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Are Economists More Likely to Hold Stocks?

Abstract: A unique data set enables us to test the hypothesis that due to informational advantages economists are more likely to hold stocks than otherwise identical investors. We confirm that economists have a significantly higher probability of participating in the stock market than investors with any other education, even when controlling for several background characteristics. We make use of a large register-based panel data set containing detailed information on the educational attainments and various financial and socioeconomic variables. We model the stock market participation decision by the probit model. The results are shown to be highly robust to various assumptions, including unobserved individual heterogeneity and instrumental variables estimation.

Keywords: Investor Education; Portfolio Choice; Stock Market Participation.

JEL Classifications: G11; I29; J24.

1 Introduction

Surprisingly large fractions of households do not invest in stocks. In the US, 51% of the households did not hold stocks, neither directly nor indirectly, in 1998 (Hong, Kubik & Stein, 2004) and 76% of the European households did not hold stocks in 1998 (Guiso & Jappelli, 2003). In the Danish data set we analyze, 72% of the investors did not invest in stocks, neither directly nor through mutual funds, in 2001.

It is puzzling why so many households choose not to participate in the stock market. In fact, standard portfolio models imply that investors hold portfolios comprising *all* assets: In the standard model with no trading costs and investors having constant relative risk aversion, all investors hold the same portfolio of risky assets (the "market portfolio") which includes *all* the risky assets in the economy. Household portfolio heterogeneity then boils down to heterogeneity with respect to how much is invested in the risk-free asset and the risky market portfolio (depending on the investor's risk aversion) and heterogeneity with respect to the correlation of non-financial income with the return on the portfolio of risky assets (Viceira, 2001; Massa & Simonov, 2005). Empirically, however, it turns out that stock market participation is strongly correlated with income, wealth, and – important for the message of this paper – the level of education of the investor.

There is a large literature investigating whether investors with high levels of education are more likely to hold stocks; see for instance Mankiw & Zeldes (1991), Halliassos & Bertaut (1995), Bertaut (1998), Guiso & Jappelli (2003), and Vissing-Jørgensen (2004). The general finding is that investors with a university degree have a higher propensity to invest in the stock market than have investors with a high school degree or primary school degree only. The explanation most often proposed is that "education reduces the fixed costs of participating, by making it easier for would-be investors to understand the market's risk-reward trade-offs, execute trades etc." (Hong *et al.*, 2004, page 138). In this paper, we take the literature one step further by evaluating whether *the kind* of investor education is important for the stock market participation decision.

We take as our starting point the fact that there are costs associated with stock investments. Such costs include not only the monetary costs associated with investments in the stock market, but also costs reflecting time spent on understanding risk-return trade-offs and information about stock markets all-in-all (Vissing-Jørgensen, 2004; Peress, 2004; and Guiso & Jappelli, 2003). Inspired by Mankiw & Zeldes (1991), Halliassos & Bertaut (1995), Bertaut (1998), Guiso & Jappelli (2003), and Vissing-Jørgensen (2004), we examine the hypothesis that if some agents are better able to gather and understand information about stock markets and investment opportunities, their effective costs of stock market participation are lower and

these investors will consequently have a higher probability of participating in the stock market. We hypothesize that economists – investors who have received formal education about economics and investment opportunities in general – are an example of investors that are better able to absorb and understand information about stock market related issues. We exploit a unique data set that allows us to investigate whether investors with an economics education are more likely to hold stocks due to informational advantages. Our most important result is that investors with an economics education have a higher probability of participating in the stock market when controlling for many background characteristics of the investors. In other words, the effect that information and education has on the stock market participation decision is not captured fully by the length of the investor's education: The kind of education and information the investor receives is also important.

Given that we study the relation between education and savings decisions, our work is also related to that of Bernheim & Garrett (2003) and Bernheim, Garrett & Maki (2001). Bernheim & Garrett (2003) show that financial education in the workplace significantly increases the probability of savings in general, whereas Bernheim *et al.* (2001) report that households who were exposed to financial curricula during high school have higher savings rates than others.

Learning about financial markets and the risk-return trade-off can be achieved by studying economics but learning can also take place more informally if the investor learns from peers. In this sense, our paper is related to the recent literature on social interaction and stock market participation. Hong *et al.* (2004) show that households that socially interact with their neighbors or attend church are more likely to invest in the stock market and Duflo & Saez (2002) demonstrate that the decision of workers to participate in retirement plans is influenced by the choices of their colleagues. In this paper we account for peer effects by investigating the effect of having an economist spouse.

It should also be noted that since we investigate the presumption that investors with economics insights are more likely to invest in the stock market, our paper is also related to the studies that show that investor information matters for portfolio choice in the sense of for instance Coval & Moskowitz (1999, 2001) and Grinblatt & Keloharju (2000) who show that investors invest in the stocks of the companies they are most familiar with.

The basic hypothesis we test in the paper is whether investors who have an economics education have a higher probability of participating in the stock market when controlling for other factors likely to affect the decision to enter the stock market. In order to investigate our main hypothesis, we analyze a unique data set that provides us with very detailed information on investor education and stock market participation choices, as well as a host of other detailed control variables. More specifically, we use a representative sample of 10% of the Danish

population for which we have annual data during the 5-year period 1997-2001. In total, we have annual observations on the stock market participation decisions and control variables of more than 400,000 individual investors. In addition to the sheer magnitude of the number of investors, our data set offers several advantages over, for instance, the PSID or the CEX data sets that are often used in studies of US individuals' stock market participation decisions. First of all, our data are register-based data and not survey data, i.e. our data does not suffer from for instance the "recall bias" documented in Vissing-Jørgensen (2002).[1] Second, we have very detailed information on the educational choices of investors, i.e. we can provide more detailed information about the relation between stock market participation choices and education than what is generally found in the literature. Third, the data contain the total value of many of the assets that investors have access to; most prominently the taxable property value. Many existing studies of stock market participation do not have data on the value of real estate. Yet, controlling for real estate is important, as real estate is the most important asset (in terms of value) for many investors apart from their human capital. Finally, we have a large number of socioeconomic control variables enabling us to focus on the effect of educational choices on stock market participation behavior after accounting for these potentially important background characteristics.

We investigate stock market participation using a probit model, and our results are astonishingly clear: Controlling for background characteristics, the probability of owning stocks increases substantially if the investor has an economics education. This effect shows up in all our robustness checks, and is both economically and statistically important. There is no other educational background that gives rise to as large an increase in the probability of stock market participation as being an economist.

Our results are consistent with the view that economists have a higher probability of participating in the stock market because they have more knowledge about investment opportunities and risk-return trade-off. In principle, there are other reasons that could account for our results, however. For instance, economists could be less risk averse or more optimistic than other investors. In order to evaluate whether it really is information about economics that makes economists more prone to holding stocks, we perform five additional kinds of analyses. First, we estimate a probit model where we allow for unobserved individual heterogeneity by including parameterized random individual effects in the basic probit model. We find that even when we control for unobserved individual heterogeneity, investors with an economics education have a higher probability of holding stocks than investors with other educations. Second, we use instrumental variables (IV) analysis to document that the positive

[1] The "recall bias" refers to fact that some respondents in surveys report that they have moved from being non-stock holders to become stock-holders, and, at the same time, report that they have not made any stock market investments.

effect from an economics education on stock market participation is a causal effect. Third, we investigate stratified subsamples comprising highly educated investors only (to make sure that differences in the levels of investor education do not blur the results). We confirm that also within the group of highly-educated investors, the probability of owning stocks is higher for investors with an economics education. Fourth, we verify that the amount of information about economics matters in the sense that investors with a long economics education have an even higher probability of participating in the stock market than investors with a shorter economics education. Fifth, we show that the probability of holding stocks increases when an economist moves into the household of the investor. This finding is consistent with information sharing in the household in the sense that those investors who interact closely with economists have a higher probability of holding stocks which yields further support to the social-interaction results of Hong *et al.* (2004). Finally, we also report further robustness tests that corroborate our findings.

Why is it important to know what makes investors hold stocks? First, Mankiw & Zeldes (1991) document that there are differences in the consumption patterns of stock holders and non-stock holders, therefore the degree of non-participation in the stock market has consequences for the distribution of welfare in the economy. Hence, to comprehend what makes investors hold stocks is crucial for understanding distributional effects of progressive tax systems. Furthermore, it has been argued that the stock market participation puzzle contributes towards explaining the international diversification puzzle (Palacios-Huerta, 2001), and the equity premium puzzle (Basak & Cuoco, 1998; Parker, 2001; Guvenen, 2003; and Malloy, Moskowitz & Vissing-Jørgensen, 2005). For instance, Malloy, Moskowitz & Vissing-Jørgensen (2005) report that the risk aversion coefficient needed to explain the equity risk premium can be brought down to around 6-7 when considering the consumption of the top third stock holders whereas the risk aversion coefficient is in the neighborhood of 80 when looking at aggregate consumption. Thus, understanding what makes investors hold stocks has the potential to help explain the equity premium puzzle. Finally, the public opinion on stock-related issues most likely depends upon the degree of stock market participation amongst individuals in the economy and hereby the development of the stock market culture. Hence, understanding the sources of the reluctance to hold stocks are relevant for renewing and maintaining a broad base of stockholders. Likewise, debates about the desirability of individuals having more freedom in allocating their mandatory pension savings to stocks relative to bonds, depend upon the extent to which individuals are likely to posses information that make them allocate funds to the stock market.

Finally, we would like to point out two last aspects of our findings: First, we do not claim that the kind of education is the only important determinant of the stock market participation

decision; in fact, we report that wealth and income are other important determinants of the stock market participation decision, as is the lagged participation decision. What is interesting is that even after controlling for wealth, income, and a number of other controls, we find that the kind of education is an important determinant. Second, we should mention that the rich data set we use allows us to draw a number of other conclusions in addition to our main result that more economists hold stocks. For instance, we find that the probability of owning stocks increases when the return on the stock market is high, and that investors who also participate in the bond market have a higher propensity of owning stocks.

The remaining part of the paper is structured as follows. In the next section, we introduce our data set. The probit model that we apply is presented in Section 3, and the basic empirical results are discussed in detail in Section 4. In Section 5 we provide a lengthy discussion of why economists are more prone to holding stocks. Some further robustness tests are discussed in Section 6. Finally, Section 7 concludes.

2 Data

For our empirical analysis we use a very rich register-based panel data set comprising a random 10% sample of the Danish population that covers the time period 1997-2001.[2] The data set is hosted by the Institute of Local Government Studies in Denmark (AKF), and it stems from Statistics Denmark, who have gathered the data from different sources, mainly from administrative registers.

For each individual, we have access to the value of a number of financial variables that apply at the end of each year (originally collected for tax reporting purposes): Cash holdings, stock holdings, bond holdings, taxable property value, the compulsory (labor-contract based) pension contributions, and the contributions to private pension funds.[3] We also know the yearly income measured by the gross non-capital income.

Exact information about the educational history of each individual is available. We also know whether the individuals are currently undertaking an education (both students and apprentices).

The individuals are divided into 11 groups based on the subject of their highest com-

[2] In 1997, financial institutions started to automatically register holdings of stocks, whereas investors had to self-report to the tax authorities their holdings of stocks before 1997. As a consequence, we see clear biases in our data for the degree of stock market participation before 1997.

[3] Mutual fund investments are included in the stock and bond holdings. Mixed mutual funds (both bonds and stocks) are counted in the stock holdings. The mixed mutual funds account for around 5% of the Danish mutual funds. So, the stock holdings are slightly overvalued at the expense of the bond holdings. Investments through mutual funds only make up 5.8% of total investments.

pleted education. We single out economics as one of the groups. We have conducted the analysis using two different definitions of economists. According to the narrow definition, the economics group only includes individuals who have completed an economics education at university level (BA, Master, and PhD). The broad definition includes the individuals from the narrow definition as well as individuals who have completed a relevant apprenticeship education in the financial services industry, e.g. bank clerks. The results obtained using the narrow and the broad economics definition are qualitatively identical, and therefore we only report the latter in the paper. In its entirety, the subject-based educational groups are as follows (the proportion of the sample in each group is provided in the lower part of Table 1): educator/teacher, humanities/arts, agriculture/food/forestry/fishing, business/commercial (excluding economics), social sciences (excluding economics), health care, natural sciences/technical educations, police/armed forces/transportation, high school, basic school/preparatory school, and economics.

The data source also contains information on a number of socioeconomic factors that are applied as control variables, including age, gender, marital status, and children living at home. We also have access to various information about the investor's cohabitant/spouse (in the following the spouse).

We restrict our sample to individuals older than 18 years (the age of majority). We exclude individuals born before 1920 because there were no regulations on compulsory school attendance before 1920. On top of that, the educational information is very poor for individuals born before 1920. After these restrictions, we have observations on 405,271 individuals during the five-year period 1997-2001. The data form an unbalanced panel data set, since some people enter the sample when they turn 18, and other leave the sample as they die or move abroad. On average, the individuals are observed for 4.6 years such that we have in total 1,870,324 observations of individual investor decisions.

2.1 Descriptive Statistics

Unless otherwise noted, we consider the pooled data set covering the entire 5-year sample period using real 2002 DKK amounts. The rate of exchange at the end of 2002 was 7.0784 DKK/USD. Summary statistics are provided in Table 1. The first column considers the entire sample and the second column only the group of economists.

The average person in the sample is 45.3 years old and has an education of 11.3 years. 49.8% are males, 51.5% are married, 14.1% have children younger than 7 years old living at home, and 17.1% have children between 7 and 18 years old living at home. 7.4 % are students receiving a government grant, and 3.6% are apprentices.

A rather large proportion of the sample, 31.7%, only holds a basic education (18.7% 7 years and 13.0% 9 years, respectively), and a small group (5.9%) has also attended preparatory school (10 years).[4] High school and apprenticeship educations account for 44.2 % of the sample (12 years). 3.5% of the sample has a short-cycle higher education (14 years) and 10.3% has a bachelor degree/medium-cycle higher education (16 years). A relatively small proportion, namely 4.2%, holds a master degree (18 years), and even fewer (0.2%) a Ph.D. degree (20 years).

The average non-capital income is DKK 235,637. The average individual in the sample holds DKK −18,273 cash at year end. 25% of the individuals in the sample take out private pension schemes.[5] This proportion is rather small, because many Danish employees (71%) have adequate pension schemes in their labor contracts. The average amount paid to compulsory pension schemes is DKK 11,372, whereas the average amount spent on private pension schemes is DKK 4,128 per year across all individuals in the sample. 60% own their own home and the average taxable property value across all individuals (i.e. also those not owning their own home) equals DKK 366,822. 8.2 % of the individuals participate in the bond market, i.e. own bonds at year end (excluding mortgage backed-bonds and bond debt).

There are 46,038 observations of economists' investment decisions. The average economist is younger than other investors (40.9 years) and has a longer education (14.1 years). Furthermore, the financial situation is on average better than that of other investors. A larger proportion of economists participate in the bond market, namely 13%.

2.2 Stock Market Participation Rates

An investor is defined to participate in the stock market if the investor holds stocks with a value in excess of DKK 1,000 (around USD 141) at year end.[6] Hereby, we obtain the stock market participation indicators for each individual for each year.[7]

Overall, during the five-year period, 23.1% participate in the stock market. The proportion that participates in the stock market varies greatly across the educational groups. Figure 1

[4] The 7-year compulsory school attendance was replaced with 9 years in 1972 applying to cohorts born in 1959 and onwards.

[5] The private pension contribution is only registered from 1999 onwards.

[6] Investors are defined as participating in the stock market if they have stocks in excess of a small threshold value. This excludes individuals who e.g. have been given a single stock by their employer as a Christmas present. Previous studies have applied a zero threshold value. Our conclusions are robust to the exact choice of threshold value.

[7] We stress that our stock market participation variable reflects an active decision of the investor to buy stocks or mutual funds. In order words, we do not consider a mandatory contribution to a public pension scheme as an active stock market participation decision, as, in Denmark, the investor has no say over such contributions.

shows the average rates of participation across the subject-based educational groups for the entire 1997-2001 period. It is noted that the stock market participation rate is much higher for economists than for others, around 42% compared to 25% or less for the other educational groups.

Figure 2 shows the time series of stock market participation rates for the entire sample as well as for economists. The overall rate of participation in the stock market is remarkably stable at around 23%. The stock market participation rate for economists increases in the sample period, from a low of 37% to a high of 47%.

More males than females participate in the stock market, on average 24.9% compared to 21.3%.

As a very first step in the empirical analysis, we apply the chi-square test of independence to the stock market participation indicators. For each year in the sample, and for the entire sample period, we test the independence of the two outcomes (participation/non-participation) across the educational groups. In all cases, with any usual level of significance, we reject that the stock market participation is independent of the education. So, this gives us a first indication that the educational choice influences the investors' stock market participation decision. However, we have not yet taken into account that there are other differences between investors than their educational background.

3 Model

To answer the question of whether economists have a higher probability of participating in the stock market than otherwise comparable individuals, we investigate the factors which collectively determine individuals' choice of participation in the stock market.

In each time period, the investor faces the decision of whether to participate in the stock market or not. According to the random utility model, the utility-maximizing investor chooses the alternative that provides the investor with the greatest utility. Let the utility that investor i derives from participating in the stock market in time period t be given by U_{it}, and normalize the utility that the investor derives from non-participation to be equal to zero for all investors, $i = 1, ..., N$, and time periods, $t = 1, ..., T_i$. Thus, investor i participates in the stock market in period t, if and only if the investor gets greater utility from participation than from non-participation, that is if and only if $U_{it} > 0$. Although we do not observe all aspects of the investor's utility, we do observe some background characteristics of the investor, X_{it}, where the educational-group indicators are of principal interest. Hence, we decompose the investor's utility into two parts: The representative utility, which is a linear function of the observable characteristics, βX_{it}, and the unobservable factors that affect utility but are not included in

the representative part, ε_{it}. The stock market participation decision can therefore be modeled as:

$$S_{it} = \mathbf{1}\left[\beta X_{it} + \varepsilon_{it} > 0\right], \tag{1}$$

where S_{it} denotes the indicator for active participation in the stock market of individual i at time t. The error terms are assumed independent and identically standard normally distributed, $\varepsilon_{it} \sim N(0,1)$, i.e. it is the univariate probit model. The variances of the error terms are normalized to one, because only the ratio $\frac{\beta}{Var(\varepsilon_{it})}$ can be identified by probit maximum likelihood estimation.

Our primary interest lies in the marginal effects of the explanatory variables on the probability of participating in the stock market. The marginal effect of an explanatory variable on the choice probability equals the change in the probability caused by a change in the relevant explanatory variable holding all other variables fixed at their mean values except length of education which is fixed at 9 years (basic schooling). For continuous variables the marginal effects concern infinitesimal changes, for indicator variables they concern changes from 0 to 1, and for discrete variables they concern a one unit increase.

4 Yes! Economists *are* More Likely to Hold Stocks

In this section we discuss the empirical results obtained using the basic probit model to describe the stock market participation.

4.1 Explanatory Variables in the Basic Probit Model

In the basic probit model, the principal explanatory variables are the subject-based educational-group indicators. In addition hereto, we apply a number of control variables, see also the discussion in Section 2 above.

The following financial control variables are applied: Bond market participation indicator (1 if participation), non-capital income, cash holdings, taxable property value, compulsory pension contribution, and private pension contribution.[8] We use non-capital income to avoid problems of endogeneity of income. Furthermore, to control for business cycle effects, we apply the return on the KFX index (the Danish blue-chip index) in the year prior to the investors stock market participation decision.

The socioeconomic explanatory variables are: Age, marital indicator (1 if married), gender (1 if male), indicator for having children below 7 years old living at home (1 if yes), and

[8] An indicator function captures that the private pension contribution is not registered during the first two years of the sample.

indicator for having children between 7 and 18 years old living at home (1 if yes).

To accommodate the fact that some investors are students at year end and thereby somewhat misplaced in the educational group for the highest completed education before starting the new education, we apply an indicator variable for being a student receiving a government grant and another indicator for undertaking an apprenticeship education (student with wage). These variables capture that the investors are acquiring new information in their ongoing education. Furthermore, we presume that households share information. Therefore, we include an indicator for whether the investors' spouse is an economist, since this provides the investor with information about economics. Finally, we apply the level of education as a control variable (official years of education).

4.2 Basic Probit Model Results

Table 2 shows the results from estimating the basic probit model. The first column contains the parameter estimates and the second column the marginal effects.

The first result to notice is that the coefficient to the economics indicator is strongly significant and positive. From this we conclude that economists have a higher probability of holding stocks than investors with basic school (the indicator for basic schooling as highest completed education is left out of the model, i.e. this is the reference group towards which we compare individuals with other educations). Notice, that the coefficient estimates give us limited information because their relative sizes carry little information, only their signs and level of significance are relevant. In contrast, the influence of an explanatory variable can be evaluated by the size of its marginal effect; the larger the marginal effect, the more important the variable is for the decision to participate in the stock market.

The stock market participation probability is significantly higher for investors having an agriculture/food/forestry/fishing, business/commercial, social sciences, health care, natural sciences/technical, high school, and an economics education compared to investors with only basic schooling. Moreover, investors with a educator/teacher and a humanities/arts education have significantly lower probability of holding stocks than investors with basic school.

The marginal effect to the stock market participation probability from being an economist is 0.18, and is by far the largest marginal effect for the educational-group indicators. Thus, becoming an economist increases the probability of holding stocks by as much as 18 percentage points compared to having only 9 years of basic schooling. The second and third largest marginal effects are for high-school graduates and business/commercial educated, which are 0.04.[9] Thereby, the marginal effects of being an economist is much larger than the marginal

[9] Note that the group of high school graduates stands out from the other educational groups in that 47% of

effect of any other education. Thus, our initial hypothesis is confirmed. Yes! More economists hold stocks.

The marginal effects to the stock market participation probability from the socioeconomic variables are fairly small. Only the marginal effects of having children living at home (both small and older) are not negligible and are significantly negative.

All the financial variables are significant and have a positive marginal effect upon the stock market participation probability. Not surprisingly, the most important financial variable is the bond market participation indicator for which the marginal effect equals 0.34. This implies that the decision to participate in the stock market is highly influenced by the decision to participate in the bond market. The second largest effect comes from the non-capital income for which the marginal effect equals 0.14, where it is noticed that the non-capital income is divided by 1,000,000. Thus, for an increase in the non-capital income by DKK 1 million (USD 141,275), the probability of participating in the stock market increases by 14 percentage points. Although this is a large effect, it is noteworthy that it is less than the marginal effect from being an economist. The positive effect from income confirms common knowledge from the literature that income plays a prominent role in determining whether an investor participates in the stock market or not. The non-capital income is followed by the taxable property value (divided by 100,000), for which the marginal effect equals 0.05. Although the effects from the pension contributions are significant (both compulsory and private) they are almost negligible.

The marginal effect from the lagged KFX return to the stock market participation probability is significantly positive and amounts to 0.05. This corresponds well with the notion that when the stock market is rising, investors are more interested in investing in stocks.

The probability of investing in stocks increases when the investor's spouse is an economist, as the marginal effect from the spouse being an economist is significantly positive, 0.03. This is consistent with information sharing in households, as well as the hypothesis that information about economics increases the probability of investing in stocks.

The marginal effects from being a student or an apprentice are significantly positive. This confirms that investors undertaking an education are in fact misplaced in the educational group for the previously completed education, as they are acquiring new information.

The marginal effect from the level of education to the probability of participating in the stock market is significant but fairly small (smaller than 0.01). This implies that the majority of the variation across educations has already been accounted for by the subject-based educational grouping.

The estimated probability of participating in the stock market equals 0.19 given that all

the investors are undertaking further education.

the explanatory variables are equal to their mean values which can be compared to the actual probability of 0.23.

In conclusion, we stress that the results from the basic probit model imply that the average investor (i.e. keeping all observable control variables at their means) with an economics education will have an 18 percentage point higher probability of participating in the stock market than the average investor with 9 years of compulsory schooling. This is much more than for any of the other subject-based educational groups. In addition, only the marginal effect from the bond market participation indicator is larger.

5 Why are Economists More Likely to Hold Stocks?

In this section, we enhance our understanding of *why* the average investor with an economics education has a higher probability of stock market participation. The basic hypothesis we pursue in this paper is that more economists hold stocks because they have been exposed to economics curricula during their study and consequently have an informational advantage compared to other investors. Below, we present five kinds of analyses that shed additional light on the question: Is it really information that makes more economists hold stocks? First, we present results from a probit model where we evaluate whether economists also have a higher probability of participating in the stock market after allowing for *unobserved* individual heterogeneity. Second, we use an instrumental variables (IV) approach to unravel whether the positive effect of having an economics education on stock market participation is really a causal effect. Third, we ask whether economists with a long education have a higher probability of participating in the stock market than other investors with a long education. Fourth, we investigate the information acquisition process in more detail. In particular, we ask whether investors with a long economics education have an even higher probability of participating in the stock market than investors with a shorter economics education. Finally, we examine the effect of interacting closely with an economist. In particular, we hypothesize that an investor with an economist spouse has lower participation costs because of information sharing in the household. We evaluate this hypothesis by investigating what happens to the stock market participation of the investor when an economist moves into the household.

5.1 Individual Heterogeneity

Investment decisions are most likely affected by *observable* characteristics, such as education, income, wealth, and age as well as by *unobservable* characteristics such as ability, tastes, and risk preferences. Thus, it is reasonable to investigate whether the results presented so far could be biased because economists have special unobservable characteristics that affect the

participation decision. In order to investigate whether economists differ from other groups of investors with respect to differences in unobserved characteristics, we allow for unobserved individual heterogeneity in our probit model.

It is essential to allow the unobserved individual heterogeneity to be correlated with the observed individual characteristics, since there is substantial evidence that there are ability differences across educational groups, cf. Willis & Rosen (1979), Carneiro, Hansen & Heckman (2003), and Arcidiacono (2004). Likewise, there is evidence of correlation between risk preferences and educational choices, cf. Chen (2003). A common way to allow for arbitrary correlation is to use a fixed effects approach, where the individual effects are estimated along with the other parameters. However, the drawbacks of this approach include its inability to identify the effect of time-invariant explanatory variables and the incidental parameters problem, cf. Heckman (1981). Instead we parameterize the random individual effects in order to deal with individual fixed effects that are correlated with the explanatory variables. That is, we directly specify the distribution of the individual effects conditional on the means of the time-varying explanatory variables, as first suggested by Mundlak (1978).[10] This way of accounting for individual effects is fairly standard, cf. e.g. Wooldridge (2001).

5.1.1 Specification of Individual Heterogeneity. We decompose the error term in the basic probit model in equation (1) into an individual specific part and an individual time specific part, $\varepsilon_{it} = \alpha_i + u_{it}$, and specify the individual effect, α_i, as a linear projection on the within-individual means of the time-varying explanatory variables, $\overline{F_i}$. Thus the portion of unobserved individual specific factors that affect utility, is given by:

$$\alpha_i = \alpha\overline{F_i} + c_i, \tag{2}$$

where $c_i \sim N\left(0, \sigma_c^2\right)$. This portion reflects the investors' propensity to participate in the stock market, and depends both on observed (through $\overline{F_i}$) and unobserved (through c_i) individual specific factors. Substituting equation (2) into our basic probit model in equation (1) yields the following model for the stock market participation decision:

$$S_{it} = \mathbf{1}\left[\beta X_{it} + \alpha\overline{F_i} + c_i + u_{it} > 0\right], \tag{3}$$

where $u_{it} \sim N(0,1)$, and the error components u_{it} and c_i are assumed to be independent for all $i = 1, .., N$ and all $t = 1, ..., T$. Hence, σ_c^2 measures the variance in unobserved utility across individuals relative to the variance across time for each individual, and the proportional

[10] A more general correlation structure could be allowed for by specifying the distribution of the individual effect conditional on all explanatory variables, as suggested by Chamberlain (1980). Given the huge size of our unbalanced panel data set, this turned out to be computationally infeasible.

contribution of the individual-specific variance component to the total variance is given by $\rho = \frac{\sigma_c^2}{\sigma_c^2+1}$. Thereby, ρ is an indicator of the relative importance of the unobserved individual effect.

By including $\overline{F_i}$ among the explanatory variables, the model can be consistently estimated by probit maximum likelihood, where the random individual effects are numerically integrated out using Gauss-Hermite quadrature.[11] The inclusion of the observed individual fixed effects, $\overline{F}_i$, has the additional advantage that it takes care of all selectivity that is dependent on observed time-invariant factors, thus it ensures that the unobserved random individual effects c_i are uncorrelated with the explanatory variables.

Note that marginal effects of the explanatory variables are calculated as the average partial effects on the stock market participation choice probability conditional on the unobserved random individual effects being at its mean values, $c_i = 0$.

5.1.2 Individual Heterogeneity Probit Results. The results from the probit model with unobserved individual heterogeneity are shown in Table 3. The first column of Table 3 contains the coefficient estimates, and the second column the marginal effects on the probability of participating in the stock market. The first part of the table concerns the explanatory variables, whereas the second part of the table concerns the individual effects.

The first point to notice is that unobserved individual heterogeneity is important: The contribution of the individual-specific variance component to the total variance is large and amounts to 90%, $\widehat{\rho} = 0.9$. Furthermore, the likelihood ratio test strongly rejects the hypothesis of $\rho = 0$.

To investigate how accounting for unobserved individual heterogeneity affects our results, we compare the first part of Table 3 with Table 2. Overall, the marginal effects of the explanatory variables decrease in absolute size when controlling for individual heterogeneity. Thus, ignoring unobserved individual heterogeneity provides an upward bias in the absolute size of the coefficient estimates. Most notably, we find that the only education that still has a significantly positive marginal effect on stock market participation is economics. Becoming an educator/teacher slightly lowers the probability of participating in the stock market by 0.2 percentage points, while becoming an economists substantially increases the probability of participating in the stock market by 1.7 percentage points.

Note that the effects of the explanatory variables are identified by their variation over time for given investors. Focusing on the educational indicators, their effects are identified

[11] Given that we only have two choices and five time periods, this is the most efficient procedure for integrating out c_i, cf. Butler & Moffitt (1982).

by investors completing the education during the observation period, and their fixed effects are identified by all investors holding the education (both those who completed the education before and during the observation period).[12]

Turning to the second part of Table 3, we find that the unobserved individual effects are positively correlated with some of the educational fixed effects, and the highest correlation is with the economics education. The interpretation is that investors who are more prone to invest in stocks also have a higher propensity of being economists. Investors having an education within educator/teacher, agriculture/food/forestry/fishing, business/commercial, health care, and police/armed forces/transportation are also more prone to hold stocks. However, the correlations with the unobserved individual effects are lower for these groups' fixed effects than for the economics' fixed effect.

Furthermore, the unobserved individual effects are positively correlated with all the financial variables' fixed effects (except non-financial income), and most strongly with the fixed effect of bond market participation. The marginal effect of the bond market participation indicator actually becomes negative (whereas it is positive in the basic probit model), since all of the positive effect of bond market participation is explained by the positive correlation of bond market participation with the unobserved individual effect. Thus, investors participating in the bond market have a higher probability of participating in the stock market only because they a priori are more prone to holding stocks.

To conclude, even though economists have unobservable characteristics that make them more prone to holding stocks, there is still a significantly positive marginal effect on the probability of participating in the stock market of having a formal economics education. The marginal effect from an economics education is still larger than for any other education. Thus controlling for individual heterogeneity does not change our initial conclusions - it only makes the picture even clearer.

5.2 Instrumental Variables Analysis

An advantage of the individual heterogeneity probit model presented in section 5.1 is that it uses the total sample and it investigates the effect of *all* educational subjects on the stock market participation decisions, while accounting for the possible endogeneity in a range of variables, including the educational indicators and the other components of the individuals' wealth portfolio. A possible disadvantage of the model with individual heterogeneity, however, is that it imposes strict assumptions on the distribution of the unobserved variables. For this

[12] We verify that there is sufficient variation in the variables; e.g. for economists 8,765 investors are economists for the entire period, 1,736 become economists during the period, and the remaining 394,770 investors remain non-economists for the entire period.

reason, we now take a more flexible approach, where we primarily focus on the binary choice of an economics education and try to unravel whether the positive effect it has on stock market participation really is a causal effect. We use an IV approach to estimate the causal effect of an economics education on the stock market participation decision.[13] As is common, the IV analysis is restricted to the subsample that is likely to be affected by the instrument. In compensation, the IV analysis takes care of any bias in the estimated effect caused by unobserved variables that drive both the stock market participation decision and the choice of an economics education.

The explanatory variable of primary interest is the indicator for whether individual i has an economics education. The estimated coefficient to the economics indicator can suffer from endogeneity bias arising from two sources: selection on outcomes and/or selection on unobservable variables. First, if individuals self-select into economics educations based on expected future stock market gains, the choice of economics may be endogenous in the stock market participation equation. For example, if individuals who aspire to get substantial financial gains by making risky stock investments choose an economics education in order to enhance their possibilities of making (more) successful stock investments, it may lead to an upward bias. Secondly, unobserved ability bias arises if for example the most talented individuals (who a priori are better able to gather and understand information about stock markets) choose an economics education, and we fail to control for this talent. In this case the estimated effect of having an economics education will also be upward biased. Similarly, the estimated effect could be biased if individuals choosing an economics education are less risk averse. The IV approach deals with both sources of endogeneity.

We propose to use the opening of a university as an instrument for choosing an economics education.[14] More precisely, we identify the causal effect of having an economics education on the stock market participation decision by exploiting the exogenous variation that is obtained from the opening of Aalborg University situated in the County of Northern Jutland; a remote part of Denmark. The opening of Aalborg University made it possible for the high school graduates in the area surrounding Aalborg to acquire an economics education at university level without moving residence, i.e. the university opening (suddenly) induce some of them to choosing an economics education (or other educations offered at Aalborg University). Since mobility costs (for these individuals) may be substantial, the university opening induces exogenous variation in the costs of choosing an economics education (which is independent of individual characteristics).

[13] An unpublished appendix (available upon request) contains further details about the IV analysis. It also documents that the IV results are robust.

[14] We are grateful to Helena Skyt Nielsen for suggesting this instrument.

5.2.1 IV Estimation Sample. From the original random sample comprising 10% of the Danish population above 18, we select a subsample of potential recruits for the new university. Hence, we select individuals living in the County of Northern Jutland when completing high school at around the time of the opening of Aalborg University in September 1974. That is, we select individuals who graduate from high school in the county of Northern Jutland in June 1972, 1973, 1974, and 1975, respectively.[15] The County of Northern Jutland is an isolated part of Denmark, and before the opening of Aalborg University, the closest university was in Aarhus (about 120 kilometers away from Aalborg).[16] It is plausible that some high school graduates in the county are not willing to move to acquire an economics education, and yet they will acquire an economics education at the local university once they get the opportunity. The identification of the causal effect on stock market participation of having an economics education is provided by the exogenous variation obtained by the existence of these individuals.

All in all, the IV sumbample comprises 577 individuals who, during the five-year period 1997-2001, made 2795 stock market investment decisions. We see that a larger portion of the individuals completing high school in 1974-1975 in the County of Northern Jutland are economists, and subsequently more of them participate on the stock market (in 1997-2001). 31% of the individuals in the 1972-1973 cohort participate in the stock market and 3% are economists, while the corresponding figures are 35% and 5%, respectively, for the 1974-1975 cohort. t-tests confirm that these differences are significant. Hence, it appears that the university opening induces some high school graduates to choosing an economics education, and that this has a positive effect on their subsequent stock market participation.

The fact that we observe the stock market participation decisions and educations of these individuals about 25 year after their high school graduation is an added strength to the analysis and, at the same time, illustrates the detailed information about the investors that we have access to. The individuals are on average 44.7 years old (the youngest being 39 in 1997), and most of them have therefore left the educational system for good.[17] They have on average 15.3 years of education, which is four years more than the average individual in the total estimation sample. Furthermore, 69% of them are married (compared to 52% in the total sample), and 69% own their own house (compared to 60% in the total sample). Therefore we expect them to have settled on the financial markets as well. We also see that

[15] To make our estimations more efficient and robust to the possibility that individuals speculate in the university opening, either by postponing or speeding up the educational decision, we have included all the cohorts of high school graduates from 1972 to 1975 in the main analysis. Including only the 1973 and the 1974 cohorts in the analysis does not change the conclusions substantially.

[16] A map of Denmark is available in the aforementioned unpublished appendix.

[17] Less than 1% of the individuals are undertaking education. Hence we exclude the indicators for ongoing education from the IV analysis.

33% of them participate in the stock market (compared to 23% in the total sample). This could also partly be due to the fact that they have higher wealth, for instance.

5.2.2 IV Estimation and Identification. To take the nonlinearity in both the stock market participation decision and the choice of an economics education into account, our IV analysis is done by estimating the bivariate probit model:

$$S_{it} = \mathbf{1}\left[\beta_S \widetilde{X}_{it} + \delta Econ_{it} + \xi_{it} > 0\right] \quad (4)$$

$$Econ_{it} = \mathbf{1}\left[\beta_E \widetilde{X}_{it} + \gamma Z_i + \nu_{it} > 0\right], \quad (5)$$

where $Econ_{it}$ denotes the indicator for individual i having completed an economics education at time t and $\widetilde{X}_{it}$ contains the background characteristics of investor i excluding the educational-group indicators. The error terms are assumed independent and identically bivariate standard normally distributed, $\binom{\xi_{it}}{\nu_{it}} \sim N_2\left(\binom{0}{0}, \begin{bmatrix} 1 & \rho \\ \rho & \sigma^2 \end{bmatrix}\right)$, i.e. it is the (seemingly unrelated) bivariate probit model. Z_i is an indicator for whether individual i completed high school in 1974-75 (the year of the university opening and the year after), and thus had the option to acquire an economics education at the local university (at a lower cost). We have imposed the exclusion restriction that Z_i does not directly affect stock market participation, it only affects stock market participation through the effect it has on the individuals' choice of an economics education. Hence, we use Z_i as an instrument for acquiring an economics education.

Having one instrument implies that we can only endogenize the decision to undertake one education. As we are primarily interested in the economics education, equation (5) models the decision to undertake an economics education.[18] We include only the $Econ_{it}$ indicator in equation (4) because we focus on the causal effect from choosing an economics education on the stock-market participation.[19]

In order to efficiently estimate the causal effect we need to have a proper instrument. In our framework, Z_i is a proper instrument if the coefficient to Z_i is significant in the economics education selection equation (5), and Z_i is independent of ξ_i and ν_i. That is, the university opening should influence stock market participation only through the effect it has on the probability of obtaining an economics education. This condition is very reasonable in our application, however, it is inherently untestable. The opening of Aalborg University works

[18] Ideally, there would be an instrument available for each educational decision. Tables 2 and 3 show that the strongest influence from education on the stock market participation decision is from the economics education. This also suggests to focus the IV analysis on the economics education.

[19] We also run the model including the other educational indicators in the stock market participation equation. The marginal effect of having an economics education is by far the largest among the educational indicator variables. These results are presented in the aforementioned appendix.

as an exogenous shock that induces more high school graduates in the surrounding county to choose an economics education. Whether the individual is born such that it graduates from high school in 1972-73 or 1974-75 is independent of the individual's ability, tastes, and risk preferences. Therefore, it is reasonable that the observed difference in stock-market participation for these two high school cohorts about 25 years after their high school graduation arises because more in the latter cohort are induced to choose an economics education because of the university opening.[20]

Furthermore, to be able to interpret our estimate as a local average treatment effect (LATE) we need to impose a monotonicity assumption. LATE is the causal effect of choosing an economics education for those who are induced to doing so because they complete high school in 1974-1975 (and thus have the possibility to study at the local newly-opened Aalborg University) rather than in 1972-1973. The monotonicity assumption guarantees identification of LATE by only allowing the instrument to affect the binary choice of economics in a monotone way. When Z_i switches from 0 to 1, individuals switch from not choosing an economics education to choosing it (not the other way around). This is plausible, since individuals in the 1972-73 cohort who choose to move to get an economics education would still have this option if they were in the 1974-75 cohort, additional to the option of getting an economics education in the home county.

We have argued that the IV method is effective in estimating the causal effect of having a formal economics education if a proper instrument for choosing economics is available. Indeed, we believe that the opening of the university is a strong instrument: It predicts the choice of economics (also after partialling out any explanatory variables), it is unrelated to unobserved heterogeneity (e.g. ability, tastes, and risk preferences), and it is redundant in the structural model of stock market participation, i.e. any stock market participation differences between the two high school cohorts are assumed to be captured by the observed explanatory variables.

5.2.3 IV Results. Table 4 shows the results from the univariate probit model (in the first column) and the IV analysis based on the bivariate probit model (in columns two and three), both based on the IV subsample.

First of all, the results from the univariate probit model show that economics education increases the probability of stock market participation significantly by 14 percentage points. In general, the results from the univariate probit model using the IV subsample are similar

[20] In Appendix A we corroborate that Z_i is a proper instrument. First, by comparing the characteristics of the two highs school cohorts at graduation and second, by performing the IV analysis on a control sample from another county.

to those using the entire sample (reported in Table 2).[21,22]

Now we turn to the IV analysis and first to the selection equation: The significantly positive coefficient to the university opening indicator implies that significantly more individuals decide to study economics as a result of the university opening. This is in correspondence with the simple t-tests we mentioned above; here, we show that the difference is significant also when conditioning on the background characteristics of the individuals.

Second, regarding the stock market participation equation, the results are generally similar to those in the univariate probit model based on the IV subsample. Most importantly, the marginal effect of an economics education is significantly positive (and amounts to 0.49). In other words, the effect of having an economics education is significant and even larger when we account for the possible endogeneity bias in the effect of the economics education (comparing the results in Table 3 and 4, for instance). Since the identification stems from exogenous variation in the cost of acquiring an economics education, we conclude that the economics education has a strong impact on the stock market participation decision for those individuals affected by the university opening. We interpret this as evidence that it really is information (from the formal economics education) that makes economists more likely to invest in stocks.

5.3 Length of Education

Now we investigate in more detail the effect of the length of education. Firstly, we restrict the analysis to a subsample of highly-educated investors. Secondly, we investigate the effect of information acquisition from economics educations of different lengths.

5.3.1 Highly-Educated Investors. Above, we argue that the costs associated with time spent on gathering and understanding information about the stock market are lower for investors with higher ability (e.g. longer educations), and especially for investors with an economics education. In our basic probit model, we control for the level of education by including years of schooling as a control variable. In order to make a cleaner comparison between investors with the same length of education, we estimate the basic probit model on a subsample of investors with at least 18 years of schooling, i.e. the roughly 5% of the investors with a master degree. Since there is evidence of ability sorting across levels of education, but

[21] The exceptions are that the variables "non-capital income", "economist spouse", and "length of education" have negative coefficients (the coefficient to "non-capital income" is significant at the 10% level only, however). The reason for these differences is probably that the subsample is small.

[22] We have also tried to look for exogenous variation around the opening of other educational institutions, as well as the introduction of new educations with an economic curricula list at the pre-existing Universities. Unfortunately these events did not induce any exogenous variation in individuals' choice of economics education. Hence, they were not considered proper instruments.

not across subjects of education within a given level, cf. Arcidiacono (2004), this analysis is presumably free of unobserved ability bias.

There are 19,233 investors with an education of at least 18 years. The groups of investors with basic school and high school drop out of the sample. The comparison group is now police/armed forces/transportation. Table 5 shows the results from the basic probit model. The most important result is that the economics education still has the highest marginal effect on the stock market participation probability compared to investors with other educations. The marginal effect of being an economist is 0.073, whereas the second highest effect is for the group of investors having an agriculture/food/forestry/fishing education (marginal effect 0.067). When controlling for individual effects, the highest marginal effect is again found for the economics education (results available upon request).

5.3.2 Economists' Information Acquisition. Our presumption is that the longer an economics education is, the more information the investor has about economics and thereby about stock market investments. There are investors with economics educations of 2, 4, and 6 years beyond high school, i.e. in total 14, 16, and 18 years of schooling.[23] This means that the investors in the economics group have different levels of information about the stock market due to differences in time spent on the formal economics education.

We estimate the basic probit model and exclude years of schooling from the set of explanatory variables. Instead, we use separate indicators for the three levels of economics education mentioned above. The results (not shown but available upon request) confirm that the more time spent on studying economics, the larger the marginal effect on the probability of investing in stocks. In other words, the 6-year economics education has a larger marginal effect upon the stock market participation probability than the 4-year economics education, which again is larger than for the 2-year economics education.

5.4 An Economist Moves In

An investor with an economist spouse is hypothesized to have lower participation costs because of information sharing in the household. Above, we find evidence hereof in the basic probit model, where the marginal effect for the economist spouse is significantly positive, cf. the discussion of Table 2 in Section 4.2. Here, we pursue the information sharing hypothesis further. We evaluate the effect of the exogenous information shock to the investor, that an economist (spouse) moves into the investor's household. We expect an increase in the probability of holding stocks when an investor moves together with an economist due to

[23] We exclude the apprenticeship educated economists as well as the very few economists with a PhD degree.

information sharing in the household.

Let $D_i = 1$ for investors who move together with an economist at $t = 0$, and $D_i = 0$ for the investors who do not cohabit with an economist during the observation period.[24] We are interested in estimating the average effect on stock market participation for the investors that move together with an economist: $E\left[S_{it}^1 - S_{it}^0 | D_i = 1\right]$ for $t > 0$,where S_{it}^1 is the stock market participation indicators for investor i at time t when the investor cohabits with an economist and equivalently S_{it}^0 is the stock market participation indicator when the investor does not cohabit with an economist. Since the stock market participation decision of an investor cannot be observed both when the investor cohabits and does not cohabit with an economist at the same point in time, the central problem of evaluating this effect is the construction of counterfactual assumptions. In the following we analyze whether the probability of holding stocks increases for investors who move together with an economist at time $t = 0$ using a commonly used evaluation strategy, namely the difference-in-difference estimator.

The difference-in-difference estimator compares the changes in participation rates for investors moving together with an economist with the changes in participation rates for investors who do not move together with an economist:[25]

$$E[S_{i1}^1 - S_{i,-1}^0 | D_i = 1] - E[S_{j1}^0 - S_{j,-1}^0 | D_i = 0] = 0.0471 \tag{6}$$

The difference-in-difference estimator is significantly positive. The implicit identifying assumption is that if none of the investors had moved together with an economist the change in stock market participation rates would have been the same for the two groups of investors, i.e. the change in the stock market participation rate of the investors actually not moving together with an economist serves to benchmark common year and/or age effects among the investors.

In summary, the stock market participation rate of investors that move together with an economist increases as a result of their social interaction with the economist.

5.5 Closing Remarks

We conclude this section by noting that it is never possible to perfectly distinguish between two unobserved individual characteristics such as e.g. the level of information and risk aversion.

[24] In order to observe the investors and all the control variables both in the year before and the year after they start cohabiting with an economist, we only consider investors who move together with an economist in the penultimate year of the sample, namely year 2000. 675 investors move together with an economist in 2000.

[25] An alternative measure is the so-called before-after estimator that compares the participation rates of investors the year before and the year after they move together with an economist. The before-after estimator is also significantly positive, but not shown here so as to save space.

In other words, an econometrician cannot determine with certainty that a given individual invests more in stocks because the individual knows more about stocks. What we have done in this section, though, is to present results from five kinds of analyses that we believe indicate that more economists hold stocks because they know more about economics, stock markets, and investment opportunities in general.

6 Further Robustness Tests

In this section we provide further evidence of the robustness of the results. To this end we conduct a number of probit estimations, some with additional explanatory variables compared to the basic probit model and others based on stratified subsamples. The results from the robustness tests are not tabulated, but available upon request.

6.1 Stratified Subsamples

Since the fixed monetary costs are less important for wealthier investors, we run the basic probit model on stratified subsamples consisting of the investors in the higher end of the income distribution. More precisely, we run two estimations using only investors in the top quartile and top decile of the income distribution, respectively. For both estimations, the economics education remains the most important educational indicator for the stock market participation.

Different age groups may have different preferences, hence cohorts might behave differently investment wise. In the basic probit model, we control for this by including age among the explanatory variables. Here, to get an even cleaner picture, we estimate the basic probit model using three samples consisting only of cohorts aged 25-35, 35-45, and 45-55, respectively. Cohort effects might also exist when we control for observed individual fixed effects, e.g. the fixed individual income effect of older cohorts may be overestimated compared to the fixed individual income effect of the younger cohort. Therefore, we also estimate the probit model with individual effects using the same three cohorts. For all three age groups and in both estimations, the marginal effect of the economics education is by far the largest and all other qualitative results hold as well.

Thus, we conclude that neither income nor cohort effects are driving our results.

6.2 Dynamic Probit Model

An interesting extension of our model is a dynamic model with state dependence which captures the fact that current behavior on the financial markets depends on past behavior. This

extends the work by Alessie, Hochguertel & van Soest (2004) who find that the dynamics of stock market participation are driven both by unobservable individual heterogeneity and state dependence. If the investor participated in the stock market last period, the investor has already paid part of the participation costs, and probably has more knowledge about investment opportunities than current non-participants. Thus, we expect that participation last period has a positive effect on the probability of participating this period. This is indeed what we find when we estimate the basic probit model extended with the 1-period lagged stock market participation indicator as an additional explanatory variable. The largest marginal effect is from the lagged stock market participation indicator and it equals 0.88, which reveals that stock market participation is highly persistent over time. The marginal effect from the bond market participation indicator falls. However, the marginal effect from being an economist is much larger than for any of the other educational groups.

6.3 Residence and Occupation

We verify that residence and occupation of investors are not spuriously driving our results.

Including three dummy variables for investors living in Copenhagen, the suburbs of Copenhagen, and the other big cities in Denmark into the basic probit model, imply that city dwellers have significantly lower probabilities of investing in stocks. Yet, including the city dummies does not influence our results.[26]

We also find that investors employed in the financial sector (banks, finance, and insurance companies) as well as self-employed and high-level employees have a significantly higher probability of participating in the stock market than otherwise comparable investors. However, including these occupational explanatory variables does not change any of our conclusions.

We do not include indicators for residence and occupation in our basic probit model because they can be considered confounders of the educational effect as they are partly outcomes of the investor's education.

7 Conclusion

It is puzzling that so few individuals hold stocks. In our data, only 23% of the investors have decided to actively participate in the stock market, even though standard portfolio theory

[26] Goetzmann, Massa and Siminov (2004) investigate how city agglomeration affects portfolio choice. Our study is different from theirs as we investigate the decision to participate in the stock market whereas they investigate the effect of city agglomeration on the kind of, and the number of, risky assets that investors include in their portfolio.

predicts that all investors should hold some fraction of risky assets in their wealth portfolio.

A promising explanation of the stock market participation puzzle is that there are costs associated with stock market participation which deter individuals from entering the stock market. Such costs include both the monetary costs associated with stock investments and costs that reflect the time spent on understanding risk-return trade-offs and general information about stock markets. Thus, if some agents are better able to gather and understand information about investment opportunities and stock markets, their effective costs of stock market participation will be lower and consequently they will have a higher probability of participating in the stock market. Previous studies have shown that income, wealth, and length of education are important factors in explaining the stock market participation, but our study is the first to apply detailed educational information. In particular, we test the hypothesis that economists have a higher probability of investing in stocks due to informational advantages. This is done by estimating a probit model where we use a unique register-based panel data set covering the period 1997-2001 comprising more than 1.87 million observations on individual investor choices at year-end, as well as a wide range of other background characteristics assumed to affect the investment choices.

We confirm the hypothesis that economists have a higher probability of holding stocks. The result is astonishingly clear; A formal education in economics implies that the probability of participating in the stock market is higher than for any other educational background. Our result that economists have a higher probability of holdings stocks is robust across a wide range of robustness specifications including accounting for unobserved individual heterogeneity. IV analysis shows that the economics education has a causal effect on stock market participation.

In the present paper we only focus on the decision of investors to participate in the stock market or not. Since investors first decide whether to participate or not, and then decide the degree of participation (i.e. the amount to invest), an interesting future extension is to analyze the proportion of investors' financial wealth invested in stocks conditional on participation. To perform this analysis, Vissing-Jørgensen (2002) estimates a sample selection model that corrects for the selection of individuals into the group of stock market participants. Our suggestion would provide an extension of Vissing-Jørgensen (2002), since she has neither access to as detailed educational information as we have, nor as detailed financial variables.

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A IV Analysis: Validity of Instrument

In this appendix we corroborate that the opening of Aalborg University is a strong instrument.

A.1 Comparing High School Cohorts

If individuals are randomly assigned to one of the two high school cohorts, any subsequent observed differences are attributable to differences in higher educational choices caused by the university opening. However, if there are systematic and significant differences between observable characteristics of the two high school cohorts at high school graduation, one might question that the two cohorts have similar distributions of unobservable characteristics. Therefore, we compare the distribution of the type of high school completed (e.g. traditional academic track, technical track or business high school track), the municipality within the county, and the age distribution of the two high school cohorts at high school graduation. t-tests of equal means cannot be rejected. Hence, the two high school cohorts appear to be identical at high school graduation.

A.2 Corresponding High School Cohorts

Other macroeconomic factors could affect the two high school cohorts differently. We use the corresponding high school cohorts from the County of Aarhus as a control group. The high school graduates from the two counties are presumably affected in the same way by macroeconomic factors. However, the (mobility) costs for the control group of acquiring an economics education are not affected by the opening of Aalborg University, since economics educations at Aarhus based universities are still the closest. The descriptive statistics show that the high school cohorts are comparable. The basic probit model based on the County of Aarhus subsample shows that having a formal education in economics increases the stock market participation probability by 14 percentage points (same as for the County of Northern Jutland subsample). However, in the County of Aarhus about 3% in both high school cohorts complete an economics education. Hence it is not a valid instrument for this subsample. This is also revealed from the bivariate probit model: The instrument is insignificant in the economics selection equation and the economics indicator is insignificant in the stock market participation equation.

Table 1: Descriptive Statistics

Variables	Mean All	Mean Economists
Age	45.34	40.92
	(16.63)	(12.76)
Married	0.5152	0.5664
Male	0.4982	0.5395
Children 0-6 Years	0,1420	0.2187
Children 7-18 Years	0.1709	0.1965
Non-capital Income	235636	373736
	(224694)	(583887)
Cash Holdings	-18273	-41119
	(487937)	(598725)
Taxable Property Value	366822	541370
	(861801)	(1246691)
Private Pension Contribution	2497	3290
	(20654)	(21117)
Public Pension Contribution	11372	32284
	(33445)	(86643)
Bond Market Participation Rate	0.0821	0.1286
KFX Return	0.2005	
	(0.2225)	
Student, Goverment Grant	0.0743	0,0750
Student, Wage	0.0362	0.0243
Length of Education	11.31	14.13
	(3.007)	(2.526)
Educator/Teacher	0.0500	
Humanities/Arts	0.0190	
Argriculture/Food/Forestry/Fishing	0.0598	
Business (excl. Economics)	0.1267	
Social Science (excl. Economics)	0.0334	
Health Care	0.0622	
Natural Sciences/Technical Educations	0.1898	
Police/Armed Forces/Transportation	0.0112	
High School	0.1026	
Basic School/Preparatory School	0.3257	
Economics	0.0246	

Notes to Table 1: The table shows summary statistics for the entire sample (column 1) and for economist (column 2). For indicator variables the proportion of the sample included in the group is shown. Otherwise, the table provides the mean and standard deviation in parenthesis.

Table 2: Basic Probit Model for Stock Market Participation

Explanatory Variables	**βs**	**dΦs/dx**
Intercept	-2.2292 ***	
	(0.0081)	
Age	0.0164 ***	0.0045
	(0.0001)	(0.0000)
Married	0.0348 ***	0.0095
	(0.0024)	(0.0007)
Male	0.0233 ***	0.0064
	(0.0025)	(0.0007)
Children 0-6 Years	-0.0540 ***	-0.0145
	(0.0036)	(0.0010)
Children 7-18 Years	-0.1268 ***	-0.0334
	(0.0032)	(0.0008)
Bond Market Participation	0.9538 ***	0.3311
	(0.0037)	(0.0015)
Non-Capital Income/1,000,000	0.5082 ***	0.1392
	(0.0074)	(0.0021)
Cash Holdings/100,000	0.0251 ***	0.0069
	(0.0002)	(0.0001)
Taxable Property Value/100,000	0.1897 ***	0.0519
	(0.0015)	(0.0004)
Cumpulsory Pension Contribution /10,000	0.0106 ***	0.0029
	(0.0004)	(0.0001)
Private Pension Contribution/10,000	0.0334 ***	0.0091
	(0.0007)	(0.0002)
KFX	0.1760 ***	0.0482
	(0.0056)	(0.0015)
Student, Government Grant	0.1353 ***	0.0389
	(0.0058)	(0.0017)
Student, Wage	0.0120 *	0.0033
	(0.0069)	(0.0019)
Spouse Education, Economics	0.0954 ***	0.0271
	(0.0070)	(0.0021)
Length of Education	0.0249 ***	0.0068
	(0.0007)	(0.0002)
Educator/Teacher	-0.0744 ***	-0.0198
	(0.0079)	(0.0020)
Humanities/Arts	-0.0378 ***	-0.0102
	(0.0101)	(0.0027)
Agriculture/Food/Forestry/Fishing	0.0972 ***	0.0276
	(0.0061)	(0.0018)
Business/Commercial (excl. Economics)	0.1497 ***	0.0430
	(0.0047)	(0.0014)
Social Science (excl. Economics)	0.0265 ***	0.0073
	(0.0077)	(0.0022)
Health Care	0.0249 ***	0.0069
	(0.0067)	(0.0019)
Natural Sciences/Technical Educations	0.0902 ***	0.0253
	(0.0048)	(0.0014)
Police/Armed Forces/Transportation	-0.0115	-0.0031
	(0.0119)	(0.0032)
High School	0.1464 ***	0.0421
	(0.0057)	(0.0017)
Economics	0.5414 ***	0.1780
	(0.0079)	(0.0030)
Observed Probability, P_1	0.2310	
Predicted Prob. (at mean), P_1	0.1928	
Log likelihood	-876171	
Pseudo R-square	0.1333	
Number of Observations	1870324	
Number of Investors	405271	

Notes to Table 2: The table shows the parameter estimates and the marginal effects from the probit regression with IID error terms. The dependent variable is the stock market indicator. The comparison groups are women, not married, not having children below 18 living at home, not undertaking an education, and basic school as highest completed education. The first column provides the parameter estimates and the second column the marginal effects, (standard errors in parentheses). ***, **, * indicates parameter significance at the 1%, 5%, 10% level of significance, respectively.

Table 3: Probit Model for Stock Market Participation with Individual Effects

Explanatory Variables	βs	dΦs/dx
Intercept	-6.2471 ***	
	(0.0518)	
Age	0.0386 ***	0.0004
	(0.0006)	(0.0000)
Married	-0.2232 ***	-0.0021
	(0.0149)	(0.0002)
Male	0.1237 ***	0.0011
	(0.0125)	(0.0001)
Children 0-6 Years	0.0945 ***	0.0010
	(0.0152)	(0.0002)
Children 7-18 Years	0.0179	0.0002
	(0.0149)	(0.0001)
Bond Market Participation	-0.0933 ***	-0.0008
	(0.0111)	(0.0001)
Non-Capital Income/1,000,000	0.5621 ***	0.0052
	(0.0228)	(0.0004)
Cash Holdings/100,000	0.0029 ***	0.0000
	(0.0008)	(0.0000)
Taxable Property Value/100,000	-0.0460 ***	-0.0004
	(0.0083)	(0.0001)
Cumpulsory Pension Contribution /10,000	0.0061 ***	0.0001
	(0.0009)	(0.0000)
Private Pension Contribution/10,000	0.0168 ***	0.0002
	(0.0014)	(0.0000)
KFX	0.4083 ***	0.0038
	(0.0112)	(0.0002)
Student, Government Grant	-0.0980 ***	-0.0008
	(0.0183)	(0.0002)
Student, Wage	-0.1056 ***	-0.0009
	(0.0200)	(0.0002)
Spouse Education, Economics	0.1558 ***	0.0018
	(0.0470)	(0.0007)
Length of Education	0.0022	0.0000
	(0.0087)	(0.0001)
Educator/Teacher	-0.2461 ***	-0.0017
	(0.0893)	(0.0004)
Humanities/Arts	-0.0608	-0.0005
	(0.1026)	(0.0008)
Agriculture/Food/Forestry/Fishing	-0.0017	0.0000
	(0.0764)	(0.0007)
Business/Commercial (excl. Economics)	0.0250	0.0002
	(0.0690)	(0.0007)
Social Science (excl. Economics)	0.0328	0.0003
	(0.0657)	(0.0007)
Health Care	-0.0961	-0.0008
	(0.0753)	(0.0005)
Natural Sciences/Technical Educations	0.0568	0.0005
	(0.0652)	(0.0007)
Police/Armed Forces/Transportation	-0.0828	-0.0007
	(0.1121)	(0.0008)
High School	-0.0718	-0.0006
	(0.0526)	(0.0004)
Economics	0.7149 ***	0.0174
	(0.0835)	(0.0044)

Table 3 *continued*

Mean(Married)	0.3853 ***	0.0035
	(0.0198)	(0.0003)
Mean(Children 0-6 Years)	-0.0482 *	-0.0004
	(0.0278)	(0.0003)
Mean(Children 7-18 Years)	-0.1933 ***	-0.0018
	(0.0228)	(0.0002)
Mean(Bond Market Participation)	4.7770 ***	0.0439
	(0.0278)	(0.0026)
Mean(Non-Capital Income/1,000,000)	-0.4641 ***	-0.0043
	(0.0291)	(0.0004)
Mean(Cash Holdings/100,000)	0.0460 ***	0.0004
	(0.0008)	(0.0000)
Mean(Taxable Property Value/100,000)	0.4265 ***	0.0039
	(0.0098)	(0.0003)
Mean(Compulsory Pension Contribution/10,000)	0.0546 ***	0.0005
	(0.0016)	(0.0000)
Mean(Private Pension Contribution/10,000)	0.2042 ***	0.0019
	(0.0038)	(0.0001)
Mean(Spouse Education, Economics)	0.0023	0.0000
	(0.0638)	(0.0006)
Mean(Length of Education)	0.0695 ***	0.0006
	(0.0096)	(0.0001)
Mean(Educator/Teacher)	0.2122 **	0.0020
	(0.0991)	(0.0009)
Mean(Humanities/Arts)	-0.1247	-0.0011
	(0.1161)	(0.0011)
Mean(Agriculture/Food/Forestry/Fishing)	0.3324 ***	0.0031
	(0.0837)	(0.0008)
Mean(Business/Commercial (excl. Economics))	0.3127 ***	0.0029
	(0.0738)	(0.0007)
Mean(Social Science (excl. Economics))	0.0779	0.0007
	(0.0794)	(0.0007)
Mean(Health Care)	0.2154 ***	0.0020
	(0.0826)	(0.0007)
Mean(Natural Sciences/Technical Educations)	0.1008	0.0009
	(0.0702)	(0.0006)
Mean(Police/Armed Forces/Transportation)	0.5105 ***	0.0047
	(0.1331)	(0.0012)
Mean(High School)	0.2753 ***	0.0025
	(0.0613)	(0.0006)
Mean(Economics)	1.2598 ***	0.0116
	(0.0918)	(0.0009)
σ^c	2.9984	
	(0.0064)	
ρ	0.8999	
	(0.0004)	
Log likelihood	-440884	
LR test of $\rho = 0$	840000	
Number of Observations	1870324	
Number of Investors	405271	

Notes to Table 3: The table shows the parameter estimates and the marginal effects from the probit regression with individual effects. The dependent variable is the stock market indicator. The comparison groups are women, not married, not having children below 18 living at home, not undertaking an education, and basic school as highest completed education. The first column provides the parameter estimates and the second column the marginal effects, (standard errors in parentheses). ***, **, * indicates parameter significance at the 1%, 5%, 10% level of significance, respectively. The marginal effects of the explanatory variables are calculated as the average effects on the choice probability of stock market participation conditional on the unobserved random individual effects being at its mean values, $c_i = 0$. σ_c indicates the cross-individual standard deviation relative to the within-individual standard deviation, and ρ indicates the proportion of total variance contributed by the individual specific variance component.

Table 4: IV Analysis

	Probit	Bivariate probit	
	Stock market Participation	Stock market Participation	Economics Selectioneq.
Explanatory Variables	βs (Std. Err) [dΦs/dx]	βs (Std. Err) [dΦs/dx]	βE (Std. Err) [dΦE/dx]
Intercept	-0.2539	-0.1653	-4.2329
	(0.4853)	(0.4843)	(0.9500)
	[0.0000]	[0.0000]	[0.0000]
Age	0.0027	0.0024	0.0189
	(0.0093)	(0.0093)	(0.0172)
	[0.0010]	[0.0009]	[0.0012]
Married	0.0340	0.0214	0.2019 *
	(0.0594)	(0.0593)	(0.1133)
	[0.0122]	[0.0077]	[0.0120]
Male	0.0819	0.0703	0.1720
	(0.0548)	(0.0547)	(0.1044)
	[0.0296]	[0.0254]	[0.0110]
Children 0-6 Years	0.1375 *	0.1171	0.1629
	(0.0731)	(0.0735)	(0.1205)
	[0.0506]	[0.0431]	[0.0116]
Children 7-18 Years	0.0868	0.1151 **	-0.4021 ***
	(0.0578)	(0.0586)	(0.1040)
	[0.0312]	[0.0414]	[-0.0281]
Bond Market Participation	0.7876 ***	0.7230 ***	0.4839 ***
	(0.0973)	(0.1063)	(0.1454)
	[0.3044]	[0.2799]	[0.0456]
Non-Capital Income/1,000,000	-0.2310 *	-0.2860 **	0.5610 ***
	(0.1260)	(0.1270)	(0.1680)
	[-0.0835]	[-0.1030]	[0.0357]
Cash Holdings/100,000	0.0073 *	0.0074 *	-0.0029
	(0.0038)	(0.0038)	(0.0064)
	[0.0026]	[0.0027]	[-0.0002]
Taxable Property Value/100,000	0.0167 ***	0.0164 ***	-0.0029
	(0.0040)	(0.0040)	(0.0075)
	[0.0060]	[0.0060]	[-0.0002]
Cumpulsory Pension Contribution /10,000	0.0488 ***	0.0463 ***	0.0122
	(0.0091)	(0.0092)	(0.0127)
	[0.0176]	[0.0168]	[0.0008]
Private Pension Contribution/10,000	0.0956 ***	0.1000 ***	-0.0753 **
	(0.0165)	(0.0165)	(0.0318)
	[0.0345]	[0.0363]	[-0.0048]
KFX	0.0685	0.0674	-0.0254
	(0.1308)	(0.1299)	(0.2379)
	[0.0247]	[0.0244]	[-0.0016]
Spouse Education, Economics	-0.2509 **	-0.3598 ***	0.8034 ***
	(0.1276)	(0.1385)	(0.1528)
	[-0.0853]	[-0.1192]	[0.0996]
Length of Education	-0.0460 ***	-0.0503 ***	0.0706 ***
	(0.0114)	(0.0115)	(0.0225)
	[-0.0166]	[-0.0182]	[0.0045]
Economics	0.3780 ***	1.3521 **	
	(0.1310)	(0.5586)	
	[0.1444]	[0.4939]	
University opening indicator			0.2446 **
			(0.0986)
			[0.0152]
Observed Probability, P_1	0.3324	0.3324	0.0394
Predicted Prob. (at mean), P_1	0.3268	0.3298	0.0276
Log likelihood	-1671.4936	-2,032.2924	
Pseudo R-square	0.0595		
Number of Observations	2795	2795	
Number of Investors	577	577	

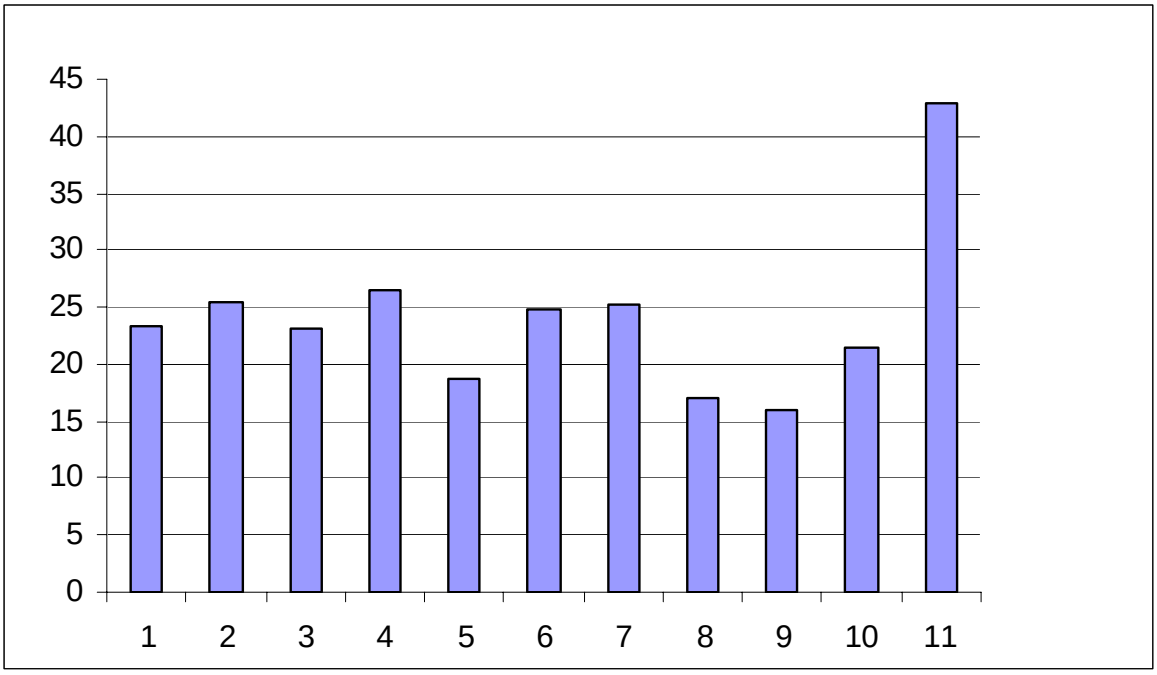
Notes to Table 4: The table shows the results from the IV analysis based on a subsample of investors from the County of Northern Jutland who graduated from high school in 1972-1975. The first column shows parameter estimates (standard errors in parentheses) and their marginal effects [in square brackets] from the probit model. The second and third columns regard the IV analysis, and show the parameter estimates (standard errors in parentheses) and their marginal effects [in square brackets] from the bivariate probit model. The second column concerns the stock market participation equation and the third column concerns the economics selection equation.

Table 5: Probit Model for Stock Market Participation - At least 18 Years of Schooling

Explanatory Variables	**βs**	**dΦs/dx**
Intercept	-2.3511 ***	
	(0.2148)	
Age	0.0133 ***	0.0049
	(0.0005)	(0.0002)
Married	-0.0838 ***	-0.0310
	(0.0113)	(0.0042)
Male	0.0669 ***	0.0245
	(0.0108)	(0.0040)
Children 0-6 Years	0.0119	0.0044
	(0.0130)	(0.0048)
Children 7-18 Years	-0.1410 ***	-0.0511
	(0.0119)	(0.0042)
Bond Market Participation	0.9322 ***	0.3577
	(0.0137)	(0.0050)
Non-Capital Income/1,000,000	0.2846 ***	0.1048
	(0.0186)	(0.0069)
Cash Holdings/100,000	0.0203 ***	0.0075
	(0.0008)	(0.0003)
Taxable Property Value/100,000	0.0781 ***	0.0288
	(0.0050)	(0.0018)
Cumpulsory Pension Contribution /10,000	0.0140 ***	0.0052
	(0.0010)	(0.0004)
Private Pension Contribution/10,000	0.0133 ***	0.0049
	(0.0015)	(0.0006)
KFX	0.1542 ***	0.0568
	(0.0241)	(0.0089)
Student, Government Grant	-0.0120	-0.0044
	(0.0307)	(0.0113)
Student, Wage	-0.0095	-0.0035
	(0.0282)	(0.0103)
Spouse Education, Economics	0.0609 ***	0.0227
	(0.0215)	(0.0081)
Length of Education	0.0559 ***	0.0206
	(0.0116)	(0.0043)
Educator/Teacher	-0.2489 ***	-0.0865
	(0.0612)	(0.0198)
Humanities/Arts	-0.1838 ***	-0.0660
	(0.0355)	(0.0124)
Agriculture/Food/Forestry/Fishing	0.1762 ***	0.0667
	(0.0391)	(0.0151)
Business/Commercial (excl. Economics)	0.1150 **	0.0432
	(0.0511)	(0.0196)
Social Science (excl. Economics)	-0.1258 ***	-0.0455
	(0.0356)	(0.0126)
Health Care	0.0473	0.0175
	(0.0357)	(0.0133)
Natural Sciences/Technical Educations	0.0356	0.0131
	(0.0347)	(0.0129)
Economics	0.1919 ***	0.0725
	(0.0364)	(0.0140)
Observed Probability, P_1	0.3543	
Predicted Prob. (at mean), P_1	0.3446	
Log likelihood	-46890	
Pseudo R-square	0.1290	
Number of Observations	82817	
Number of Investors	19233	

Notes to Table 5: The table shows the parameter estimates and the marginal effects from the probit regression with IID error terms conducted for a subsample of investors with at least 18 years of schooling. The dependent variable is the stock market indicator. The comparison groups are women, not married, not having children below 18 living at home, not undertaking an education, and police/armed forces/transportation as highest completed education. The first column provides the parameter estimates and the second column the marginal effects, (standard errors in parentheses). ***, **, * indicates parameter significance at the 1%, 5%, 10% level of significance, respectively.

Figure 1: Stock Market Participation Rates across Educational Groups



Notes to Figure 1: The figure shows the proportion (in percentage) of investors who hold stocks across educational groups, 1997-2001. Subject 1: Education. Subject 2: Humanities/arts. Subject 3: Agriculture/food/forestry/ fishing. Subject 4: Business/Commercial (excluding economists). Subject 5: Social sciences (excluding economists). Subject 6: Health care. Subject 7: Natural sciences/technical educations. Subject 8: Police/armed forces/transportation. Subject 9: High school Subject 10: Basic school/preparatory school Subject 11: Economics.

Figure 2: Stock Market Participation over Time

Notes to Figure 2: The figure shows the time-series of the proportion (in percentage) of investors (all and economists) who hold stocks.

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