexpl}} = T_i - E[T_i | \boldsymbol{X}_i^T],$$

where $j = 0, 1, \ldots 10,$ since T scales from 0 (low trust) to 10 (high trust). $\boldsymbol{X}_i^T$ consists of all the explanatory variables for individual i in equation (13). $\text{Prob}[T_i = j | \boldsymbol{X}_i^T]$ is the predicted probability that the level of trust of individual i is equal to j, conditional on $\boldsymbol{X}_i^T$. See equation (B1) in Appendix B for a calculation of $\text{Prob}[T_i = j | \boldsymbol{X}_i^T]$.

The second part of the analysis relates stock-market participation to the explained and unexplained parts of trust. The dependent variable, stock-market participation, is binary and coded as one if the household owns stocks and zero otherwise. The regression for the latent variable y_i^*, determining the stock-market participation of individual *i*, is specified as

$$y_i^* = a_0 + a_1 T_i^{\text{expl}} + a_2 T_i^{\text{unexpl}} + \sum_{k=2}^{K} a_{k+1} Z_{ki} + u_i, \tag{15}$$

where Z_{ki} is control variable *k* for individual *i*.

The marginal effect of the explanatory variables of the logit model in equation (15) is computed in the conventional way. However, we need to use the chain rule to compute the marginal effects on stock-market participation of the variables included in equation (13) for trust—the institutional quality of country of origin and country of residence, and education.

4 Data

The paper is based on micro data on individual and household characteristics and portfolio composition. The main source is the dataset of the second wave of the Survey of Health, Aging and Retirement in Europe (SHARE), which was collected in 2006 and 2007. SHARE includes comparable household-level data for people aged 50 and above in 14 European countries: Austria, Belgium, Czech Republic, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Poland, Spain, Sweden, and Switzerland. SHARE contains detailed information on stock-market participation, wealth, income, employment, immigration background,[10] and other demographic characteristics. The advantage of using survey data as compared to actual micro data collected by statistical bureaus is the fixed nature of the questionnaire; it facilitates cross-country comparisons. More importantly, as opposed to micro data, SHARE contains information about individuals' self-assessed (subjective) degree of risk aversion and trust in other people.

In the empirical estimation, we use stock-market participation (i.e. stock ownership), wealth, and household income, while household level of trust, risk aversion, and demographic attributes are assumed to be those of the household head. For households with more than one possible decision maker, we first select the person in the household with the higher income as the decision maker. For households not reporting an income, we use the person in the household with the higher education as the decision maker. If neither income nor education is reported, we pick the man as the decision maker.

[10] For households that responded to the questions about immigration background in the first wave and not in the second wave, information about immigration background is extracted from the dataset of the first wave of SHARE, collected in 2004.

In the estimation of the trust regressions, the sample consists of 19,034 native-born individuals and 1,228 immigrants. The level of trust is an ordinal variable (from 0 to 10) extracted from individual answers to the following question in SHARE:

"Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"

Here 0 means that the interviewee can't be too careful and 10 means that most people can be trusted. For institutional quality in each country, we use the index "Rule of law"[11] collected by the World Bank, which "reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence." Panel A of Table 1 presents summary statistics for trust and institutional quality. We can see that the variations in individual trust and countries' institutional quality are reasonably large in our sample. The institutional quality of immigrants' country of origin has a larger variation than the institutional quality of the fourteen European countries. Also, the mean of the institutional quality of the country of origin is considerably lower than that of the institutional quality of the country of residence, which reflects that most (77%) immigrants in our sample emigrated from a country with lower institutional quality. Immigrants' learning factors are also summarized in Panel A. Education is the number of years spent on education, and duration is the number of years of stay in the country of residence.

[Insert Table 1]

Panel B of Table 1 presents summary statistics for the variables used in the estimation of the stock-market participation regression. Stock-market participation is a binary variable equal to one if the household owns stocks and zero otherwise. Income is the household's income after tax in the year prior to the survey. Wealth is the household's financial wealth at the time of the survey. Married is a binary variable equal to one if the household head is married or in a registered partnership. Risk aversion is equal to 1 if the interviewee is willing to take substantial financial risks expecting to earn substantial returns, 2 if the interviewee willing to take above-average financial risks expecting to earn above average returns, 3 if the interviewee is willing to take average financial risks expecting to earn average returns, and 4 if the interviewee not willing to take any financial risks. The sample consists of 7,411 native-born individuals and 520 immigrants. This sample is of a smaller size than the one used for

[11] For the sake of robustness, we also use the index of legal system and property-rights protection from Fraser Institute as our measure of institutional quality. Our empirical results continue to hold.

the trust regression because the values of some variables such as wealth and income are missing for some households.

In addition, we show for each country its institutional quality and the average institutional quality of its immigrants' country of origin (see Figure 1). There is a considerable difference between the two series for most of the countries. For all countries except Poland, immigration tends to be from countries with lower institutional quality. The reverse pattern in Poland is mainly due to its own low institutional quality rather than the higher institutional quality of the immigrants' countries of origin. Figure 2 shows the average values of trust, presenting averages separately for natives and immigrants in each country. As seen in the figure, there are no considerable differences between natives' and immigrants' average values of trust. This indicates that immigrants' trust may depend not only on the institutional quality of their country of origin, but also on the institutional quality of their country of residence. Further, Denmark has the largest mean value, followed by Sweden, Switzerland, the Netherlands, and Ireland, while residents in France and Italy seem to be the most skeptical groups in our sample. We also show the rate of stock-market participation in different countries (see Figure 3). The participation rate varies considerably across countries. Among natives, it is considerably higher in Denmark and Sweden (over 35%) than in the other countries. Sweden also has the largest rate of stock-market participation among immigrants (over 25%). Poland and the Czech Republic have the lowest participation rates (1% and 2%, respectively) among natives. In our sample, the immigrants in Austria, Czech Republic, Greece and Poland own no stocks.

[Insert Figures 1 to 3]

5 Results

In this section, we present our empirical results. We follow a two-step estimation procedure. In the first step, we estimate a relation between trust and institutional quality. In the second step, we consider the relation between stock-market participation and the explained and unexplained parts of trust from the first regression. Our results confirm our hypotheses: Institutional quality has a significant effect on trust and the part of trust that is explained by institutional quality has, in turn, a significant effect on stock-market participation. We also find that the more highly educated immigrants' trust is, to a larger extent, influenced by the institutional quality of their new country of residence. This is in line with the notion that more highly educated immigrants need to exert less effort to adapt to the institutional quality of their new country of residence.

5.1 The effect of institutional quality on trust

In this section, we analyze the impact of institutional quality on households' level of trust. Here, our purpose is not to explain the trust variable by investigating all its determinants; rather, we decompose trust into a component that is related to institutional quality and a component that is not. Therefore, we do not use any individual-level variables in the model.

To give a simple illustration of the relationship between trust and institutional quality, we start by running an unrestricted ordered probit model of the variable trust on institutional quality before estimating the restricted model in (12) and (13):

$$T_i^* = b_0 + b_{\mathrm{N}} D_{\mathrm{N},i} X_{\mathrm{i}}^{\mathrm{res}} + b_{\mathrm{I}}^{\mathrm{ori}} D_{\mathrm{I},i} X_{\mathrm{i}}^{\mathrm{ori}} + b_{\mathrm{I}}^{\mathrm{res}} D_{\mathrm{I},i} X_{\mathrm{i}}^{\mathrm{res}} + \varepsilon_i. \tag{16}$$

The first column in Table 2 reports the estimates. The parameter b_N represents the response of the trust level of a native resident to changes in the institutional quality of the country of residence, $b_{\mathrm{I}}^{\mathrm{ori}}$ is the response of the immigrant's trust level to the institutional quality in the country of origin, and $b_{\mathrm{I}}^{\mathrm{res}}$ is the response of the immigrant's trust level to the institutional quality in the country of residence. All the parameters are positive and highly significant, confirming our expectation regarding the impact of institutional quality on trust. For people who have emigrated, the institutional qualities of both the country of residence and the country of origin have significant impact on trust.

Now we estimate the restricted models in (12) and (13) with the standard maximum likelihood procedure. The related likelihood functions are maximized using the simulated annealing algorithm (see Goffe, Ferrier, and Rogers, 1994), which is very robust and seldom fails to reach the global optimum, even for very complicated problems. The second column of Table 2 reports the estimates. b_{N} and b_{I} are positive and highly statistically significant, implying that better institutions make both natives and immigrants more trustful. The test for equality of b_{N} and b_{I} cannot reject the hypothesis that the response to institutional quality is the same for immigrants and natives. For immigrants, w, the weight of the institutional quality of the country of residence is equal to 78.7% and significantly different from zero, indicating that the institutional quality of the country of residence plays a significant role in forming immigrants' beliefs. Furthermore, we test the null hypothesis: $w = 1$ against the one-sided alternative $w < 1$. The null is rejected with a p-value of 0.17%. This test result indicates that people who have experienced a sudden change in institutional environment due to immigration do not fully adopt a level of trust that is consistent with the institutional quality of their new country of residence: The institutional quality of their country of origin still influences their beliefs. This is consistent with the finding in Osili and Paulson (2008b) that the impact of home-country institutions is persistent and absorbed early in life. However, we also find that the institutional quality of the country of residence is more influential on average: A one-tailed test shows that $\hat{w}$ is larger than 0.5 at the 1% significance level.

Note that the product of w and b_I from the restricted model gives the estimated b_I^{res} of the unrestricted model and taking the product of $(1 - w)$ and b_I yields the estimated b_I^{org}. Comparing the results of the restricted model with those of the unrestricted model shows that the large difference between natives' and immigrants' responses to institutional quality of the country of residence (b_N and b_I^{res}, respectively), in the unrestricted model is mainly due to the relative influence of the institutional qualities of the immigrants' country of origin and country of residence, measured by w, rather than differences in the response of trust to changes in institutional quality.

[Insert Table 2]

5.2 Learning factors and the degree of adaptation

In this subsection, in line with our theoretical motivation, we investigate the importance of learning factors for the adaptation process of people who have experienced a sudden change in institutions due to immigration. We consider duration of stay in the country of residence and years spent on education as potential learning factors. As people with higher education often have higher cognitive abilities, we expect that highly educated people learn new institutional environments and update their beliefs more easily. In addition, we expect that immigrants with longer tenure in a new country of residence adapt their beliefs to the new institutional environment to a larger extent. Haliassos, Jansson, and Karabulut (2014) show that, with longer exposure to the new institutional environment, the financial behavior of immigrants converges to that of natives.

To examine the importance of education and duration of stay for immigrants' adaptation, we use the extended model in (13), where the weight of the institutional quality of the country of residence depends on each of these two learning factors. The results are reported in the last two columns of Table 2. The parameter $\hat{\gamma}$ is positive and highly significant for education, indicating a positive relationship between education and the weight assigned to the institutional quality of immigrants' country of residence. Based on our estimates, we show the relationship between the weight and education graphically in Figure 4. The figure shows remarkable differences in the degree of adaptation to the new institutional environment between immigrants with lower education and those with higher education. Immigrants with no education have very low degrees of adaptation, with the weight of the institutional quality of the country of residence, ($\widehat{w}$) having a value of around 25%. The degree of adaptation increases sharply with education for slightly educated immigrants and $\widehat{w}$ turns larger than 50% when the level of education reaches the inflection point $\hat{c}$, about 5 years. At about 12 years of education, approximately corresponding to high school education, $\widehat{w}$ is above 80%. Thus, the trust of highly educated people responds most to the institutional quality of the country of residence.

[Insert Figure 4]

When we use immigrants' duration of stay in the country of residence as the learning factor, the parameter $\hat{\gamma}$ has the expected sign—it is positive—but it is not statistically significant. The insignificance of this factor may be due to the age composition and the long duration of stay of the immigrants in our sample. For example 80% of the immigrants in our sample have spent more than 20 years in their country of residence, as can be seen in Figure 5. The insignificance of duration might also be induced by the negative correlation (-0.16) between education and duration in our sample. However, testing different specifications using both education and duration as learning factors, we find no improvement in the significance of duration. Thus, we conclude that−in our sample−the differences in immigrants' duration of stay cannot explain the differences in their degree of adaptation to the institutional quality of the country of residence. Therefore, we use education as the only learning factor in the subsequent analysis.

[Insert Figure 5]

5.3 Institutional quality, trust and stock-market participation

In this section, we examine the effect of institutional quality on stock-market participation through the belief-forming process. For this purpose, build on our previous estimation with education as the learning factor (see Section 5.2), we decompose trust into two parts using equation (14): one that is explained by institutional quality and one that is not explained by institutional quality. We use these two components together with control variables to explain stock-market participation according to equation (15). We use the logit model because the dependent variable (stock-market participation) contains many more zeros than ones.

Table 3 presents the estimation results. The first column of Table 3 shows the results for Model 1 (M1), the benchmark model with only the controls as explanatory variables. The second column shows the results for M2, where we augment the benchmark model by adding the self-assessed level of trust from SHARE to see whether trust explains stock-market participation. Finally, in the third column we present the results of our main model, M3—described in equation (15)—showing the relative importance of the trust component related to institutional quality. The positive and highly significant coefficient for trust in M2 shows that there is indeed a positive relation between trust and stock-market participation. According to the likelihood ratio test, M2 outperforms M1, which confirms the importance of trust in stock-market participation. In M3, we regress stock-market participation on the decomposed parts of trust: one that is explained by institutional quality and one that is not explained by institutional quality. In order to take into account the presence of regressors generated from a prior regression, we employ bootstrap techniques to obtain standard errors. The third column of Table 3 shows that both the explained and the unexplained parts of trust have positive and highly significant effects on stock-market participation. The highly significant results of the likelihood ratio test show that M3 outperforms M1. Furthermore, judging from the pseudo R-square, and Akaike and Bayesian information criteria, M3 improves upon M2 markedly by accounting for the role of institutions in the belief-forming process. The last two columns of the table report the coefficients and average marginal effects of the explanatory variables across observations[12] in M3. To facilitate a comparison between the effect of the explained part of trust and that of the unexplained part, we calculate their marginal effects at their standardized values in the last column, where we standardize so that both variables have zero mean and unit variance. We find that the part of trust explained by institutional quality has a much higher impact on stock-market participation than the unexplained part of trust.

[Insert Table 3]

For the most part, the control variables display the expected signs. Wealth,[13] years of education, gender (male), and the status of being married are all positively related to participation. Age has a hump-shaped effect on participation, with age 70 as the turning point.

[12] Another common approach for estimating marginal effects in binary-choice models is to calculate marginal effects at the sample means of the explanatory variables. Such estimates are thus conditional effects for an average person. Comparing the two common approaches, Verlinda (2006) concludes that averaging over the values of the marginal effects across observations should be the approach taken if one desires to purge the marginal effect of the explanatory variable and show the average effect in the population.

[13] As income and wealth both have highly skewed distributions, we make log transformation of these two variables. The transformation function we use is $\ln(x+1)$, since income or wealth may be equal to zero.

Risk aversion affects participation negatively. Standard theory suggests that, in general, risk aversion is dependent on wealth, and intuitively, it ought to be a decreasing function of wealth. Since the coefficients related to these variables are both significant, we conclude that wealth affects participation not only through its effect on risk aversion. This might be considered as support for our theoretical results regarding wealth effects induced by participation costs (see Appendix A.2). Income is significant in M1 and M2, but it becomes insignificant in M3, where we include trust related to institutional quality. A possible explanation may be the correlation between institutional quality and countries' average level of income. Therefore, a positive coefficient on income in M1 and M2, might be related to a missing variable in these models rather than the income variable itself.

Since explained trust is related to country-level institutional quality, it is possible that the significant effect of this variable on stock-market participation is to some extent related to other country-specific variables correlated with institutional quality (see the discussion above about income). To control for this possibility, we should include country fixed effects in the model. However, it would not be valid to estimate a fixed effects model for the entire sample, since explained trust would be highly correlated with country-specific fixed effects in an estimation that includes a large number of native residents. An additional issue with using the entire sample is that the observations of native residents may dominate the results.

To address these issues and possible mass significance in the main regression, we perform a bootstrap estimation of M3 with country-of-residence fixed effects. Due to the large number of countries of origin and the fact that only a few immigrants are from each specific country, it is not appropriate to estimate the model with country-of-origin fixed effects. The number of bootstrapped samples is 999. Each bootstrap sample consists of all the 520 immigrants and the same number of randomly drawn native residents. Table 4 presents the estimated coefficients and the bootstrapped standard errors together with 95% confidence intervals. The value of the coefficient for explained trust is still significant, but it is smaller than the value in the regression without fixed effects, i.e., M3 in Table 3. This indicates that the effect of explained trust may partly reflect country-level variables other than institutional quality. However, the coefficients for unexplained trust, age, age-squared, married and male are no longer significant. On the one hand, the fact that these coefficients become insignificant may be related to the potential mass-significance problem in the main regression. On the other hand, the effect of these variables may be captured by country fixed effects in our estimation.

The insignificance of unexplained trust seems to contradict the finding in Guiso, Sapienza, and Zingales' (2008) cross-country estimation that trust has a highly significant and positive effect on stock-market participation even though they control for institutional quality. Although based on the same survey question, the variable trust used in Guiso, Sapienza, and Zingales (2008) is aggregated at the country level (extracted from the World Values Survey). Thus, they cannot use country fixed effects to control for all the country characteristics that may be important for trust.

The significance of explained trust and the insignificance of unexplained trust confirm that the part of trust related to institutional quality is relevant to stock-market participation and that the effect of explained trust on stock-market participation cannot be captured by unobserved country-level variables.

[Insert Table 4]

5.4 A further look at institutional quality and stock-market participation

We now connect the results from Tables 2 and 3 in order to study the effect of institutional quality on stock-market participation. In order to show the relation between participation and institutional quality, we use equation (B2) in Appendix B to calculate the predicted probabilities of participation based on the estimates of equations (13) and (15). We show the predicted probability of stock-market participation for individual natives and immigrants in Figures 6 and 7, respectively. Figure 6 presents the predicted probability of participating in the stock market for natives in each country and its relation to institutional quality. We calculate predicted probabilities, as described in equation (B1) in Appendix B, using the results from the estimation of the participation regression (15). In general, the predicted probabilities of participation tend to increase with institutional quality. This trend can easily be spotted by comparing the average predicted probabilities across countries, represented by bold dots in Figure 6.[14] In countries with good institutions, such as Denmark, Sweden and Switzerland, the average predicted probabilities of stock-market participation are high, and the opposite is true for countries with lower institutional qualities, such as Poland, Italy and the Czech Republic. However, it should be noted that predicted probabilities depend not only on institutional quality, but also on all the individual characteristics. This is reflected by the dispersion of the predicted probabilities within countries. As some of the individual

[14] Note that the average predicted probabilities are in line with the actual stock-market participation rates shown in Figure 3, which suggests that the model describes the data well.

characteristics, such as income, may be correlated with institutional quality, the observed trend in Figure 6 may be driven both by cross-country variations in individual characteristics and differences in institutional quality. In order to isolate the effect of institutional quality, we will later on look at a typical individual by fixing individual characteristics at their median values.

Figure 7 illustrates the relation between institutional quality and the predicted probability of participating in the stock market for immigrants. The figure confirms that, also for immigrants, higher institutional quality is associated with higher predicted probabilities. More specifically, the immigrants' predicted probabilities of participation increase both with the institutional quality of the country of residence and that of the country of origin.

[Insert Figure 6 and Figure 7]

To clearly see the estimated functional relation between participation and institutional quality, we calculate the predicted probabilities of participation for a typical immigrant and a typical native (see Table 5 and Figure 8, respectively). We define a typical native (immigrant) as a person with median values on individual characteristics among all natives (immigrants). As seen in the first column of Table 5, the predicted probability is 1.2% for a typical native residing in the country that has the minimum value on the institutional quality of the country of residence (X^{res})—i.e., Poland. The probability is 9% if this person resides in the country that has the median value of X^{res} (Ireland), and 17.3% if he or she resides in the country that has the maximum value of X^{res} (Denmark). This considerable difference in predicted probabilities shows the importance of institutional quality for natives' stock-market participation. In the second column of Table 5, we compute the predicted probability of participation for a typical immigrant, fixing the institutional quality of the country of origin (X^{ori}) at the median value for all countries of origin (0.58, corresponding to the value for Turkey). For this typical immigrant, the predicted probability is 0.9% if he or she immigrates to Poland. The probability will be 3.5% (5.8%) if he or she immigrates to Ireland (Denmark). Figure 8 shows how the predicted probability for a typical immigrant with median values on individual characteristics varies with institutional quality of both country of residence and country of origin. We can clearly see that the predicted probability increases monotonically with institutional quality of both countries. In addition, the figure shows that the probability of a typical immigrant participating increases faster with the institutional quality of the country of residence than with that of the country of origin.

[Insert Table 5 and Figure 8]

Now we want to see how the effect of institutions on immigrants' stock-market participation varies with their educational background. As previously shown, education determines the importance of institutional quality in the country of residence relative to that in the country of origin in the formation of trust (see Table 2 and Figure 4), which in turn affects participation (see Tables 3 and 4). We calculate the marginal effects of institutional quality on the probability of participating in the stock market (see equations (B3)–(B12) in Appendix B). In Figure 9, we show the marginal effect of institutional quality on participation at different levels of education (from no education to 25 years of education).[15] As expected, the impact of the institutional quality of the country of residence increases with education. However, the impact of the institutional quality of the country of origin initially increases with higher education and it decreases after the time spent on education has reached five years. The initial increase can be explained by the fact that education also has a direct effect on participation, which is captured by including it as a control variable.[16] For households with very low education, participation is influenced to a large extent by experiences in the home country. The effect of the institutional quality of the country of residence exceeds that of the home country if the household head has five or more years of education. Furthermore, the institutional quality of the country of origin has only a negligible effect on the participation of the most highly-educated immigrants, which is in line with the notion that adaptation requires much less effort for these immigrants.

[Insert Figure 9]

6 Conclusion

In this paper, we analyze the effects of institutional quality on stock-market participation, both theoretically and empirically. In our theoretical motivation, institutional quality affects trust through learning. We model agents as Bayesian updaters who, from time to time, observe frauds. In the model, higher institutional quality is likely to lead to a higher level of trust, and for a sufficiently high level of trust, agents want to invest in the stock market. Immigrants who emigrate from a country of lower institutional quality tend to exhibit lower levels of trust, which in turn means that they tend to be less prone to participate in the stock market. This

[15] The values of all variables but education are fixed. The values of the binary variables, married and male are fixed at 0, while the values of the others are fixed at their sample means.
[16] In equation (B13), education enters in w_i as well as in $f\left(\alpha' X_i^p\right)$.

effect is more pronounced in immigrants with lower the education, and those from countries with lower the institutional quality.

In accordance with our theoretical motivation, we construct an empirical model to investigate the degree to which stock-market participation is affected by households' level of trust, which in turn is affected by institutional quality. Using European survey data (the SHARE data set), covering more than 30,000 individuals in fourteen European countries, and a measure of institutional quality from the World Bank, we find strong support for our hypotheses: Institutional quality has a significant effect on individuals' level of trust and the part that of trust that is explained by institutional quality significantly affects the probability of stock-market participation. Estimation with country-specific fixed effects confirms that the effect of explained trust on stock-market participation cannot be captured by unobserved country-level variables. However, the impact of the individual variation in trust that is orthogonal to institutional quality becomes insignificant. Furthermore, we find that the responses of trust to institutional quality are not statistically different for natives and immigrants, but immigrants are affected not only by the institutional quality of their country of residence, but also by that of their country of origin. However, on average, the former is more influential than the latter. Education emerges as an important learning factor in immigrants' adaptation to new institutional environments. The more time the immigrants have spent on education, the larger the impact of the institutional quality of the country of residence. This result is in line with the notion that highly educated immigrants need to exert less effort to learn about their new institutional environment.

In general, our study supports the findings in the previous literature regarding the importance of institutional quality and trust for stock-market participation. However, this is the first study to explicitly show that only trust related to institutional quality significantly affects participation, and that educational background plays an important role in the underlying learning process.

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Table 1. Summary statistics

The table shows summary statistics for out variables. Panel A and Panel B present the variables we use in the trust and stock-market participation regressions, respectively. All variables except institutional quality are from the Survey Health, Ageing, and Retirement in Europe. Trust is a self-reported index variable (from 0 to 10); where 0 (10) corresponds to the lowest (highest) level of trust. Institutional quality is the rule-of-law variable collected from the World Bank. Education is the number of years spent on education. Duration is the immigrant's number of years in the country of residence. Participation is a binary variable equal to one if the household owns stocks and zero otherwise. Income is the household's income after tax in the year prior to the survey. Wealth is the household's financial wealth at the time of the survey. Married is a binary variable equal to one if the household head is married or in a registered partnership. Risk aversion is elicited from answers to a question regarding the amount of financial risk that the household head is willing to take (integers from 1 to 4, where 1 corresponds to the lowest level of risk aversion). The sample summarized in Panel A consists of 19,034 native-borns and 1,228 immigrants, whereas the sample summarized in Panel B consists of 7,411 native-borns and 520 immigrants.

Panel A. Sample statistics for the variables included in the trust regression

	Mean	Median	Std. dev.	Minimum	Maximum
Trust	5.61	6.00	2.53	0	10
Inst. qual. residence	1.31	1.45	0.51	0.40	1.95
Inst. qual. origin	0.64	0.58	0.98	-2.32	1.99
Education (immig.)	11.52	12	4.83	0	25
Duration (immig.)	42.04	43	18.48	0	93

Panel B. Sample statistics for the variables included in the participation regression

	Mean	Median	Std. dev.	Minimum	Maximum
Participation	0.14	0	0.35	0	1
Income (in euro)	9,692	1,560	22,460	9	666,255
Wealth (in euro)	191,828	73,290	390,257	0	4,900,000
Education	10.81	11	4.30	0	25
Age	66.81	66	10.41	29	99
Married	0.48	0	0.50	0	1
Male	0.57	1	0.49	0	1
Risk aversion	3.66	4	0.65	1	4

Table 2. The effect of institutional quality on trust

The table shows the results for ordered probit regressions of trust at the individual level on institutional quality at the country level (i.e. the rule-of-law variable from the World Bank). The first column shows the estimates of equation (16), where b_{N} is the response of a native resident's trust level to changes in the institutional quality of the country of residence, and $b_{\mathrm{I}}^{\mathrm{ori}}$ and $b_{\mathrm{I}}^{\mathrm{res}}$ are the responses of an immigrant's trust level to changes in the institutional quality of the country of origin and the country of residence, respectively. The second column shows the estimates for equation (12), where b_{I} is the response of the trust level of an immigrant to the weighted average of institutional quality in the country of residence and institutional quality in the country of origin and w is the weight assigned to country of residence. The third and fourth columns consist of estimates from equation (13), where we use the household head's years of education and duration of stay in the country of residence, respectively, as learning factors. Standard errors are in parentheses. ** and * indicate significance at the 1% and 5% levels, respectively. The estimations are based on observations of 20,262 households.

Dependent var.: Trust	(1) Unrest.	(2) Restr.	(3) Restr. with Edu.	(4) Restr. with Dur.
b_N	0.439**	0.439**	0.438**	0.439**
	(0.014)	(0.014)	(0.014)	(0.014)
b_I		0.372**	0.379**	0.327**
		(0.028)	(0.027)	(0.022)
w		0.787**		
		(0.073)		
b_I^{res}	0.293**			
	(0.026)			
b_I^{ori}	0.079**			
	(0.030)			
γ			0.216*	1.353
			(0.087)	(6.075)
c			5.109*	40.355
			(2.214)	(128.123)

Table 3. Explaining stock-market participation

The table relates stock-market participation to trust. The dependent variable is stock-market participation in all specifications. In specification M1, we use household-specific variables other than trust as explanatory variables. In M2 we add the self-assessed level of trust extracted from the SHARE survey data to the explanatory variables. In M3, we replace the self-assessed level of trust with the explained and unexplained parts of trust calculated according to equation (14). Apart from trust-related variables, we include household income, wealth, years of education, age and age-squared of household head, a dummy for being married (including cohabitation), a male dummy, and level of risk aversion. All the specifications are estimated with logit. The fourth column displays the average marginal effect of the variables across observations in M3. The last column displays the average marginal effect of the explained part and the unexplained part of trust in M3 when these two variables are standardized. Bootstrapped standard errors are in parentheses. ** and * indicate significance at the 1% and 5% levels, respectively.

	M1	M2	M3	Average marginal effect	Average marginal effect (st. variables)
Trust		0.108**			
		(0.017)			
Expl. trust			1.767**	0.157**	0.089**
			(0.118)	(0.010)	(0.006)
Unexpl. trust			0.039*	0.003*	0.009*
			(0.018)	(0.002)	(0.004)
ln(*Income* + 1)	0.215**	0.202**	0.052	0.005	
	(0.029)	(0.029)	(0.032)	(0.003)	
ln(*Wealth* + 1)	0.328**	0.327**	0.331**	0.029**	
	(0.024)	(0.024)	(0.022)	(0.002)	
Education	0.076**	0.070**	0.067**	0.006**	
	(0.009)	(0.010)	(0.010)	(0.001)	
Age	0.226**	0.217**	0.142**	0.013**	
	(0.052)	(0.052)	(0.054)	(0.005)	
Age^2	-0.001**	-0.001**	-0.001**	-9e-05*	
	(0.000)	(0.000)	(0.000)	(3e-05)	
Married	0.131	0.141	0.217**	0.019*	
	(0.090)	(0.090)	(0.096)	(0.008)	
Male	0.121	0.151	0.192*	0.017*	
	(0.093)	(0.093)	(0.099)	(0.009)	
Risk aversion	-0.875**	-0.856**	-0.777**	-0.069**	
	(0.047)	(0.047)	(0.050)	(0.004)	
Pseudo R^2	0.247	0.254	0.302		
Log *L*.	-2,402	-2,381	-2,228		
AIC	4,808	4,778	4,475		
BIC	4,813	4,771	4,466		
N	7,776	7,776	7,776		

Table 4. Fixed-effect model for stock-market participation

The table reports the bootstrapping results for the logit regression of stock-market participation (15) with country-of-residence fixed effects. The number of bootstrapped samples is 999. Each bootstrap sample consists of all 520 immigrants and 520 native residents randomly drawn from the sample summarized in Panel B of Table 1. 95% confidence intervals are calculated from the empirical distribution of the coefficients. ** and * indicate significance at the 1% and 5% levels, respectively.

	Coefficient	Std. error	95% confidence interval	
Expl. trust	0.793*	0.372	0.075	1.525
Unexpl. trust	0.048	0.040	-0.027	0.127
ln(*Income* + 1)	0.030	0.072	-0.112	0.169
ln(*Wealth* + 1)	0.358**	0.039	0.280	0.438
Education	0.049**	0.020	0.009	0.088
Age	0.083	0.122	-0.155	0.311
Age^2	-0.001	0.001	-0.002	0.001
Married	0.106	0.211	-0.317	0.495
Male	0.236	0.218	-0.167	0.682
Risk aversion	-0.890**	0.109	-1.104	-0.669

Table 5. Predicted probabilities of participation for different levels of institutional quality

The table shows the predicted probabilities of participating in the stock market for three levels of institutional quality of country of residence (X^{res}): minimum, median, and maximum. The probabilities are calculated for a typical native in column (1) and for a typical immigrant in column (2). We define a typical native (immigrant) as a person with median values on individual characteristics among all natives (immigrants). When calculating the predicted probability of participation for a typical immigrant, we fix the institutional quality of country of origin (X^{ori}) at its median. The median values on the individual characteristics are reported in the lower part of the table. Countries with corresponding values on institutional quality are given within parentheses.

		(1) Typical native	(2) Typical immigrant X^{ori}= 0.58 (Turkey)
Predicted prob.	Min $X^{\text{res}} =$ 0.40 (Poland)	1.2%	0.9%
	Median $X^{\text{res}} =$ 1.53 (Ireland)	9.0%	3.5%
	Max $X^{\text{res}} =$ 1.95 (Denmark)	17.3%	5.8%
Individual characteristics	*Income*	1,500	1,968
	Wealth	73,231	25,994
	Education	11	12
	Age	66	64
	Married	0	0
	Male	1	1
	Risk aversion	4	4

Figure 1. Institutional quality of the countries in the sample

The figure shows the institutional quality of the countries in the sample and for each country, it also shows the average institutional quality of its immigrants' countries of origin.

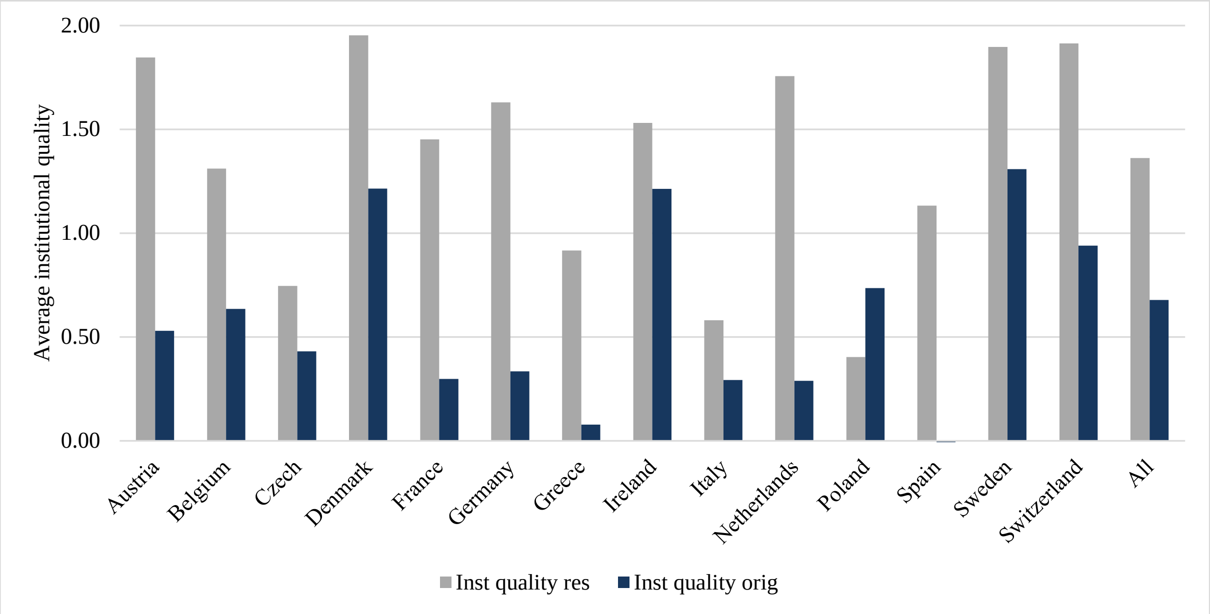


Figure 2. Average value of the trust variable

The figure shows the average values of the individual self-assessed level of trust for different countries. The trust variable ranges between zero and ten, where zero corresponds to the lowest level of trust. The averages are calculated separately for natives and immigrants in each country. The last two bars show the average values for all countries.

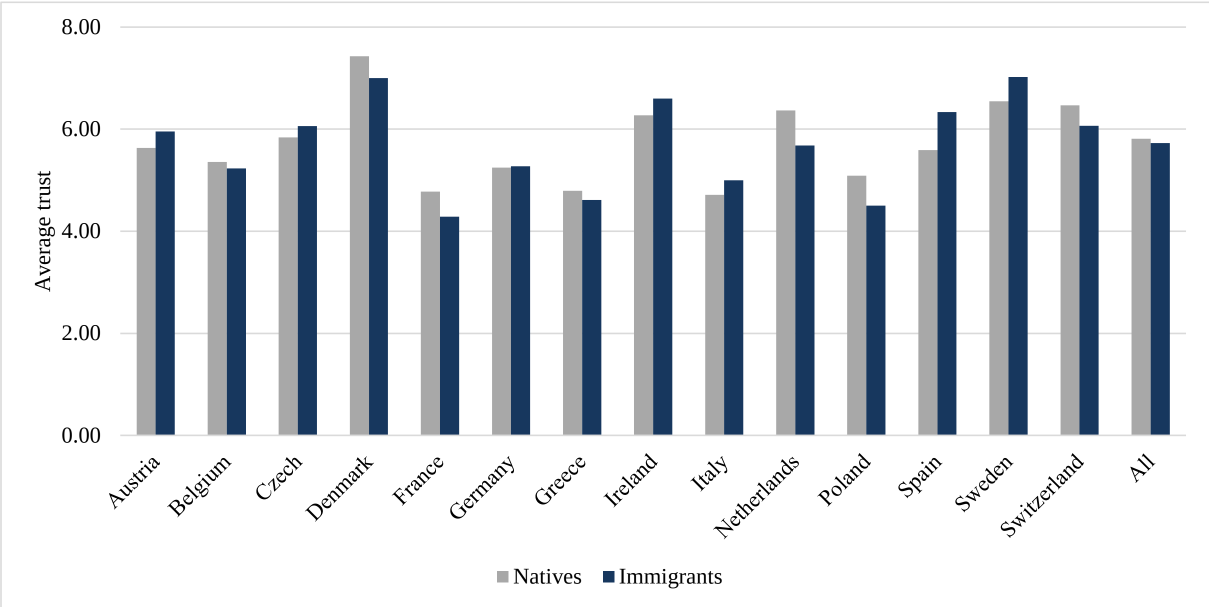


Figure 3. Actual rate of stock-market participation in the sample

The figure shows the average rate of stock-market participation across countries. The averages are calculated separately for natives and immigrants in each country. The last two bars show the average values over all the countries.

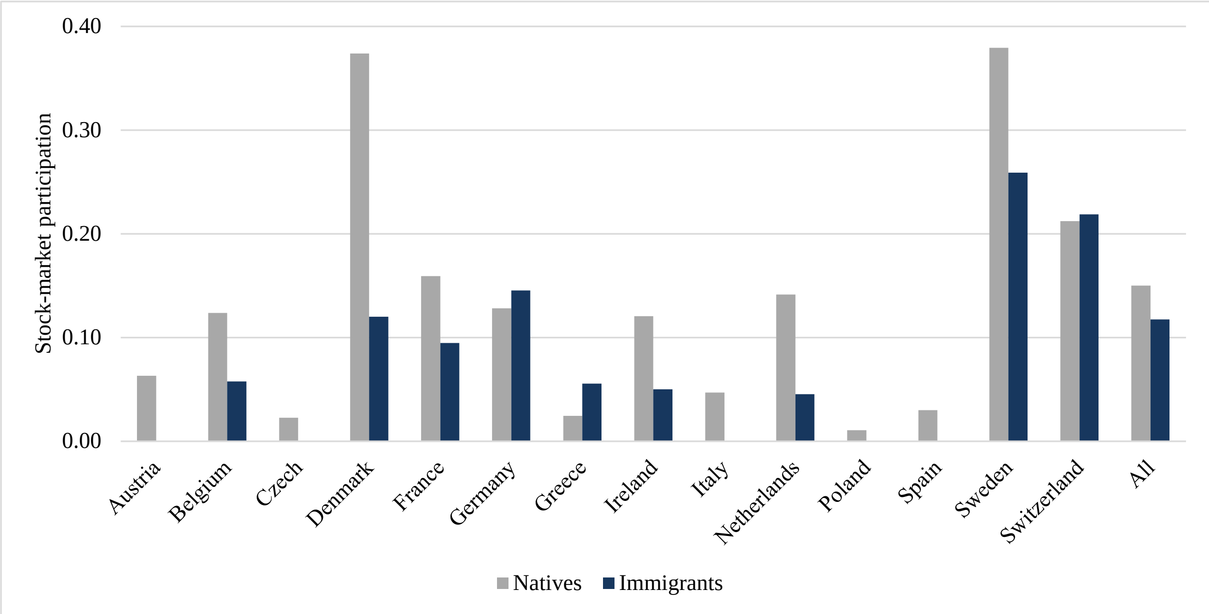


Figure 4. The relative importance of institutional quality of country of residence for immigrants' level of trust

The figure shows the importance (weight) of institutional quality of country of residence for immigrants' level of trust, relative to that of institutional quality of country of origin, at different levels of education. The relative importance (weight) of institutional quality of country of residence is calculated as a function of education in equation (13), for which estimated coefficients are reported in Table 2.

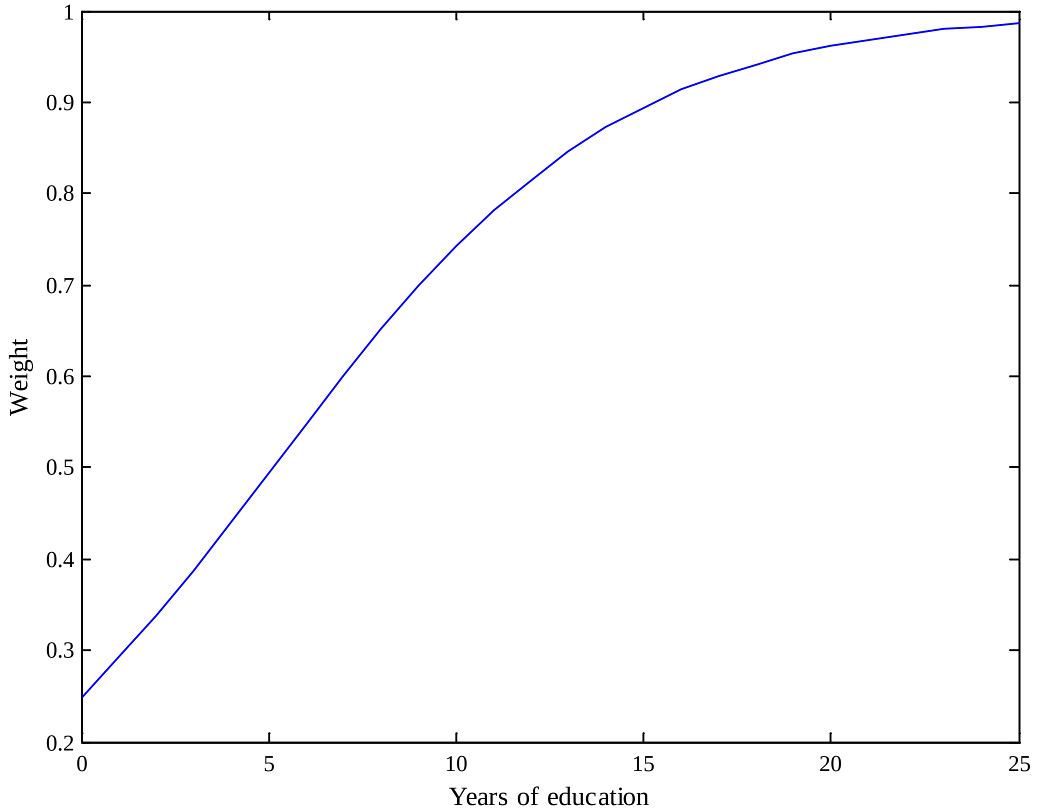


Figure 5. Distribution of immigrants' duration of stay in their country of residence

The figure shows the histogram and cumulative distribution of immigrants' duration of stay in their country of residence. The histogram is constructed using three year intervals. The number of observations is 1,228.

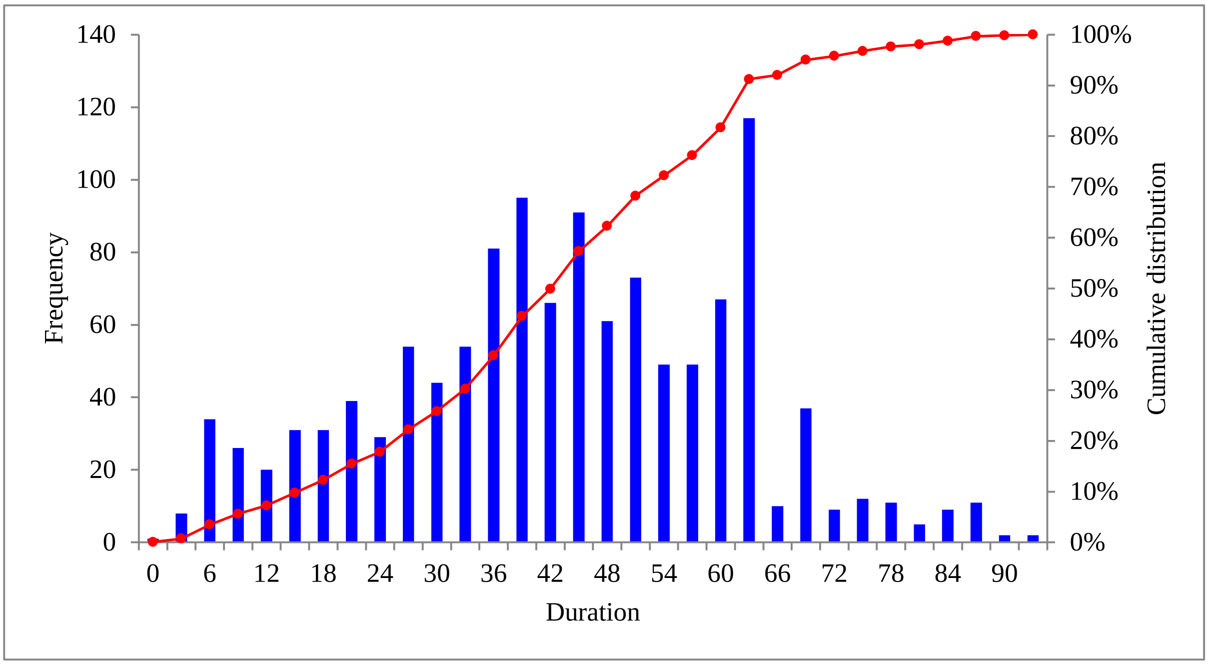


Figure 6. The predicted probabilities of participating in the stock market for natives in 14 European countries

This figure presents the predicted probability of participating in the stock market for natives in each country and its relation to institutional quality. We calculate predicted probabilities, as described in equation (B1) in Appendix B, using the results from the estimation of the stock-market participation equation (15). For each country, the average value of predicted probabilities is represented by a bold red dot.

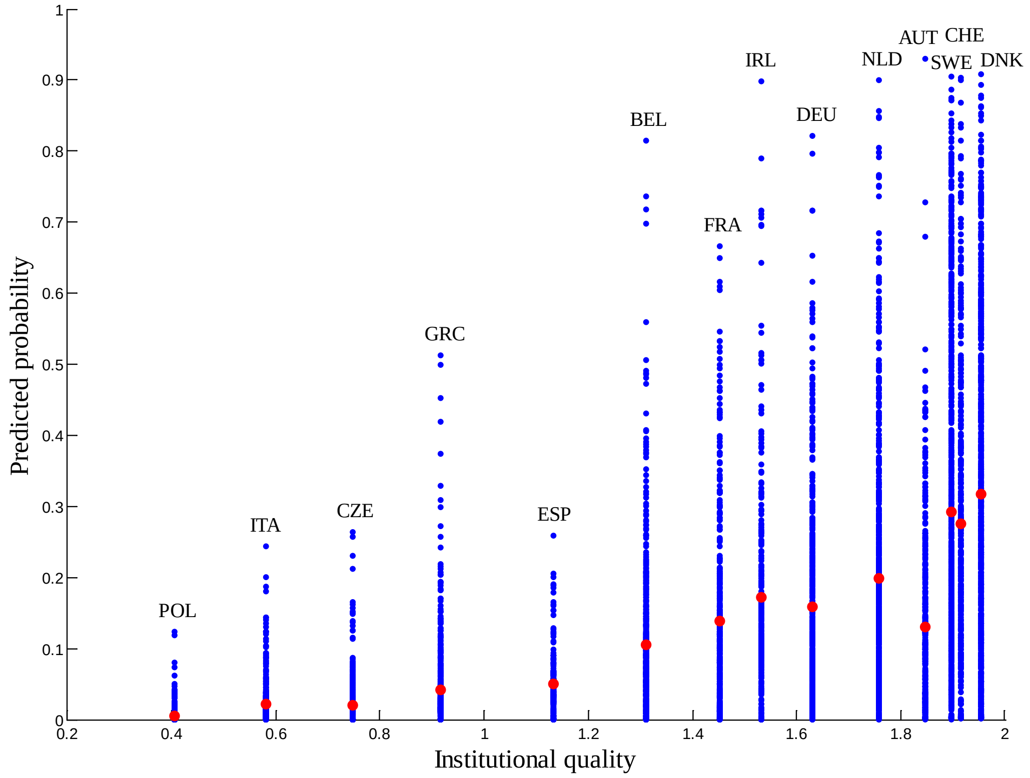


Figure 7. Each immigrant's predicted probability of participating in the stock market

This figure presents the predicted probability of participating in the stock market for each immigrant in the sample and its relation to the institutional quality in the countries of residence and origin. We calculate predicted probabilities, as described in equation (B1) in Appendix B, using the results from the estimation of the stock-market participation equation (15).

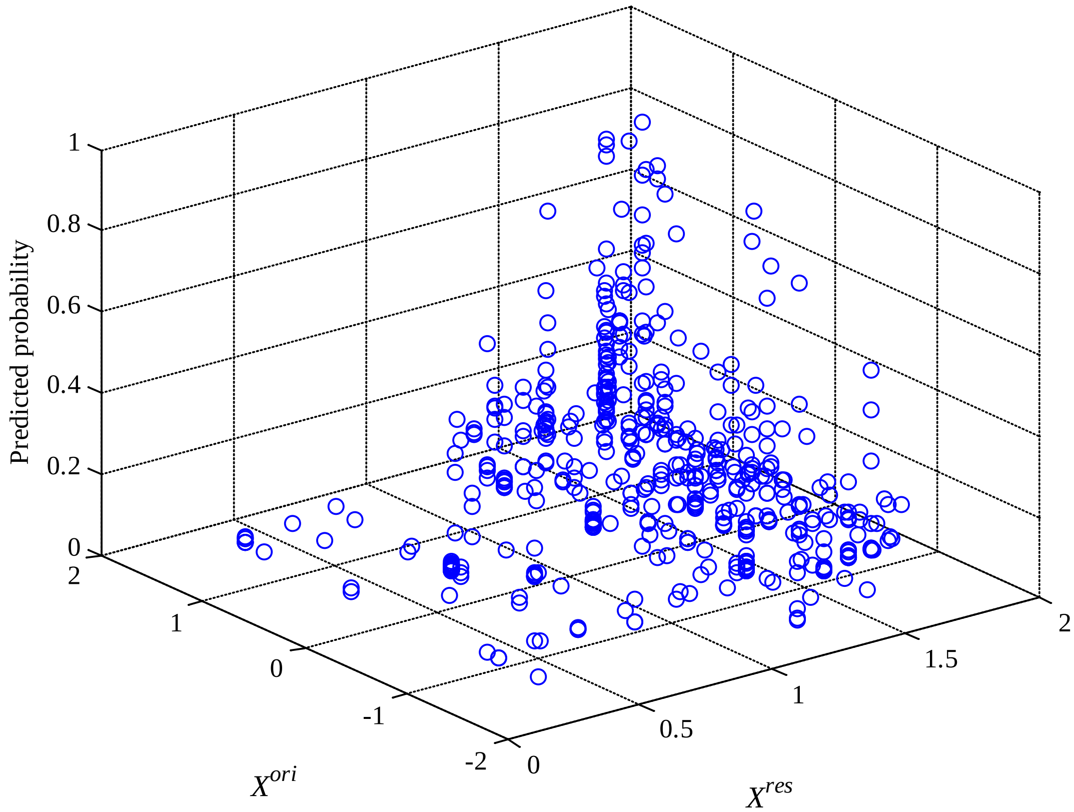


Figure 8. The predicted probability of an immigrant participating in the stock market

This figure shows the predicted probability of an immigrant participating in the stock market as a function of institutional quality in the countries of origin and residence. We calculate predicted probabilities, as described in equation (B1) in Appendix B, using the results from the estimation of the stock-market participation equation (15).

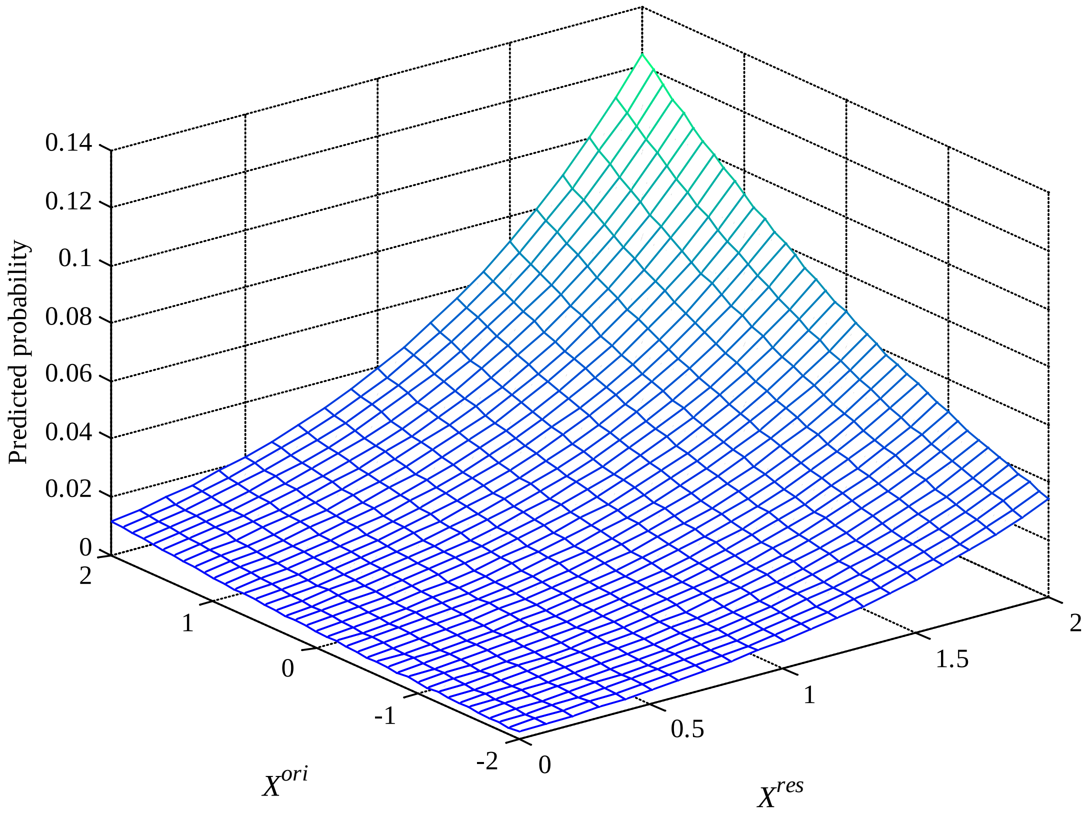
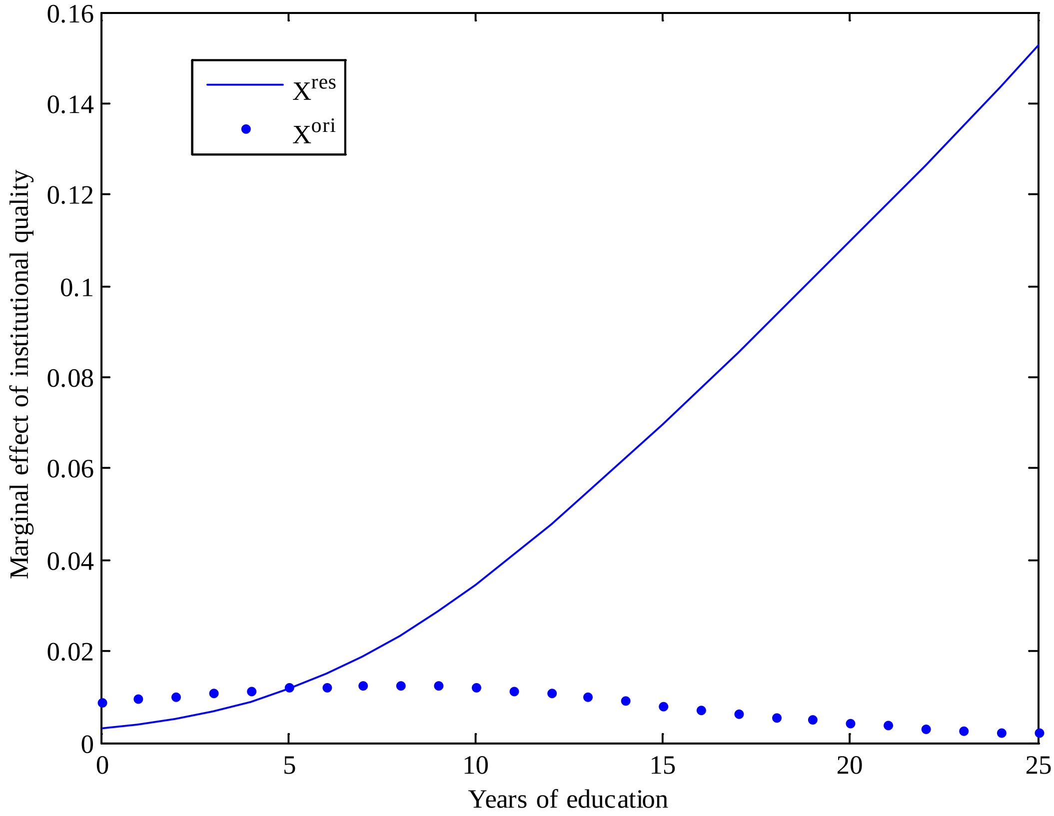


Figure 9. Marginal effect of institutional quality on immigrants' stock-market participation

The figure shows the marginal effects of institutional quality in country of origin and country of residence on immigrants' stock-market participation for different levels of education. All variables are fixed at their sample medians except for the variable years of education, whose value we vary from 0 to 25.



Appendix A

A.1 Condition for log utility investors' stock-market participation

At date $t = T - 1$ (where T is the final date), the agents' problem looks as follows (for ease of exposition, we suppress individual-specific indices):

$$\max_{\alpha_{T-1}\geq 0} \text{Prob}\big(\tilde{R}_T = \varepsilon \big| D_{T-1}\big) E_{T-1}\big[\ln \widetilde{W}_T \big| \tilde{R}_T = \varepsilon\big]$$

$$+ \Big(1 - \text{Prob}\big(\tilde{R}_T = \varepsilon \big| D_{T-1}\big)\Big) E_{T-1}\big[\ln \widetilde{W}_T \big| \tilde{R}_T > \varepsilon\big] \qquad \text{(A1)}$$

$$\text{s.t. } \widetilde{W}_T = W_{T-1}\big[R_f + \alpha_{T-1}\big(\tilde{R}_T - R_f\big)\big].$$

Inserting the wealth constraint into the objective function, we find that solving the above maximization problem is equivalent to finding a nonnegative α_{T-1} that maximizes the function

$$f_{T-1}(\alpha_{T-1}) = \text{Prob}\big(\tilde{R}_T = \varepsilon \big| D_{T-1}\big) \ln\Big(R_f + \alpha_{T-1}\big(\varepsilon - R_f\big)\Big)$$

$$+ \Big(1 - \text{Prob}\big(\tilde{R}_T = \varepsilon \big| D_{T-1}\big)\Big) E_{T-1}\Big[\ln\Big(R_f + \alpha_{T-1}\big(\tilde{R}_T^{+} - R_f\big)\Big)\Big]. \qquad \text{(A2)}$$

We note that this function is strictly concave in α_{T-1}. Therefore, the agent will participate in the stock market ($\alpha_{T-1} > 0$) if and only if $f_{T-1}{}'(0) > 0$, or, equivalently, if and only if

$$\xi_{T-1} \equiv \frac{E_{T-1}\big[\tilde{R}_T^{+} - R_f\big]}{R_f - \varepsilon} > \frac{\text{Prob}\big(\tilde{R}_T = \varepsilon \big| D_{T-1}\big)}{1 - \text{Prob}\big(\tilde{R}_T = \varepsilon \big| D_{T-1}\big)}. \qquad \text{(A3)}$$

We call $\xi_t \equiv E_t\big[\tilde{R}_{t+1}^{+} - R_f\big]/(R_f - \varepsilon)$ the stock's *normalized conditional risk premium* at time t. By assumption, this is a strictly positive quantity. The interpretation of the condition in (4) is straightforward: In order for the agents to participate in the stock market, the total expected return on the stock needs to be greater than the risk-free rate. Alternatively, we can say that the conditional expected return in the absence of fraud needs to be sufficiently large, or, the probability of fraud needs to be sufficiently small.

The problem clearly has a recursive structure. As we solve the maximization problem working backwards period-by-period until we reach time 0, the problem looks as follows at date $t = T\text{-}q$.

$$\max_{\alpha_{T-q}\geq 0} \text{Prob}\big(\tilde{R}_{T-q+1} = \varepsilon \big| D_{T-q}\big) E_{T-q}\big[\ln \widetilde{W}_T \big| \tilde{R}_{T-q+1} = \varepsilon\big]$$

$$+\left(1-\text{Prob}\left(\tilde{R}_{T-q+1}=\ \varepsilon\middle|D_{T-q}\right)\right)E_{T-q}\left[\ln\widetilde{W}_T\middle|\tilde{R}_{T-q+1}>\ \varepsilon\right]$$

$$\text{s.t. } \widetilde{W}_T=W_{T-q-1}\left[R_f+\alpha_{T-q}\left(\tilde{R}_{T-q+1}-R_f\right)\right]\prod_{i=1}^{i=q-1}\left[R_f+\alpha_{T-i}^{*}\left(\tilde{R}_{T-i+1}-R_f\right)\right], \quad \text{(A4)}$$

where α_{T-i}^{*} are the optimal solutions from the previously solved problems.

Due to the additivity of the logarithmic function, solving the above maximization problem is equivalent to finding a nonnegative α_{T-q} which maximizes the function

$$f_{T-q}\left(\alpha_{T-q}\right)=\text{Prob}\left(\tilde{R}_{T-q+1}=\ \varepsilon\middle|D_{T-q}\right)\ln\left(R_f+\alpha_{T-q}\left(\varepsilon-R_f\right)\right)$$

$$+\left(1-\text{Prob}\left(\tilde{R}_{T-q+1}=\ \varepsilon\middle|D_{T-q}\right)\right)E_{T-q}\left[\ln\left(R_f+\alpha_{T-1}\left(\tilde{R}_{T-q+1}^{+}-R_f\right)\right)\right] \quad \text{(A5)}$$

Repeating the arguments above, the agent will participate in the stock market if and only if

$$\xi_{T-q}\equiv\frac{E_{T-q}\left[\tilde{R}_{T-q+1}^{+}-R_f\right]}{R_f-\varepsilon}>\frac{\text{Prob}\left(\tilde{R}_{T-q+1}=\ \varepsilon\middle|D_{T-q}\right)}{1-\text{Prob}\left(\tilde{R}_{T-q+1}=\ \varepsilon\middle|D_{T-q}\right)}, q=1,2,\dots,T, \quad \text{(A6)}$$

meaning that, for time $t = 1, 2, \dots, T - 1$, the condition is as stated in equation (2).

A.2 Condition for myopic investors' stock-market participation

Here, we study the investment problem of a myopic investor and we show that the condition in (8) also applies to any *myopic* investor with strictly increasing, strictly concave and twice-continuously differentiable elementary utility function u satisfying $\lim_{W\to 0}u'(W)=+\infty$. Consider such an investor's objective function at time t (where we have inserted the wealth constraints and used notation consistent with the one in the main text):

$$g_t(\alpha_t)\equiv\text{Prob}\left(\tilde{R}_{t+1}=\ \varepsilon\middle|D_t\right)u\left(W_t\left(R_f+\alpha_t\left(\varepsilon-R_f\right)\right)\right)$$

$$+\left(1-\text{Prob}\left(\tilde{R}_{t+1}=\ \varepsilon\middle|D_t\right)\right)E_t\left[u\left(W_t\left(R_f+\alpha_t\left(\tilde{R}_{t+1}^{+}-R_f\right)\right)\right)\right]. \quad \text{(A7)}$$

The investor also faces a no-short-selling constraint, $\alpha_t\geq 0$.

The first- and second-order derivatives with respect to α_t are given by

$$g_t{}'(\alpha_t)=\text{Prob}\left(\tilde{R}_{t+1}=\ \varepsilon\middle|D_t\right)u'\left(W_t\left(R_f+\alpha_t\left(\varepsilon-R_f\right)\right)\right)W_t\left(\varepsilon-R_f\right)$$

$$+\left(1-\text{Prob}\left(\tilde{R}_{t+1}=\ \varepsilon\middle|D_t\right)\right)E_t\left[u'\left(W_t\left(R_f+\alpha_t\left(\tilde{R}_{t+1}^{+}-R_f\right)\right)\right)W_t\left(\tilde{R}_{t+1}^{+}-R_f\right)\right], \quad \text{(A8)}$$

$$g_t''(\alpha_t) = \text{Prob}\big(\tilde{R}_{t+1} = \varepsilon \big| D_t\big) u''\Big(W_t\Big(R_f + \alpha_t\big(\varepsilon - R_f\big)\Big)\Big) W_t^2\big(\varepsilon - R_f\big)^2$$

$$+\Big(1 - \text{Prob}\big(\tilde{R}_{t+1} = \varepsilon \big| D_t\big)\Big) E_t\Big[u''\Big(W_t\Big(R_f + \alpha_t\big(\tilde{R}_{t+1}^{+} - R_f\big)\Big)\Big) W_t^2\big(\tilde{R}_{t+1}^{+} - R_f\big)^2\Big].$$

Since u is strictly concave, $g_t''(\alpha_t) < 0$ for all α_t, i.e., g_t is strictly concave in α_t. Therefore, the investor will participate in the stock market ($\alpha_t^* > 0$) if and only if $g_t'(0) > 0$, i.e., if and only if

$$\text{Prob}\big(\tilde{R}_{t+1} = \varepsilon \big| D_t\big) u'\big(W_t R_f\big) W_t\big(\varepsilon - R_f\big)$$

$$+\Big(1 - \text{Prob}\big(\tilde{R}_{t+1} = \varepsilon \big| D_t\big)\Big) u'\big(W_t R_f\big) W_t E_t\big[\tilde{R}_{t+1}^{+} - R_f\big] > 0. \qquad \text{(A9)}$$

The above condition is equivalent to the one in (8).

A.3 Proof of Lemma 1

By inverting the requirement for stock-market participation in (11), we get

$$\theta_0 < \frac{p_l^k(1-p_l)^{t-k}[(1-p_l)\xi_t - p_l]}{p_l^k(1-p_l)^{t-k}[(1-p_l)\xi_t - p_l] + p_h^k(1-p_h)^{t-k}[p_h - (1-p_h)\xi_t]}. \qquad \text{(A10)}$$

Dividing both the numerator and the denominator by $p_l^k(1-p_l)^{t-k}$, we get

$$\theta_0 < \frac{(1-p_l)\xi_t - p_l}{[(1-p_l)\xi_t - p_l] + \left(\frac{p_h(1-p_l)}{p_l(1-p_h)}\right)^k \left(\frac{1-p_h}{1-p_l}\right)^t [p_h - (1-p_h)\xi_t]}. \qquad \text{(A11)}$$

We note that denominator in the right-hand side limit is increasing in *k*, meaning that the limit is decreasing in *k*, which in turn implies that the θ_0 required for stock-market participation is decreasing in the number of observed frauds (*k*).

A.4 Proof of Lemma 2

We can rewrite equation (10) as

$$\text{Prob}\big(\tilde{R}_{t+1} = \varepsilon \big| D_t = k\big) = \frac{ap_h + bp_l f(k)}{a + bf(k)}, \qquad \text{(A12)}$$

where $a = \theta_0(1-p_h)^t$, $b = (1-\theta_0)(1-p_l)^t$, and

$$f(k) = \left(\frac{p_l(1-p_h)}{(1-p_l)p_h}\right)^k. \qquad \text{(A13)}$$

Since $p_h > p_l$, we have that $f'(k) < 0$. Now, consider how the probability in (19) changes as we increase the number of observed frauds:

$$\frac{\partial \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t = k\right)}{\partial k} = \frac{ba(p_l - p_h)}{(a + bf(k))^2} f'(k) > 0 \tag{A14}$$

A.5 Proof of Lemma 3

Here, we make use of the law of total differentiation, holding $\text{Prob}^{\text{I}}\left(\tilde{R}_{t+1} = \varepsilon | D_t^L, D_t^H\right)$ constant:

$$0 = \text{dProb}^I\left(\tilde{R}_{t+1} = \varepsilon | D_t^L, D_t^H\right) =$$

$$w'(\Lambda)\left(\text{Prob}\left(\tilde{R}_{t+1} = \varepsilon | D_t^H\right) - \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon | D_t^L\right)\right) \text{d}\Lambda$$

$$+\left(w(\Lambda)\frac{\partial \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t^H\right)}{\partial \theta_0} + (1 - w(\Lambda))\frac{\partial \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t^L\right)}{\partial \theta_0}\right) \text{d}\theta_0. \tag{A15}$$

Hence, we have

$$\frac{\text{d}\theta_0}{\text{d}\Lambda} = -\frac{w'(\Lambda)\left(\text{Prob}\left(\tilde{R}_{t+1} = \varepsilon | D_t^H\right) - \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon | D_t^L\right)\right)}{w(\Lambda)\frac{\partial \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon | D_t^H\right)}{\partial \theta_0} + \left(1 - w(\Lambda)\right)\frac{\partial \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon | D_t^L\right)}{\partial \theta_0}} > 0, \tag{A16}$$

$$\Lambda \in [0, \Lambda_{\text{max}}),$$

where the inequality is due to $w'(\Lambda) > 0$, $\frac{\partial \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t^j\right)}{\partial \theta_0} > 0$ $(j = H, L)$ and, by Lemma 2, $\text{Prob}\left(\tilde{R}_{t+1} = \varepsilon | D_t^H\right) < \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon | D_t^L\right)$ because $D_t^H < D_t^L$.

A.6 Participation costs

In line with Guiso, Sapienza, and Zingales (2008), we now introduce a fixed cost of participation in the stock market, *f*. That is, wealth is decreased by *f* if the investor invests in the stock market. This induces wealth effects which interact with trust. Guiso, Sapienza, and Zingales (2008) show that a small probability of fraud substantially increases the level of wealth required for stock-market participation. Unless stated otherwise, we assume that $\xi_t > \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t\right) / \left(1 - \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t\right)\right)$, so that the investor would participate in the stock market in the absence of participation costs (see equation (2) in Section 2 and also Appendix A.1). Defining the certainty-equivalent stock return $\hat{R}_t$ implicitly through

$$\text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t\right) u\left((W_t - f)\left(R_f + \alpha_t^*\left(\varepsilon - R_f\right)\right)\right)$$

$$+\left(1 - \text{Prob}\left(\tilde{R}_{t+1} = \varepsilon \middle| D_t\right)\right) E_t\left[u\left((W_t - f)\left(R_f + \alpha_t^*\left(\tilde{R}_{t+1}^+ - R_f\right)\right)\right)\right] =$$

$$u\left((W_t - f)\left(R_f + \alpha_t^*(\hat{R}_t - R_f)\right)\right), \tag{A17}$$

where α_t^* is the optimal fraction of wealth allocated to the stock in the absence of participation costs if wealth is $(W_t - f)$, we can express the threshold level of wealth in terms of this quantity, as shown in the following proposition. Because of the assumption that $\xi_t > Prob(\tilde{R}_{t+1} = \varepsilon | D_t)/\left(1 - Prob(\tilde{R}_{t+1} = \varepsilon | D_t)\right)$, α_t^* is strictly positive.

Proposition 1: There exists a threshold level of wealth above which the investor will participate in the stock market. This threshold level of wealth is given by

$$\bar{W}_t = f \frac{R_f + \alpha_t^*(\hat{R}_t - R_f)}{\alpha_t^*(\hat{R}_t - R_f)}, \tag{A18}$$

where $\hat{R}_t$ is defined implicitly through equation (A4).

Proof: At the threshold value of wealth, we have that

$$\begin{aligned} &\text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t) u\left((\bar{W}_t - f)\left(R_f + \alpha_t^*(\varepsilon - R_f)\right)\right) \\ &+ \left(1 - \text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t)\right) E_t\left[u\left((\bar{W}_t - f)\left(R_f + \alpha_t^*(\tilde{R}_{t+1}^+ - R_f)\right)\right)\right] = u(\bar{W}_t R_f), \end{aligned} \tag{A19}$$

and thus,

$$u\left((\bar{W}_t - f)\left(R_f + \alpha_t^*(\hat{R}_t - R_f)\right)\right) = u(\bar{W}_t R_f). \tag{A20}$$

The result then follows from the strict monotonicity of u.

The above proposition shows that participation costs induce wealth effects and we determine the threshold level of wealth required for stock-market participation. More interestingly, as we show in the following proposition, the learning mechanism interacts with the participation costs in such a way that having a nonzero prior probability of fraud increases the wealth required for stock-market participation.

Proposition 2: The higher the prior probability of fraud, the more wealth required for stock-market participation.

Proof: Suppose that $\bar{\bar{\theta}}_0 > \bar{\theta}_0$ and suppose also that $\bar{W}_t$ is the threshold value of wealth corresponding to the lower prior ($\bar{\theta}_0$), meaning that

$$\begin{aligned} &\text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t;\, \bar{\theta}_0) u\left((\bar{W}_t - f)\left(R_f + \alpha_t^*(\varepsilon - R_f)\right)\right) \\ &+ \left(1 - \text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t; \bar{\theta}_0)\right) E_t\left[u\left((\bar{W}_t - f)\left(R_f + \alpha_t^*(\tilde{R}_{t+1}^+ - R_f)\right)\right)\right] = u(\bar{W}_t R_f). \end{aligned} \tag{A21}$$

With a higher prior probability of fraud, the expected utility that can, ceteris paribus, be achieved in the absence of participation costs when wealth is $(W_t - f)$ must be lower:

$$\text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t;\ \bar{\bar{\theta}}_0) u\left((\bar{W}_t - f)\left(R_f + \alpha_t^{**}(\varepsilon - R_f)\right)\right)$$
$$+ \left(1 - \text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t; \bar{\bar{\theta}}_0)\right) E_t\left[u\left((\bar{W}_t - f)\left(R_f + \alpha_t^{**}(\tilde{R}_{t+1}^{+} - R_f)\right)\right)\right] <$$
$$\text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t;\ \bar{\theta}_0) u\left((\bar{W}_t - f)\left(R_f + \alpha_t^{*}(\varepsilon - R_f)\right)\right)$$
$$+ \left(1 - \text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t; \bar{\theta}_0)\right) E_t\left[u\left((\bar{W}_t - f)\left(R_f + \alpha_t^{*}(\tilde{R}_{t+1}^{+} - R_f)\right)\right)\right] = u(\bar{W}_t R_f). \quad \text{(A22)}$$

Therefore, by Proposition 1, the threshold value of wealth corresponding to the prior $\bar{\bar{\theta}}_0$ must be higher than $\bar{W}_t$. That is, $\bar{\bar{W}}_t > \bar{W}_t$.

Conversely, adding participation costs to our learning model lowers the value of the prior that triggers nonparticipation, as shown in the proposition below.

Proposition 3: Adding a participation cost lowers the threshold value of the prior probability of fraud that triggers nonparticipation.

Proof: Suppose that $\hat{\theta}_0$ triggers participation in the absence of participation costs. That is,

$$\text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t;\ \hat{\theta}_0) u\left(W_t\left(R_f + \alpha_t^{*}(\varepsilon - R_f)\right)\right)$$
$$+ \left(1 - \text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t;\ \hat{\theta}_0)\right) E_t\left[u\left(W_t\left(R_f + \alpha_t^{*}(\tilde{R}_{t+1}^{+} - R_f)\right)\right)\right] = u(W_t R_f). \quad \text{(A23)}$$

With the same prior $\hat{\theta}_0$, the expected utility achieved in the absence of participation costs when wealth is $(W_t - f)$ must be lower:

$$Prob(\tilde{R}_{t+1} = \varepsilon | D_t;\ \hat{\theta}_0) u\left((W_t - f)\left(R_f + \alpha_t^{**}(\varepsilon - R_f)\right)\right)$$
$$+ \left(1 - Prob(\tilde{R}_{t+1} = \varepsilon | D_t;\ \hat{\theta}_0)\right) E_t\left[u\left((W_t - f)\left(R_f + \alpha_t^{**}(\tilde{R}_{t+1}^{+} - R_f)\right)\right)\right] <$$
$$Prob(\tilde{R}_{t+1} = \varepsilon | D_t;\ \hat{\theta}_0) u\left(W_t\left(R_f + \alpha_t^{*}(\varepsilon - R_f)\right)\right)$$
$$+ \left(1 - Prob(\tilde{R}_{t+1} = \varepsilon | D_t;\ \hat{\theta}_0)\right) E_t\left[u\left(W_t\left(R_f + \alpha_t^{*}(\tilde{R}_{t+1}^{+} - R_f)\right)\right)\right] = u(W_t R_f). \quad \text{(A24)}$$

Now, the expected utility that can be achieved is decreasing in the posterior probability of fraud, $\text{Prob}(\tilde{R}_{t+1} = \varepsilon | D_t;\ \theta_0)$, and the posterior probability of fraud is, in turn, increasing in the prior probability of fraud, θ_0, meaning that, in the case when there are participation costs, the prior probability that triggers participation must be lower than $\hat{\theta}_0$.

Appendix B: Predicted probabilities and marginal effects for the two-step estimation

We use an ordered probit model to estimate (13) by assuming the censoring mechanism,

$$T_i = j \text{ if } \mu_{j-1} < T_i^* \leq \mu_j ,$$

where j = 0, 1, 2, …, 10, since in SHARE, the variable trust, T, is an ordinal variable that goes from zero (low trust) to ten (high trust). The predicted probabilities of different levels of trust are obtained as

$$\text{Prob}[T_i = j|\boldsymbol{X}_i^T] = \text{Prob}\left[\varepsilon_i \leq \mu_j - \text{func}(\boldsymbol{X}_i^T)\right] - Prob\left[\varepsilon_i \leq \mu_{j-1} - \text{func}(\boldsymbol{X}_i^T)\right]$$

$$= F\left(\mu_j - \text{func}(\boldsymbol{X}_i^T)\right) - F\left(\mu_{j-1} - \text{func}(\boldsymbol{X}_i^T)\right), \text{ for } j = 1, 2, \ldots 10, \tag{B1}$$

where $\mu_{-1} = -\infty, \mu_{10} = +\infty$, $\boldsymbol{X}_i^T$ is the vector of all the explanatory variables for individual i in equation (13) and func(·) is the function from institutional quality to trust specified in equation (13).

The predicted probability that individual i participates in the stock market is obtained from the logit model in equation (15):

$$\text{Prob}\left[y_i = 1|\boldsymbol{X}_i^p\right] = 1 - F\left(-\boldsymbol{\alpha}'\boldsymbol{X}_i^p\right), \tag{B2}$$

where $\boldsymbol{X}_i^P$ is the vector of all the explanatory variables for individual i in equation (15) and $\boldsymbol{\alpha}$ is the corresponding vector of parameters.

We compute the following marginal effects for the variables of the model in equation (13)**.**

a) Marginal effect of a change in institutional quality of the country of residence for natives ($D_{N,i} = 1$) on stock-market participation:

$$\frac{\partial\text{Prob}\left[y_i = 1|\boldsymbol{X}_i^p\right]}{\partial X_i^{\text{res}}} = \frac{\partial\text{Prob}\left[y_i = 1|\boldsymbol{X}_i^p\right]}{\partial T_i^{\text{expl}}} \cdot \frac{\partial T_i^{\text{expl}}}{\partial X_i^{\text{res}}}. \tag{B3}$$

The first term on the right-hand side is given by

$$\frac{\partial\text{Prob}\left[y_i = 1|\boldsymbol{X}_i^p\right]}{\partial T_i^{\text{expl}}} = a_1 f\left(\boldsymbol{\alpha}'\boldsymbol{X}_i^p\right), \tag{B4}$$

and, according to the definition of T_i^{expl} in equation (14), the second term is given by

$$\frac{\partial T_i^{\text{expl}}}{\partial X_i^{\text{res}}} = \frac{\partial \sum_{j=1}^{J} \text{Prob}[T_i = j|\boldsymbol{X}_i^T].j}{\partial X_i^{\text{res}}}$$

$$= \sum_{j=1}^{J} \left(\frac{\partial F\left(\mu_j - \text{func}(\boldsymbol{X}_i^T)\right)}{\partial X_i^{\text{res}}} - \frac{\partial F\left(\mu_{j-1} - \text{func}(\boldsymbol{X}_i^T)\right)}{\partial X_i^{\text{res}}} \right) j. \quad \text{(B5)}$$

For natives, the above expression is equal to

$$\frac{\partial T_i^{\text{expl}}}{\partial X_i^{\text{res}}} = -b_N \sum_{j=1}^{J} \Big(f\big(\mu_j - \text{func}(\boldsymbol{X}_i^T)\big) - f\big(\mu_{j-1} - \text{func}(\boldsymbol{X}_i^T)\big)\Big) j. \quad \text{(B6)}$$

Thus, we have that

$$\frac{\partial \text{Prob}\big[y_i = 1|\boldsymbol{X}_i^p\big]}{\partial X_i^{\text{res}}} = -b_N H_i a_1 f\big(\boldsymbol{\alpha}'\boldsymbol{X}_i^p\big), \quad \text{(B7)}$$

where

$$H_i = \sum_{j=1}^{J} \Big(f\big(\mu_j - \text{func}(\boldsymbol{X}_i^T)\big) - f\big(\mu_{j-1} - \text{func}(\boldsymbol{X}_i^T)\big)\Big) j.$$

b) Marginal effect of a change in institutional quality of the country of residence for immigrants ($D_{I,i} = 1$):

$$\frac{\partial \text{Prob}\big[y_i = 1|\boldsymbol{X}_i^p\big]}{\partial X_i^{\text{res}}} = \frac{\partial \text{Prob}\big[y_i = 1|\boldsymbol{X}_i^p\big]}{\partial T_i^{\text{expl}}} . \frac{\partial T_i^{\text{expl}}}{\partial X_i^{\text{res}}}. \quad \text{(B8)}$$

The first term is given by equation (B4) and the second term can be obtained from equation (B5) for immigrants as

$$\frac{\partial T_i^{\text{expl}}}{\partial X_i^{\text{res}}} = -b_I \omega \sum_{j=1}^{J} \Big(f\big(\mu_j - \text{func}(\boldsymbol{X}_i^T)\big) - f\big(\mu_{j-1} - \text{func}(\boldsymbol{X}_i^T)\big)\Big) . j$$

$$= -b_I \omega H_i. \quad \text{(B9)}$$

Thus, we have that

$$\frac{\partial \text{Prob}\big[y_i = 1|\boldsymbol{X}_i^p\big]}{\partial X_i^{\text{res}}} = -b_I w_i H_i a_1 f\big(\boldsymbol{\alpha}'\boldsymbol{X}_i^p\big). \quad \text{(B10)}$$

c) Marginal effect of a change in institutional quality of the country of origin for immigrants ($D_{I,i} = 1$):

$$\frac{\partial \text{Prob}\left[y_i = 1|\boldsymbol{X}_i^p\right]}{\partial X_i^{\text{org}}} = \frac{\partial \text{Prob}\left[y_i = 1|\boldsymbol{X}_i^p\right]}{\partial T_i^{\text{expl}}} . \frac{\partial T_i^{\text{expl}}}{\partial X_i^{\text{org}}}. \tag{B11}$$

The first term is given by equation (B4) and the second term can be written as

$$\frac{\partial T_i^{\text{expl}}}{\partial X_i^{\text{org}}} = -b_I(1-\omega)\sum_{j=1}^{J}\Big(f\big(\mu_j - \text{func}(\boldsymbol{X}_i^T)\big) - f\big(\mu_{j-1} - \text{func}(\boldsymbol{X}_i^T)\big)\Big).j. \tag{B12}$$

Thus, we have that

$$\frac{\partial \text{Prob}\left[y_i = 1|\boldsymbol{X}_i^p\right]}{\partial X_i^{\text{org}}} = -b_I(1-w_i)H_i a_1 f\big(\boldsymbol{\alpha}'\boldsymbol{X}_i^p\big). \tag{B13}$$