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Abstract

Using the Survey of Consumer Finances data about individual stocks ownership, I compare households' decision to invest in domestic versus foreign stocks. The data show that information plays a larger role in households' decision to enter foreign stock markets. Households that invest in foreign stocks are more sophisticated in their sources of information – they use the Internet more often as a main source of information, talk to their brokers, trade more frequently, and shop more for investment opportunities. Adding to the wedge between the two groups of investors, foreign stock owners are also substantially wealthier, more educated, and less risk averse than households who focus on domestic stocks only. Furthermore, ownership of foreign stocks increases if the household is headed by women.

JEL classification codes: G11, G14, G15, F21
Keywords: foreign stocks, household portfolios, participation, information

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1 Introduction

One of the main puzzles in the household finance literature is the so-called participation puzzle: a large fraction of the population does not participate in the stock market. It is also puzzling that a much greater share of households do not participate in foreign stock markets, despite the well-known gains from keeping a diversified portfolio of assets.[1] While substantial normative and positive analysis has tried to explain the drivers of household holdings of *domestic* stocks, there is limited knowledge about households' decision to own *foreign* stocks.

The household finance literature describes the decision to invest in stocks as a two-step process, in which households first decide whether or not to enter the stock market, and subsequently decide on the share and type of assets to hold in their portfolios. The international finance literature has mostly focused on the second step, i.e., the decision about the *share* of foreign assets to hold in their portfolios, documenting a large home bias on households' portfolio holdings. More recently, the latter literature has pointed toward the role of information in explaining agents' small share of foreign assets (e.g., Veldkamp and Van Nieuwerburgh (2010) and Mondria and Wu (2010)).

However, preceding investors' choice about the share of foreign assets to hold is the decision on whether to own foreign assets, in particular, foreign stocks. Hence, in this paper, I take one step back from the literature and try to assess empirically whether there is role for information acquisition in explaining the first step, i.e., the decision to enter the foreign stock market. Are foreign stocks holders more attentive? Is there a role for information acquisition in the ownership decision? Is there empirical evidence that can help answer these questions?

Theoretically, a simple extension of the model developed by Abel et al. (2007), to account for the possibility of investing in more than one type of risky asset, indicates a positive answer to the first two questions. Consumers/investors that tilt their portfolio to riskier assets by also investing in foreign stocks are more attentive and update their information set more frequently.

Motivated by these theoretical predictions, I try to answer the questions of interest empirically. The Survey of Consumer Finances inquires households about their holdings of individual foreign and domestic stocks, and several questions regarding their information acquisition when making investment decisions. In particular, survey respondents are asked to list their main sources of information, and how frequently they talk to financial advisers to make investment decisions. Using the Survey of Consumer Finances data, I disentangle *direct* ownership of foreign and domestic stocks, i.e., households that hold individual stocks outside of investment funds, and compare the effect of these informational variables on the probability of holdings either foreign or domestic stocks. If foreign stock holders are more attentive and information plays a role on households' decision to also hold foreign stocks, one would expect to find a stronger relation between these informational variables and ownership among households who own foreign stocks than among those who opt to concentrate on domestic stocks only.

I find that the Survey of Consumer Finances data are informative to the questions of interest and point to a wedge between the aforementioned two groups of stock holders. The results show that households that hold individual foreign stocks seem better informed regarding their financial choices: they use the Internet more often as a main source of information, talk more frequently to their brokers,

[1] For a review of the literature on participation puzzle see Campbell (2006) and Lewis (1999).

and shop more for investment opportunities. Foreign stock holders are also more willing to take risks. I also find a positive relationship between being a female headed household and the probability of holding foreign stock. In addition, wealth and education seem to play a large role in explaining the differences between the two types of investors. Relative to households who hold domestic stocks only, foreign stock investors have higher incomes, financial, real estate, and business wealth. Foreign stock holders also have larger debt levels. Finally, the results indicate that for both foreign and domestic stocks owners there is a role of background risks arising from other investments – households with larger private business wealth have a smaller probability of holding any type of stocks.

The empirical analysis focuses on the comparison between households who hold individual foreign stocks and those who hold domestic stocks only. This is because the Survey of Consumer Finances lacks detailed information about indirect stock ownership. Although the Survey inquires both about stocks held directly and through investment funds, the questionnaire *does not* discriminate between holdings of domestic and foreign stocks held through investment funds, and hence this paper focuses only on direct holders of stocks.[2] While this data limitation constrains my analysis, the data still allow for contrasting two comparable, and *a priori* similar, groups of households, foreign versus domestic-only holders of individual stocks. In addition, information about direct holdings of stocks is potentially a good source for inference about households' own choice of investments, since for this type of investment there is no portfolio manager making the decision for the household.

A natural follow-up question is whether information is also important for holders of foreign stocks through investment funds. Since this question cannot be answered using the Survey of Consumer Finances, I turn to the various reports provided by the Investment Company Institute, which tracks the investment fund industry in the United States. These reports reinforce the results obtained from the Survey of Consumer Finances by confirming the use of Internet as a main source of information, and as a proxy for information acquisition sophistication.[3] The reports also indicate that investors start their financial investments through funds, and later migrate to individual holdings. The Survey of Consumer Finances data analysis confirms these findings showing a positive effect of having stock funds on the probability of owning individual stocks, while keeping unchanged the aforementioned wedge between foreign and domestic holders.

The motivating theoretical framework is presented in Section 2. I depart from the Abel et al. (2007) model by introducing foreign stocks as an additional risky asset. Consumers can invest in a riskless asset and in domestic and foreign stocks. To update their information set and their portfolio of investments, agents have to pay an "observation cost." This simple extension to their model shows that agents who also invest in foreign stocks optimally choose to update their portfolios more frequently. Intuitively, although it is costly to obtain information, consumers that also decide to invest in foreign stocks increase the overall share of risky assets in their total portfolio. These risk averse agents gain from investing in different types of assets but also face larger risks, and hence, they update their information set more frequently.

[2] I complement the analysis by also looking at the estimation results for indirect holdings of stocks and overall equity holdings using the aggregate measure provided in the Survey of Consumer Finances.

[3] The absence of information about foreign stocks held through investment funds also precludes an analysis about the share of foreign assets held, therefore, this paper focuses only on the participation decision, and does *not* study the well-known home bias on agents portfolio of assets. For a survey on home bias, see Lewis (1999).

Section 3 starts exploring the Survey of Consumer Finances and the Investments Company Institute data. It provides an unconditional analysis of households' financial and nonfinancial characteristics, along with their answers to several questions regarding their sources of information and their information acquisition process to make investment decision.

Subsequently, a conditional data analysis is obtained in Section 4 by estimating probability models on the ownership of individual foreign and domestic stocks while controlling for a large set of households characteristics. The regression analysis reinforces the unconditional data predictions that foreign stock investors seem distinct from those who hold domestic stocks only – relative to households who hold individual domestic stocks only, households that hold foreign stocks are more sophisticated in their sources of information, referring more frequently to the Internet, newspapers and talking more frequently to their broker. As previously described, the later households are also distinct in their wealth, taking characteristics, and gender. I also reestimate the main results while constraining the sample among holders of individual stocks (domestic or foreign). This regression provides a direct estimation of the "wedge" between foreign and domestic holders. The results corroborate with those obtained with the unconstrained estimations.

Section 5 discusses possible estimation caveats, such as the limited number of holders of individual stocks, and considers alternative samples and estimation methods to solve these problems. This section also discusses the role of wealth on the probability of holding foreign stocks, and provides an analysis of marginal effects of the Internet on the probability of holding either type of assets. Finally, Section 6 concludes.

This paper relates to the literature on households' portfolios and the participation puzzle. The latter literature is vast, with a substantial documentation and analysis of household portfolios available in Guiso et al. (2002) and a summary by Campbell (2006). A highly studied reason for such low participation is participation costs, but the literature shows that participation costs alone are not enough to account for the large fraction of the population that remains out of the stock market. Vissing-Jorgensen (2003) and Attanasio and Vissing-Jorgensen (2003) explore the interactions of transaction costs, participation costs, and large risk aversion; Curcuru et al. (2009) introduce a short-sale constraint as an additional source of limitation to participation. Recent papers incorporate information as one factor that drives participation in stock markets. Abel et al. (2007) introduce an information update cost into investor problems; Alvarez et al. (2010) look at the effects of introducing consumption of durable goods on agents; Veldkamp and Van Nieuwerburgh (2010) look at the optimal amount of information needed to acquire; Huang and Liu (2007) assume that agents can extract a signal from asset returns and analyze how information processing affects their portfolio decisions; and Kyrychenko and Shum (2009) use the same Survey of Consumer Finance data to analyze the decision to hold foreign stocks and bonds and find that among holder of those two assets, the extent of the so-called home bias is very limited. This work also relates to the classic papers such as Merton (1969, 1971, and 1973) and Samuelson (1969), where agents take positions in all assets available and the portfolio shares are constant over the life cycle. Finally, this paper also relates to Baumol (1952) and Miller and Orr (1966) who look at the effects of transaction costs in cash-in-advance models (in their model, consumers hold cash to finance consumption between updating periods, when they remain inactive).

2 Motivating framework – a model with costly information

The home bias puzzle literature has entertained models that relate agents' relative share of foreign assets to information acquisition, e.g., Veldkamp and Van Nieuwerburgh (2010) and Mondria and Wu (2010). The household finance literature has developed models that relate holdings of risky assets to investors' information acquisition, e.g., Abel et al. (2007), Abel et al. (2009), and Gabaix and Laibson (2002). In particular, the Abel et al. (2007) relates investment allocation to the frequency at which consumers update their information set. In their model consumers can invest in a risk-free bond and a risky asset (such as a stock). To update and decide on whether to rebalance their portfolio, consumers must pay a fixed cost proportional to their wealth. The authors find that consumers/investors optimally choose to update their information set and portfolio infrequently.

One may consider whether there is a relation between holdings of foreign assets and information. To study a possible channel through which information may play a role on the decision to hold foreign stocks, I depart from Abel et al. (2007) model and introduce foreign stocks as an additional asset to consumers' portfolio choice. Hence, besides holding a riskless asset, consumers can also invest in two types of stocks, labeled as Domestic and Foreign, which are meant to proxy for investments in domestic and foreign stocks on consumers' portfolio of assets. This simple extension of Abel et al. (2007) allows for a discussion of the role of information acquisition on agents' stock holdings.

2.1 The model – investment decision and attention

In the model, consumers hold wealth in an investment portfolio and in a riskless liquid asset used for transactions. If the consumer decides to enter the stock market, the investment portfolio is composed of a riskless bond and risky stocks, domestic and foreign. To observe the value of her wealth and portfolio of assets, the consumer pays a fixed cost, θ, proportional to the contemporaneous value of wealth.

The consumer maximizes:

$$E_t \int_0^\infty \frac{1}{1-\alpha} c_{t+s}^{1-\alpha} e^{-\rho s} ds, \tag{1}$$

where c stands for consumption, $0 < \alpha \neq 1$ is the inverse of the intertemporal elasticity of substitution, and $\rho > 0$ is the intertemporal rate of discount.

The investment portfolio is composed of a riskless bond that pays a constant rate of return $r > 0$, and of nondividend paying domestic and foreign stocks with prices D_t and F_t, respectively. Stock prices $P_t = \binom{D_t}{F_t}$ are assumed to follow a geometric Brownian motion:

$$\begin{aligned} \frac{dP_t}{P_t} &= \mu dt + \Omega^{\frac{1}{2}} dZ, \\ \mu &> R, \\ & \text{where:} \\ \mu &= \begin{pmatrix} \mu_d \\ \mu_f \end{pmatrix}, R = \begin{pmatrix} r \\ r \end{pmatrix} \\ \Omega &= \begin{pmatrix} \sigma_d^2 & \sigma_{df} \\ \sigma_{df} & \sigma_f^2 \end{pmatrix}, \end{aligned}$$

and Z is a Wiener process, μ_d and μ_f are returns on domestic and foreign stocks, respectively, and Ω is the variance-covariance matrix of stock returns.[4]

The consumer can observe the investment portfolio by paying a fraction θ, $0 \leq \theta < 1$, of the contemporaneous value of her wealth.[5] She can only withdraw funds from the portfolio if she observes its value. Hence, to finance consumption within observation periods, the consumer also holds a riskless liquid asset that pays r^L, with $0 \leq r^L < r$.

Let t_j, $j = 1, 2, 3, ...$, be the times at which the consumer observes the value of her portfolio. At time t_j, she chooses: (i) the next "*observation date,*" $t_{j+1} = t_j + \tau$; (ii) the amount of the riskless liquid asset, $X_{t_j}(\tau)$, to finance consumption from t_j to t_{j+1}; and (iii) the shares $\phi = \binom{\phi_d}{\phi_f}$ invested in domestic, ϕ_d, and foreign stocks, ϕ_f.

Between observation dates, from time t_j to $t_j+\tau$, the amount of riskless assets to finance consumption is:

$$X_{t_j}(\tau) = \int_0^\tau c_{t_j+s} e^{-r^L s} ds. \tag{2}$$

Since $r^L < r$, when observation time arrives, the amount held in the riskless asset will have reached zero, i.e., $X_{t_\tau} = 0$. At this time, the consumer pays the observation cost, θ, and observes the value of her wealth that equals:

$$W_{t_{j+\tau}} = (1 - \theta)\left(W_{t_j} - X_{t_j}\right) R\left(t_j, t_j + \tau\right),$$

where $\mathcal{R}(t_j, t_j + \tau)$ is the gross rate of return to investment from time t_j and $t_j + \tau$, and $\mathcal{R}(t_j, t_j) = 1$.

For simplicity, I follow Abel et al. (2007) and also assume that, between observation times (t_j and t_{j+1}), a portfolio manager continuously rebalances the portfolio to maintain a fixed proportion of assets invested in stocks.[6] In this case, the portfolio return follows a geometric Brownian motion:

$$\frac{d\mathcal{R}(t_j, t_j + s)}{\mathcal{R}(t_j, t_j + s)} = \left[r + \phi'(\mu - R)\right] ds + \phi' \Omega^{1/2} dZ.$$

I solve the consumer's problem in four steps: the consumption choice between two consecutive observation dates; the choice of riskless assets and the share invested in stocks; and two final steps that uncover the value function and the optimal observational frequency. Proposition 1 highlights the main results. The Appendix provides detailed derivations, proposition proofs and additional results.

Proposition 1 *The solution to the consumer's problem implies the following:*

a. *The value function is such that*

$$V(W) = \gamma(\tau) \frac{W^{1-\alpha}}{1-\alpha}, \tag{3}$$

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[4] I follow Abel et al. (2007) and assume constant return and volatility of returns. Rossi (2010) studies a case with time variant returns but abstracts from alternative risky assets.

[5] Assuming the observation cost as a fraction of wealth allows one to obtain a closed-form solution for the consumer's optimization problem. Gabaix and Laibson (2002) instead assume the observation cost to be constant in terms of utility and obtain an approximate solution for the consumer's problem.

[6] Assuming continuous rebalancing substantially simplifies the solution. Duffie and Sun (1990) work on a version of the model with transaction costs and instead assume that interest payments are reinvested in bonds and dividends are reinvested in equity.

where:

$$\gamma(\tau)=\left[\frac{1-e^{-\omega\tau}}{1-\chi e^{-\lambda\tau}}\right]^{\alpha}\omega^{-\alpha}. \tag{4}$$

b. *The optimal shares held in domestic and foreign stocks equal:*

$$\phi^{*}=\frac{1}{\alpha}\Omega^{-1}(\mu-R).$$

c. *The consumer optimally chooses to observe and update her portfolio at time τ^{*}, obtained from solving*

$$\frac{(\omega-\lambda)}{\omega}e^{-\lambda\tau^{*}}+\frac{\lambda}{\omega}e^{(\omega-\lambda)\tau^{*}}-\frac{1}{\chi}=0. \tag{5}$$

A second-order approximation to this equation yields

$$\hat{\tau}^{*}=\left(\frac{2\left(\chi^{-1}-1\right)}{(\omega-\lambda)\lambda}\right)^{\frac{1}{2}}, \tag{6}$$

where $\chi=(1-\theta)^{\frac{(1-\alpha)}{\alpha}}$, $\omega=\frac{\left(\rho-(1-\alpha)r^{L}\right)}{\alpha}$ *and* $\lambda=\frac{\rho-(1-\alpha)\left(r+\frac{1}{2}\frac{1}{\alpha}(\mu-R)'\Omega^{-1}(\mu-R)\right)}{\alpha}$.[7]

Note that between observation times, the share invested in foreign and domestic stocks is fixed at ϕ^{*}, and so is the frequency of updating $\hat{\tau}^{*}$. Every time the consumer updates her information set, she gathers new information about investment return and risks (r^{L}, r, μ and Ω) and reoptimizes her investment decision, choosing new levels of ϕ^{*} and $\hat{\tau}^{*}$. The portfolio manager rebalances the portfolio at each period, to guarantee that ϕ^{*} is kept fixed between observation periods.

2.2 Participation in domestic stock markets only

The decision problem of an investor who only holds domestic stocks is isomorphic to the one presented in the previous section. The solution of a model that excludes foreign stock investments is similar to the one obtained in Proposition 1 and replicates exactly the one extensively described in Abel et al. (2007).

When consumers invest only in domestic stocks, I add a subscript "d" to all relevant variables, and the value function, the optimal share invested in stocks, and the optimal inattention are such that:

$$\begin{aligned} V(W) &= \gamma_{d}(\tau)\frac{W_{0}^{1-\alpha}}{1-\alpha}, \\ \phi &= \phi_{d}=\frac{1}{\alpha}\frac{(\mu_{d}-r)}{\sigma^{2}}, \\ \hat{\tau}_{d}^{*} &= \left(\frac{2\left(\chi^{-1}-1\right)}{(\omega-\lambda_{d})\lambda_{d}}\right)^{\frac{1}{2}}, \end{aligned} \tag{7}$$

[7] I follow Abel et al. (2007) and assume both $\omega>0$ and $\lambda>0$ to obtain a unique solution. Refer to Abel et al. (2007) for a full description of their solution.

where

$$\gamma_d(\tau) = \left[\frac{1-e^{-\omega\tau_d}}{1-\chi e^{-\lambda_d\tau_d}}\right]^{\alpha}\omega^{-\alpha}, \quad \text{and} \tag{8}$$

$$\lambda_d = \frac{\rho - \left[(1-\alpha)\left(r + \frac{1}{2}\frac{1}{\alpha}\frac{(\mu_d - r)^2}{\sigma_d^2}\right)\right]}{\alpha}.$$

2.3 Analytical results: optimal level of inattention

The isomorphism between Abel et al. (2007) and the extended version of their model allows for an easy comparison between model-implied optimal levels of inattention.

Proposition 2 *If $\alpha > 1$, the (approximately) optimal level of inattention is smaller once foreign stock holdings are introduced into the model, i.e.,*

$$\hat{\tau}^* < \hat{\tau}_d^*.$$

Proposition 2 shows that the introduction of foreign stocks into the model implies that consumers update their portfolios more frequently (when $\alpha > 1$). Intuitively, consumers who invest both in foreign and domestic stocks tilt their portfolio toward risky assets, and hence, despite the cost of updating their information set, risk averse investors optimally choose to update their information set more frequently.

Both the original and the extended versions of the model predict that consumers will invest in all available assets, including domestic and foreign stocks. This prediction of the model may seem at odds with the empirical literature which reports low participation of households in stock markets (e.g., see Guiso et al. (2002) for a cross-country evidence, and Campbell (2006) for a more recent summary for the U.S.). This model drawback can be easily resolved by the introduction of an entry cost (in addition to the updating cost) to start investing in stocks. For example, consumers may pay a one-time entry cost out of their initial wealth to enter domestic and/or foreign stock markets. This entry cost can represent financial costs and time spent learning about investment opportunities, acquiring information about risks and returns, and any type of brokerage commissions.[8] In this further extended model, consumers that decide to also invest in foreign stocks have to pay an entry cost and optimally choose to update more frequently their information set, implying that some households will choose not to enter the foreign stock market. For brevity, such a model is presented only in the Appendix.

3 The data – unconditional analysis

The extension of Abel et al. (2007) suggests that the decision to hold foreign stocks relates (positively) to investors information acquisition process. Motivated by this finding, this section explores the Survey of Consumer Finances data set and tries to grasp whether this relationship also holds empirically.

[8] The presence of participation costs is also found by Christelis and Georgaralos (2009), who investigate foreign asset ownership using the SCF data, and compare household decisions of holding stocks, bonds and liquid accounts. Their results point to participation costs in stock investments and corroborate some of the empirical findings of this paper.

The ideal data set should have five main characteristics: cover a representative sample; measure both total wealth and its complete breakdown in relevant categories; be disaggregated enough to distinguish among main assets; be highly accurate; and follow households over their life (Campbell 2006).

The Survey of Consumer Finances (SCF), conducted by the Federal Reserve Board, fulfills well the first two properties. Information provided by the SCF is vast and covers several aspects of household wealth, asset holdings, and liabilities.[9] It consists of a triennial household survey on asset holdings in the United States in which roughly 3000 randomly selected households and some additional 1500 high-wealth households selected from tax records are interviewed. Since most financial and nonfinancial assets are held by wealthier individuals, this oversampling of wealthier households allows for a better description of household portfolios. The sampling method of the SCF makes the use of survey weights particularly important to uncover statistics for the U.S. population. Throughout this paper, all data and statistics from the SCF are weighted. I focus on the data collected in 1998, 2001, 2004, and 2007, resulting in a sample of 17,684 households.

Measurement errors and accuracy are a common worry of survey data, and the SCF is no exception. To deal with measurement errors, the SCF implements an imputation method, where each response is replicated five times in the system. In addition, the large and detailed questionnaire allows for numerous cross-checks of the answers provided by households.[10]

Although the level of information disaggregation in the SCF has increased over the past few years, the Survey still lacks enough information about a possible large fraction of households' portfolio. Most importantly for this paper, the Survey does not distinguish between holdings of foreign and domestic stocks through investment funds. In particular, the SCF explicitly asks if agents hold individual foreign and/or domestic stocks in their portfolio (mostly through brokerage accounts), in addition to inquiring about total holdings of stocks through investment funds. However, it *does not* discriminate between holdings of foreign and domestic stocks through funds, inquiring only whether households hold any stock through different types of funds. Therefore, detailed information about what may be a large part of agents' portfolios is missing.

In trying to briefly address this deficiency, this paper also relies on information provided by the Investment Company Institute (ICI). The ICI is a national association of U.S. investment companies including mutual funds, closed-end funds, exchange traded funds, and unit investment trusts. They produce a series of reports on recent developments in the investment fund industry, in addition to sporadic surveys among investors. I use their publications as a secondary source of information about indirect holdings of foreign assets.

While the SCF covers a larger share of the population, the ICI reports only include the universe of holders of these assets, and hence, the latter does not allow one to analyze participation decisions.

[9] The estimates of wealth from the SCF tend to be 10% to 20% less than those obtained from the Flow of Funds Accounts (FFA). This difference can be attributed to: (1) underreporting; (2) to the exclusion of some items from the Survey that are accounted for in the FFA, such as durable goods other than vehicles; or (3) to the fact that individuals at the very top of the wealth distribution are not included. In Antoniewicz (1996), after adjusting for the differences between the SCF and the FFA, the estimates tend to be somewhat similar.

[10] Kennickell (1998) reports that the refusal rates in 1995 were substantial and especially large for higher-wealth individuals. In addition, numerous households refused to provide dollar values for their assets or only reported ranges when asked about the dollar amount of their investments. For more details on the SCF imputation method and on its implications for the results of this paper, see footnote 24.

The size of the sample of investors is also limited, raising concerns about data representativeness. Nevertheless, the ICI data and reports provide an interesting summary of the recent trends in indirect stock ownership, signaling a significant increase in holdings of foreign stocks through investment funds. In addition, their reports corroborate the findings regarding direct ownership from the SCF and the role of information.

3.1 Household finances – evidence from the Survey of Consumer Finances

Among the numerous questions about their asset holdings, households are inquired about their individual holdings of domestic and foreign stocks. In this Section I report recent patterns and characteristics of households who own individual foreign stocks and compare the findings with households who hold domestic stocks only.[11]

I focus my analysis on the comparison between two main variables: direct holdings of *foreign* stocks versus direct holdings of *domestic* stocks. More specifically, holders of stocks directly are those who responded positively to the question:

"Do you (or anyone in your family living here) own any stock which is publicly traded? (If yes: Please do not include stock held through pension accounts, or assets that I have already recorded.)"

Among those, holders of foreign stocks directly are those who responded positively to the question:

"Of your stock, is any of it stock in a company headquartered outside of the United States? (Of your family's stock, is any of it stock in a company headquartered outside of the United States?)"

The two main variables of interest are labeled as "*Foreign*" and "*Domestic*," which correspond, respectively, to households who responded positively to the second question and those who responded positively to the first question and negatively to the second one. And hence, by construction, "*Domestic*" excludes households who own individual foreign stocks.

Note that these questions only inquire households about their direct holdings of stocks. As discussed, the SCF does not distinguish whether holders of stocks through funds hold foreign and/or domestic stocks. Hence, households that hold foreign stocks through investment or trust funds are not included in the sample. This data limitation will be further discussed in Section 3.2.

While I focus the analysis on the comparison between holders of foreign stocks versus those who only hold domestic stocks, to make these results comparable to the participation literature, I also report some information about total *indirect holdings of stocks* held through investment and retirement funds, and overall equity holdings, which include both indirect and direct holdings of stocks. The variable labeled as "*Indirect*" corresponds to holdings of both domestic and foreign stocks through investment funds and retirement accounts. I choose not to exclude direct holders from those who own stocks indirectly, hence, those who own stocks indirectly can also hold some individual stocks. "*Equity*" is an aggregate measure of stocks holdings that includes both direct and indirect holdings of domestic and foreign stocks (and is the usual measure reported in the participation puzzle literature).[12] Finally, throughout the paper,

[11] While the spotlight is on the ownership decision, the Appendix also provides some information about the share of assets held on agents portfolio to allow for comparison to the equity holdings literature.

[12] To build aggregate measures of asset holdings, such as total equity and indirect holdings, total wealth, and income I follow the guidelines of the Federal Reserve Board publications and codes to build aggregate measures. Details (and codes) to build those measures are available on the Survey of Consumer Finance website: http://www.federalreserve.gov/PUBS/oss/oss2/bulletin.macro.txt.

"*Participation*" refers to the percentage of households out of the population (weighted data) holding the asset.

For brevity, throughout the paper, unless otherwise noted, I refer to individual holders of foreign stocks as holders of foreign stocks and refer to individual holders of domestic stocks as holders of domestic stocks only. I reinforce the caveat that this is a loose terminology since these holdings only refer to direct holdings of stocks, excluding those held through stock funds.

3.1.1 Participation and allocation: financial and demographic variables

I start by reporting aggregate ownership (*Participation*) of individual holdings of foreign stocks (*Foreign*), direct holdings of domestic stocks (*Domestic*), indirect holdings of stocks (*Indirect*), and equity holdings (*Equity*) in Table 1.[13]

The results confirm previous findings in the participation puzzle literature by showing that overall participation in equity markets have increased since 1998, reaching 51% of U.S. households in 2007. The second row indicates that the bulk of the increase in participation comes from indirect holdings of stocks, which can be associated with the rising participation in stocks through retirement funds, particularly in defined-contribution funds.

Focusing on direct stock holdings, participation in domestic stock markets ranges from 15% to 19%, its peak in 2001. Participation in foreign markets is relatively limited during survey years, but it has increased steadily since 1998. More recently, between 2004 and 2007, diverging from its pattern, participation in foreign stocks increased while individual domestic stock ownership reduced. As Section 3.2 will show, ICI data indicate that the same pattern is true for indirect holdings of foreign versus domestic stocks; i.e., holdings of foreign stocks through investment funds substantially increased during this period, while after 2005 holdings of domestic stocks dropped.

Due to the nature of the data and its limitations, from here on I focus the analysis on the two comparable, and *a priori* similar, groups of households – holders of either foreign or domestic stocks.

The household finance literature relies on three main variables to control for differences across stocks investors; wealth, age, and education. For these same variables, the asset-holding literature documents with little divergence three facts about equity ownership. The literature shows that participation in equity markets is: increasing in wealth (e.g., Bertaut and Starr-McCluer 2002); increasing in education (e.g., Guiso and Jappelli 2005); and hump-shaped in age (e.g., Ameriks and Zeldes 2004).

Figure 1 shows participation in Foreign and Domestic across wealth percentiles (in 2007 dollars).[14] It shows that participation is increasing in wealth for both asset classes, but its distribution varies somewhat. Participation in individual domestic stocks starts around the 30^{th} percentile and has slightly increased over the past few years for households in the higher end of the wealth distribution. Participation in foreign stocks is much more limited and concentrated among the wealthiest. It only increases at the highest 10^{th} percentile of the wealth distribution. Note, however, that despite being much smaller than any other asset class, ownership of foreign assets has increased over the past few years and peaked in 2007 for the top 10^{th} wealth percentile.[15]

[13] Tables 9 and 10 in the Appendix provide complementary information on recent developments of household financial and nonfinancial assets.

[14] See footnote 12 for information on how to build aggregate measures of wealth.

[15] Auxiliary Figure 3 in the Appendix reorganizes Figure 1 to allow for an easier comparison between data in 1998 and

The next set of tables reports comparisons between holders of foreign versus domestic stocks. The tables also provide information about nonholders of stocks, that is, households who answered negatively to the question about whether they hold individual stocks (who can, in principle, hold stocks through funds) . The tables provide information about these three main variables above and report unconditional means for different measures of household holdings of financial wealth, in addition to nonfinancial characteristics such average education and age, and other households' characteristics. I refer the reader to the Appendix for a more detailed information about wealth, age and education, in addition to a comparison to statistics for Indirect and Equity.

Table 2 summarizes household financial characteristics. For each year, the table reports the mean values (in 2007 thousand dollars) of household income, financial wealth, real estate wealth, business wealth, and debt for holders of domestic, foreign, and nonholders of individual stocks.

Relative to nonholders, domestic stockholders have more income and larger financial, real estate, and business wealth. Their larger indebtedness suggests that they also have more access to credit. Households who hold foreign stocks are, however, on average, considerably wealthier than the two former groups. For all survey years, income, financial, real estate, and business wealth are much larger for households who participate in foreign stock markets. For all measures of wealth, the increase in mean values is very large when moving from domestic stock holdings to foreign stock holdings. The debt level is also larger for foreign stock holders, although the gap is not as wide as for the other variables.

Since the holders of stocks are mostly concentrated among wealthier households, in the appendix, I replicate Tables 2 and 3 while limiting the sample to the top 10% of the wealth distribution. For this special group, it is still true that income and, financial and real estate wealth are, in general, larger for holders of stocks than for nonholders, and again, much larger for those who own foreign stocks. For business wealth, however, nonholders in the top 10% of the wealth distribution have considerably more business wealth than holders of domestic stocks, suggesting that background risks influence the decision to enter the stock market.[16]

Table 3 complements Table 2 by presenting demographic characteristics of stock holders. It shows that the mean age of participants in foreign stock markets is higher than the mean age of household heads who invest only in domestic stocks or are nonholders. The same is true for the average years of education, even though the difference between domestic and foreign holders is not as large. While the percentage of married households is higher among domestic stock investors than among nonholders, and this share is smaller among foreign holders than for domestic ones for most years.

A smaller fraction of households headed by women hold foreign stocks relative to domestic ones. As Section 4 will show, however, these results reverse when controlling for other variables. To capture income variability, Table 3 also reports a measure of income uncertainty ("*Inc.Certain*"), which reflects an answer to the dichotomous question: "*At this time, do you have a good idea of what your income for next year will be?*" Households with individual holdings have a higher share of positive responses. Finally, households also answer about their willingness to take risks, when answering to the question

2007.

[16] A positive relation between stock returns and returns to investment would imply that agents with higher business wealth will tend to participate less in the domestic stock market. The opposite should be true if the relation between business returns and foreign stocks is weak or negative. For evidence on these correlations and implications, see Heaton and Lucas (2000a, 2000b) and Baxter and Jermann (1997).

"*How much risk are you willing to take on a scale from* 1 *(take substantial financial risk) to* 4 *(not willing to take any risk)?*". For all years, participants in the stock market self-report as being more willing to take risk (or less risk averse). Foreign stock holders are even less risk averse than domestic stock investors.

3.1.2 Participation decision: informational variables

The SCF asks several questions that can be related to households' information acquisition process when making their investment decisions. In particular, households are asked, "*What sources of information do you (and your family) use to make decisions about saving and investments?*", and respondents can list several sources. Table 4 provides the main sources of information reported by households and the percentage of households that cite each source.

The data show that the main sources of information are quite different for the different types of investors. As an example, in 2007, "*Internet*" is cited as a main source of information by 25% of nonholders of stocks, 40% of holders of domestic stocks and 57% of holders of foreign stocks. In fact, the Internet is consistently reported as a main source of information by holders of foreign stocks. Foreign holders also more frequently cite newspapers, bankers, brokers, and financial planners as main sources. Domestic stock holders more often cite friends and family as their main sources of information.

In addition to their main source of information, households are asked several other questions regarding their information acquisition process when making their investment decisions. Table 5 reports on some of those questions.

Households are asked about the amount of "*Shop Around*" they do when making investment decisions: "*When making major decisions about borrowing money or obtaining credit, some people shop around for the very best terms while others don't. On a scale from one to five, where one is almost no shopping, three is moderate shopping, and five is a great deal of shopping, where would (you/your family) be on the scale?*" Table 5 shows that, once more, the same pattern follows: foreign stock holders shop around the most, followed by domestic investors and nonholders.

Respondents report the number of times they talked to their broker within the year, answering the question: "*Over the past year, about how many times did you buy or sell stocks or other securities through a broker?*" The mean number of times is reported by the variable "*Times*" in Table 5, showing that holders of foreign assets trade substantially more often than nonholders and holders of domestic stocks only.[17] Note that this result corroborates the model predictions, in which investors that also own foreign stocks (and tilt their portfolio to riskier assets) update their portfolio of investments more frequently. This positive relation between the probability of holding individual foreign stocks and the number of times households talk to their broker will be confirmed in the regression analysis of Section 5.

Households also report the number of financial institutions in which they have accounts: "*With how many financial institutions do you currently have accounts or loans, or regularly do personal financial business? Include banks, savings and loans, credit unions, brokerages, loan companies, and so forth, but not institutions where you have only credit cards or business accounts.*" Households that hold foreign

[17] Some nonholders of stocks also report talking to their broker as a source of information in their investment decisions, but opt not to hold this type of investments.

stocks also have accounts in a larger number of institutions (variable "*Institutions*").

Finally, households frequently hold individual stocks though brokerage accounts. Besides answering about holding a brokerage account, they are also asked: "*Do you have a 'cash' or 'call money' account at a stock brokerage?*" This would include agents who used to have a broker to invest in stock market and still keep a brokerage account, but are not currently an investor. The table shows that the share of agents that hold these accounts is larger for foreign holders than for domestic holders or nonholders (variable "*Brokerage Acc.*").

To close this descriptive section, some other variables which are not reported in Tables 1-5 are still worth noting. Households who invest in stocks directly target longer term investments more frequently. In particular, among foreign stock holders, a higher percentage of respondents say they have an investment time frame of 10 years or more, while domestic stock holders have a smaller time frame. Foreign stock holders also report they gain more often with their investments in individual stocks, and lose less often than those who concentrate in domestic stocks only. The magnitude of gains is at least twice as much as for households who own foreign stocks than for agents who only hold domestic. Losses tend to be only slightly larger for holders of foreign than for households who hold only domestic stocks directly. As for reasons for investing, agents are more similar. The two most cited reasons for investing are "for retirement" and for "rainy days" irrespective of the year or portfolio decision.

Finally, for the statistics presented above, I focused on unconditional probabilities, but is also interesting to look at some cross-conditional probabilities. Among direct holders of stocks, the percentage of households who hold foreign stocks ranges from 12% in 1998 to 16% in 2007.[18] Moreover, households who hold foreign stocks directly are also indirect holders of stocks. Among those who hold individual foreign stocks, the percentage of agents also holding stocks indirectly ranges from 83% in 1998 to 90% in 2004, and 84% in 2007. The share of agents who hold stocks indirectly given that they only hold domestic stocks is smaller, ranging from 75% to 80% during the survey years.

3.2 Indirect holdings – evidence from the Investment Company Institute

One of the main limitations of the SCF is the lack of information about foreign stocks held through investment and trust funds. To try to bypass this limitation, in this section I resort to publications and reports from the Investment Company Institute.

The Investment Company Institute (ICI) is a national association of U.S. investment companies, including mutual funds, closed-end funds, exchange traded funds, and unit investment trusts. It provides a series of reports covering recent trends for investment funds, in addition to producing sporadic surveys among investors. As of 2007, investment companies managed \$13 trillion in assets for \$90 million U.S. investors.

The ICI and the Securities Industry Association reported that while the direct ownership of foreign stocks has not largely increased since 1999, the percentage of stock mutual fund investors owning international funds has increased substantially. Their survey results show that among individual stock investors, 15% held foreign stocks directly in 1999, 18% in 2002, and 21% in 2005 (see Equity Ownership in America 2005). Note that despite the differences across samples, these figures show some similarities

[18] As Section 3.2 will show, these participation shares are consistent with reports from the ICI.

relative to the statistics of Table 1 which report that according to the SCF, among individual holders of stocks, 12% of individual stock investors held foreign stocks in 1998, 2001 and 2004, while this number rises to 16% in 2007. Among mutual fund investors, the percentage of investors who held Global (International) Mutual Funds is 62% in 1999, 56% in 2002 and 65% in 2005.

In addition, the ICI 2009 Investment Company Fact Book (Investment Company Institute 2009*a*) shows that the share of household assets held in investment companies has increased steadily since 1990, ranging from 8% of agents financial assets in 1990 to 23% in 2007, although dropping to 19% in 2008. In 2006 and 2007, in particular, there was a steep increase of inflows to stock mutual funds. The bulk of this increase is led by investments in international mutual funds, when for the first time, domestic funds experienced a net outflow. Recall that Table 1 confirms this trend by showing an increase in direct holdings of foreign stocks and a decrease in domestic stocks in 2007. This same pattern of investment flows verifies among the other different types of funds that the ICI tracks, showing an increase in holdings of foreign assets and a reduction in holdings of domestic ones.[19]

Regarding the role of information on investors' portfolio choices, another recent ICI publication (Equity and Bond Ownership in America 2008) reveals that around 65% of investors start their financial investments in stock markets through the purchase of investment funds, and then migrate to individual stock holdings. In addition, concerning the Internet usage, an ICI survey shows that along with the increase in foreign stock holdings through investment funds, there is a continuous increase in the use of the Internet as a main source of information about investment opportunities. In 2009, 82% of these investors used the Internet to manage financial investments or obtain information about investment opportunities. This latter number drops to 60% for nonholders of funds (see Investment Company Institute 2009*b*). These reports show that using the Internet as a source of information has become central for investors, suggesting the use of the Internet as a proxy for information and as evidence of more sophistication in the information acquisition process.

4 Econometric analysis

In this Section, I follow the participation puzzle literature and look at Foreign and Domestic while controlling for a set of variables. For each regression, I pool data from 1998, 2001, 2004 and 2007 surveys resulting in a sample of 17,684 households, from which 10,901 hold equity directly or indirectly ("*Equity*"), 9,933 hold indirectly ("*Indirect*"), 4,591 hold domestic stocks directly ("*Domestic*"), and 1,183 hold foreign stocks ("*Foreign*"). Subsequently, I estimate *probit* regressions where the dependent variable corresponds to a categorical variable valued one if the household owns the asset and zero otherwise.[20]

[19] Since some of the reports produced by the *ICI* are released on a yearly basis, the effects of the recent financial crisis already appear in their latest statistics, and by the end of 2008, these investment companies managed $10.3 trillion, down from the $13 trillion reported for 2007. In 2008, investors withdrew $234 billion from stock mutual funds ($152 billion out of the domestic and the remaining $82 billion out of foreign stock funds), which also reflects the large drop in stock prices.

[20] Agents face two decisions about their portfolio allocation; they decide whether to enter the stock market and how much to hold of each type of asset. While it would be of interest to analyze the share held of such assets, due to the lack of detailed information about indirect holdings, I focus my analysis on the entry decision. In principle, these decisions can be made jointly or separately. The household may opt to hold the asset only if the share invested is at its optimal level, and hence, entering the asset market and the share to be held comprise the same decision problem. If this is the case, a censored estimation such as a Tobin regression should be considered as the estimation process (see Tobin 1958).

The ownership equation estimated for an asset I is such that:

$$\begin{aligned} Ownership_I &= const. + \Sigma_k \delta_k \times \begin{pmatrix} \text{Controls for Wealth, Age, Education,} \\ \text{Demographics, Income variation,} \\ \text{Risk aversion, Year dummies} \end{pmatrix} \\ &\quad + \delta \times (\text{Information Acquisition variable}) \\ where\ I &= \textit{Foreign} \text{ or } \textit{Domestic} \\ k &= \text{number of control variables} \end{aligned}$$

To control for household wealth, I include the logarithms of total assets ("*Assets*"), and income ("*Income*"). To control for other types of investments, I add the logarithm of the net value of household business ("*Business*"), and the logarithm of the total value of debt holdings ("*Debt*"). Household indebtedness is mostly related to housing and opting to invest in the housing market can drive agents out of stocks, if agents have to opt between financial and nonfinancial investments.[21] Having a business enterprise can not only change agents' risk-taking profile, but also compete directly with the allocation of wealth across different types of investment. Therefore, the variable for business wealth tries to capture background risks agents may face. If there is a positive correlation between stock returns and returns to investment, one expects a negative relation between the value of the business wealth and stock ownership.[22]

To control for age and year, I include the household head age ("*Age*") and its square ("Age^2"), and dummies for the different years (excluding 1998): "*2001*", "*2004*", and "*2007*."[23] Including the square of age (along with age itself) is meant to test whether the literature finding of a hump-shaped effect of age on equity holdings is also present on direct holdings of stocks.

To control for education, I include dummies for households whose head does not have high school diploma ("*No high school*") and those with at least a college degree ("*College*"), omitting the intermediate case. I also include dummy variables for households headed by women ("*Female*") or headed by a married individual ("*Married*"). To capture income variability, I include the dummy variable ("Inc. Certain") as reported in Table 5. Guided by the household finance literature, I further control for income uncertainty by adding dummies for households headed by a self-employed person ("*Self-employed*"), or retired ("*Retired*"). Finally, to control for risk characteristics, I include a self-reported measure of risk aversion ("*Risk aversion*"), previously reported in Table 5.

The decision to hold each type of asset – the entry decision – can be affected by other factors and entry costs, such as information acquisition. To control for information, in the benchmark analysis, I add a dummy variable for whether households report the Internet as an information source when shopping for investments ("*Internet*"). The "*Internet*" dummy variable attains a value of 1 if the Internet was

The literature in household finance, however, vastly documents a two-step decision on equity ownership and share held, and for this case, ownership should be modeled separately from the share held and a Heckman estimation method is more appropriate (see Heckman 1979).

[21] Chetty and Szeidl (2010) look at the effects of housing on portfolio choice.

[22] See Footnote 16 for references.

[23] Ameriks and Zeldes (2004) highlight that it is not possible to separately identify age, time, and cohort effects, since, by construction, at a time t, a person born in year b is x years old, and hence, $x = t - b$. I follow Heaton and Lucas (2000) and abstract from cohort effects by only adding year and age variables.

one of the sources, and zero otherwise. Section 5, entertains alternative sources of information.

Table 6 shows the benchmark regression results for foreign and domestic holdings.[24] The first column of Table 6 presents the *probit* estimation results for ownership of foreign stocks, while the second one shows the equivalent results for ownership of domestic stocks. In each regression, standard deviations are reported in parentheses, next to their respective coefficients. Following Jordà and Taylor (2011), all estimation results are accompanied by the area under the ROC curve statistics for an additional measure of estimation performance.

Among the results highlights, for both regressions, the levels of income and assets have a positive and significant effect, while the business and debt levels have negative and significant effects. Confirming the unconditional analysis of Table 3, age is positively related to ownership of foreign stocks, but the results are not statistically significant. In addition, the hump-shaped pattern between age and holdings of equity does not seem to hold for either type of individual holdings of stocks.

Households headed by women seem to affect positively the probability of holding foreign stocks, and so do households headed by individuals with college degree. As expected, risk aversion has a negative correlation with holdings of both domestic and foreign stocks. In line with the evidence from Table 1 and the ICI reports, the percentage of people holding domestic stocks decreases in 2007, but the 2007 dummy is not statistically significant for Foreign.

Finally, using the Internet as a main source of information correlates positively and is statistically significant for holdings of foreign stocks, that is, using Internet as a main source of information increases the probability of holding individual foreign stocks. The regression for domestic holdings show that using the Internet as a main source of information also correlates positively with the probability of holding domestic stocks, but this coefficient is not statistically significant. As Section 5 will discuss, this result is robust to several variations in the regression specification.

This first set of results points to the role of information and risk aversion in determining agents' participation in stock markets. The regressions show that having the Internet as a main source of information when deciding on investment opportunities correlates positively with both types of investments but the coefficient is statistically significant for ownership of foreign stocks only. Second, the results also highlight the role of risk aversion, with negative and statistically significant coefficients.

The results in the first two columns of Table 6 suggest that holders of individual foreign stocks are more sophisticated in their source of information than those who focus on domestic ones. Another alternative way to grasp on this assertion is to consider a regression similar to the one reported in the first column of Table 6 while constraining the sample to the universe of holders of individual stocks. Recall that, by construction, "Domestic" excludes households that own foreign stocks. Hence, the coefficient estimates of the regression of "Foreign" when constraining the sample to households that

[24] For dealing with missing observations in the survey data, a multiple imputation procedure yielding five values for each missing value is used to approximate the distribution of the missing data. The individual imputation is made by drawing repeatedly from an estimate of the conditional distribution of the data. This implies that the number of observations in the full data set is five times the actual number of respondents, for each year. The SCF documentation suggests two possible ways of dealing with these replications in regressions: averaging the dependent and independent values across implicates, or multiplying their standard errors by the square root of five. The former procedure is preferable if one is interested in regression analysis. The documentation provided with the data includes a code that accounts for any biases generated by the imputation method. In this paper, for all regressions reported, I apply their coding to the data to obtain the corrected standard deviations. In unreported results, I also implement the second method and the results are not changed.

own individual stocks only would reveal any wedge between foreign and domestic stock holders.

The last column of Table 6 presents the estimation results. Most of the coefficients and their statistical significance confirm the results reported on the first column of Table 6. Among households who hold stocks individually, the probability of holding foreign stocks increases with the level of assets and income, although the latter is not statistically significant. This probability decreases with households' indebtedness and the value of their business. The probability is also larger among households headed by women and with smaller risk aversion. The effect of higher education is still positive although its statistical significance is missed. Finally and more importantly, the effect of using the Internet as a main source of information maintains its sign and statistical significance reinforcing the conjecture that foreign stock owners have some informational acquisition sophistication relative to the remaining owners of individual stocks.

5 Robustness

5.1 Adjusting for nonholders

The lack of information about indirect holdings of foreign stocks implies that the sample of foreign stock holders is much limited (as Table 1 revealed). In other words, since ownership of individual stocks is limited, the regressions results reported in the first two columns of Table 6 are obtained from a small sample of stock owners relative to a much larger sample of nonholders.

The estimation results reported in the last column of Table 6 partially addresses this problem when it limits the sample to holders of individual stocks. An alternative approach to handle cases in which there is a large sample of nonholders is to consider other estimation methods, such as estimating by *logit* or by a complementary log-log (*cloglog*) model on the probability of holding foreign or domestic stocks. The results of the logit and the cloglog estimations are presented in Table 7. Cloglog results are reported in the first two columns while *logit* estimation are reported in the last two columns. The two methods yield similar results. They also show little change relative to the ones reported on Table 6. The effect of using the Internet as a main source of information has a positive and statistically significant effect only for the ownership decision of holding individual foreign stocks.

5.2 The role of wealth

Figure 1 and Table 2 show that participation in individual stock markets is highly concentrated among wealthier households, in particular for owners of foreign stocks. This concentration suggests that controlling for wealth is very important, and that at lower percentiles of wealth there is a large concentration of nonholders.

While the regressions of Tables 6 and 7 already control for wealth variables, it is unavoidable to question if the strong effects of wealth on agents' holding decisions, and its correlation to informational variables, can bias the regression results. In particular, households who have high level of wealth (in housing, business, or other asset classes) are also holders of foreign stocks, and if this correlation is large enough, the coefficients estimated in the benchmark regressions of Tables 6 and 7 could be biased. Hence, to further control for wealth and disentangle the effects of informational variables, I reestimate the probit regressions for Foreign and Domestic while restricting the sample across each of the 10 wealth deciles and at the top 5 percentile of wealth distribution.[25]

The role of the Internet is robust to these changes. The positive sign and statistical significance of the Internet persists when the dependent variable is Foreign, and it does not hold when the dependent variable is Domestic. In addition, when restricting the wealth at the top 10 and 5 percentiles of the wealth distribution (in which most of the individual holders of stocks are concentrated), the bulk of the results are qualitatively unchanged, with the majority of the variables keeping their previously estimated sign, and the effect of consulting the Internet remains statistically significant only for foreign holdings.

The previous exercise highlights the strong and robust effects of information in holdings of foreign stocks, in addition to providing a first test for the possible biasing effects of the correlation between wealth and the remainder variables. As an additional robustness test, I reestimate the regressions of Tables 6 and 7 dropping each wealth variable at a time, and all of them altogether (namely "*Assets*", "*Income*", "*Business*", and "*Debt*"). The results are qualitatively unchanged. Despite the absence of these variables, their signs and statistical significance are unchanged. Separate probit and other estimations are available upon request.[26] Together with the above described results, the sample characteristics help to conclude that endogeneity of wealth, if present, is likely to have minor effect to the result of this paper.

5.3 Alternative informational variables

The SCF provides several alternative proxies for information acquisition variables. Tables 4 and 5 list some of these variables, namely the number of times the head of the household talked to his/her broker to change their portfolio; the amount of shopping around for investments; and additional sources of information such as newspapers, friends, financial planners, bankers, and brokers. As a robustness check, I reestimate the regressions in Tables 6 and 7 using each of these alternative measures of information acquisition to replace the Internet. While some of the results are statistically weaker than than the ones obtained when using the Internet as a proxy for information acquisition, most informational variables have the expected sign for individual holdings of stocks. For example, the probit estimations show a positive and statistically significant correlation between the number of times households talk to their broker and ownership of foreign stocks, while having friends as a main source of information is positively correlated with ownership of domestic stocks and negatively correlated with ownership of foreign stocks. Using newspapers as a main source of information also has a positive and significant effect for Foreign. For brevity, only the results for the *cloglog* estimations are provided in the Appendix. The remaining estimation results are available upon request.

I also reestimate the same regressions including all information proxies at once. The results confirm that foreign stock holders are more sophisticated in their information acquisition process. In particular,

[25] Given the large concentration of nonholders at low levels of wealth distribution, this regression can only be re-estimated for wealth levels above the 5^{th} decile.

[26] When looking at equity holdings, the household finance literature constrains their sample between the 1^{st} and the 99^{th} percentiles to account for possible outliers. In this paper, since the bulk of direct holdings of stocks are located at the top percentiles of the wealth distribution, such sample limitation eliminates a substantial share of stock holders, in particular foreign ones. Hence, I opt to present the benchmark results without this restriction on the sample. My results are, however, qualitatively unchanged if the 1^{st} and the 99^{th} percentiles of wealth are removed.

the effects of using the Internet as a main source of information and the number of times households talk to their broker positively affect the probability of holding foreign stocks, while the effect of these two variables on domestic stock ownership is more muted.

Finally, as reported in Section 3.2, the ICI publications reveal that a large share of investors start their financial investments through investment funds and later migrate to individual stock holdings. Since the SCF is not a panel, such inference is not possible. Nevertheless, to shed some light about the effects of indirect holdings, I reestimate the first two regressions of Table 6 and the regressions of Table 7 while adding indirect stocks ownership as an explanatory variable. The results show that this variable is positive and statistically significant for both domestic and foreign holdings. In addition, the sign and statistical properties of the remaining variables do not change.[27] Results are available upon request.

5.4 Marginal effects

The analysis so far has focused on the sign and statistical significance of estimated coefficients. This is so because the magnitude of probability regression coefficients are not easily interpreted. Estimating the size of the marginal effect of each variable on the probability of holding domestic versus foreign stocks can be cumbersome. The reason is because several independent variables in the above regressions are binary, so a simple marginal effect of one variable assuming all other variables are held at their mean value can be misleading. One alternative is to estimate the marginal effect of one variable, while holding other binary variables at some fixed value (either zero or one).

Table 8 reports the marginal effects for "Internet" on the decision to hold foreign and domestic individual stocks. The first row includes unconstrained marginal effects for the main probit regressions; for the probit estimation when including only holders of individual stocks; and when constraining the sample to the top 10^{th} percentile. The second row replicates this analysis but considers instead marginal effects after imposing some values for the binary variables, namely, "Female," "College", and "Inc. Certain" are set to one.

The results show that using the Internet as a main source of information has a larger effect on the probability of holding foreign stocks than the probability of holding domestic ones. This is true, in particular, when constraining the sample at the top 10^{th} percentile and when imposing considering households headed by women with college degree and certain income. For brevity, other marginal effects are omitted and are available upon request.

6 Conclusion

The international finance and the household finance literatures have shown that information plays a role on investment decisions. These two branches of the literature have studied how information affects the *share* of foreign assets held in portfolios and that investors may be periodically inattentive, respectively. A simple extension of Abel et al. (2007) suggests that attention can also be affected by ownership and holders of foreign stocks are more attentive.

[27] The Appendix also shows that using the Internet has a positive and significant effect on the probability of holding stocks through investment funds.

Using the Survey of Consumer Finances I identify a wedge between foreign stock holders and those who only hold domestic stocks. Households that own foreign stocks are substantially wealthier, more educated, and with a different age profile. More importantly, the results show that foreign stock holders are more sophisticated in their sources of information than those who hold domestic stocks only – they refer to the Internet as a main source of information in their investment decisions. They also report to more frequently use newspapers, to talk more often to their brokers, and shop more for investments. Households headed by women and more willing to take risks are also more likely to invest in foreign stocks. The magnitude of the effects of Internet is also larger among foreign stock holders than among those who only hold domestic stocks.

The above summarized results indicate that attention and information play a role on households' decision to own foreign stocks – the participation decision. The comparison between two *a priori* similar groups of investors – owners of individual domestic and foreign stocks – show that their financial and demographic characteristics are somewhat different, and their information acquisition processes vary substantially. These results are robust to a series of alternative estimation methods, sample restrictions and proxies for information.

One of the main caveats on these results relates to the sample. The Survey of Consumer Finances only disentangles direct ownership of foreign and domestic stocks, leaving indirect ownership (though investment or trust funds) aside. This limitation precludes this paper from discussing the so-called home bias on agents portfolio since a potentially large fraction of information about household' holdings of foreign stocks, through funds, is missing. More importantly, this data limitation implies that the participation decision analysis is only based on direct ownership of stocks, excluding those who may have opted to hold foreign stocks indirectly.

Using individual holdings of foreign stocks reveals a wedge between these two types of investors and show that for these two groups information plays a different role on their decision to hold one or the other type of stock. Whether those results are indicative that information plays a role on overall foreign stock ownership is still an open question. Unfortunately, the data at hand does not allow for a definite answer. The estimation results focusing on direct ownership only, along the ICI reports give an indication that this might be the case. A more complete and disaggregated description of household assets, particularly of indirect holdings, could provide the tools for a complete analysis.

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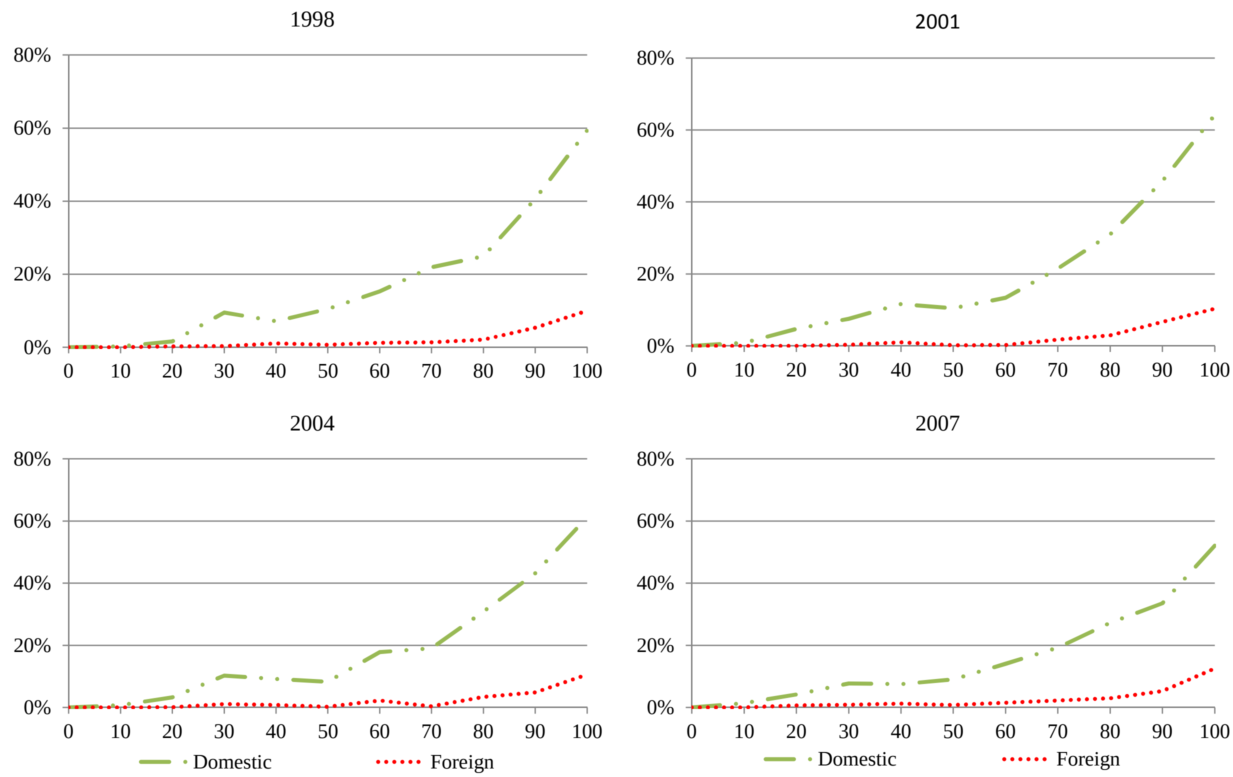

Figure 1: Household participation rates by asset class across wealth percentiles

Table 1: Household participation by asset class

	1998	2001	2004	2007
Participation[a]				
Equity	48.87	52.26	50.22	51.12
Indirect	44.21	48.27	46.15	46.86
Domestic	17.00	18.99	18.27	15.07
Foreign	2.21	2.32	2.38	2.83

[a]Fraction of population holding the asset.

Table 2: Stock holders versus nonholders – financial characteristics*

	1998			2001		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Income	50.5	133.1	186.9	57.1	161.9	224.2
Fin. Wealth	72.0	506.9	1,239.4	93.5	618.5	1,454.5
RE Wealth	91.7	216.1	276.0	103.5	279.2	387.0
Bus. Wealth	31.5	211.2	445.6	45.1	221.5	421.0
Debt	47.6	110.9	111.0	49.1	113.7	151.9
	2004			2007		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Income	138.8	145.3	214.9	74.7	159.6	305.1
Fin. Wealth	54.3	565.3	1,308.5	80.1	603.2	1,589.2
RE Wealth	70.7	356.7	500.0	158.4	409.0	563.0
Bus. Wealth	168.9	236.6	407.0	74.7	304.6	710.8
Debt	132.9	147.1	153.4	80.1	171.4	186.2

*Mean values in 2007 thousand dollars.

Table 3: Stock holders versus nonholders – financial characteristics

	1998			2001		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Age[a]	48.2	50.6	52.6	48.6	49.9	54.9
Education[b]	12.7	14.5	15.0	12.7	14.6	15.3
Married [c]	0.55	0.73	0.61	0.56	0.75	0.77
Female [c]	0.30	0.17	0.19	0.31	0.13	0.11
Inc. Certain [c]	0.68	0.78	0.80	0.67	0.74	0.78
Risk Aversion[d]	3.2	2.7	2.5	3.3	2.6	2.6
	2004			2007		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Age[a]	48.8	52.0	54.5	49.6	51.5	54.7
Education[b]	12.9	14.8	15.3	12.9	14.8	15.5
Married[c]	0.54	0.72	0.67	0.56	0.70	0.68
Female [c]	0.31	0.16	0.18	0.30	0.17	0.14
Inc. Certain [c]	0.64	0.78	0.72	0.67	0.76	0.77
Risk Aversion[d]	3.3	2.8	2.6	3.3	2.8	2.6

[a]Mean age of head of household, [b]Mean years of education of head of household, [c]Share of agents for each characteristic,[d]Self-reported willingness to take risk on a scale from 1(low) to 4 (high).

Table 4: Stock Holders versus nonholders – main sources of information*

	1998			2001		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Internet	6.40	15.18	24.32	11.54	26.43	29.20
Papers	15.58	30.67	43.29	13.54	24.74	34.83
Call Around	22.40	19.87	13.53	20.02	17.30	15.70
Friends/Relatives	37.16	39.12	26.52	36.06	35.34	37.75
Banker	25.07	22.29	18.88	26.75	22.50	29.52
Broker	7.69	22.08	40.98	7.51	28.08	31.99
Fin. Planner	15.89	28.40	36.44	15.70	25.28	24.62
	2004			2007		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Internet	16.52	30.42	35.64	25.20	39.67	57.32
Papers	14.59	25.30	27.79	15.38	25.93	34.05
Call Around	18.52	14.68	21.28	17.96	18.49	16.68
Friends/Relatives	34.07	34.18	37.39	41.01	40.13	41.73
Banker	26.08	26.60	20.50	32.15	28.69	31.82
Broker	7.92	23.18	27.66	8.79	20.12	34.26
Fin. Planner	17.03	28.07	32.73	19.93	30.91	31.90

*Percentage of households that cite each item as a main source of information.

Table 5: Stock holders versus nonholders – information acquisition

	1998			2001		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Shop Around[a]	3.22	3.37	3.57	3.20	3.17	3.37
Times[b]	3.09	8.45	11.35	4.30	9.70	15.68
Institutions[c]	4.96	4.95	5.71	4.99	4.83	5.97
Brokerage Acc.[d]	7.61	8.87	16.83	12.44	11.51	20.35
	2004			2007		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Shop Around[a]	3.01	3.15	3.46	3.03	3.19	3.29
Times[b]	3.02	7.66	9.59	4.81	7.27	17.12
Institutions[c]	4.87	4.86	5.75	4.98	4.67	5.33
Brokerage Acc.[d]	9.71	9.73	19.51	11.71	7.00	21.36

[a]Mean self-reported degree of shopping for investments on a scale from 1 (low) to 4 (high), [b]Mean number of times households traded last year, [c]Mean number of financial institutions, [d]Mean share of agents who hold a cash account at a brokerage.

Table 6: Regression results – foreign and domestic holdings of stocks

	Foreign	Domestic	Among holders of individual stocks Foreign
Constant	-7.484***	-2.963***	-5.837***
	(1.12)	(0.665)	(1.279)
Assets	0.381***	0.318***	0.268***
	(0.076)	(0.05)	(0.095)
Income	0.166**	0.1*	0.112
	(0.067)	(0.053)	(0.079)
Business	-0.108***	-0.084***	-0.083**
	(0.032)	(0.024)	(0.038)
Debt	-0.075**	-0.01	-0.076*
	(0.036)	(0.026)	(0.045)
Age	0.023	-0.054**	0.045
	(0.033)	(0.023)	(0.037)
Age2	0	0.001**	0
	(0)	(0)	(0)
Married	-0.005	-0.065	-0.074
	(0.203)	(0.137)	(0.22)
Female	0.409	-0.313	0.549*
	(0.259)	(0.191)	(0.3)
No High School	0.159	-0.36*	0.259
	(0.402)	(0.212)	(0.502)
College	0.399***	0.229***	0.298
	(0.154)	(0.086)	(0.183)
Self-employed	0.16	-0.137	0.185
	(0.142)	(0.085)	(0.162)
Retired	0.045	0.101	0.008
	(0.212)	(0.208)	(0.241)
Inc.Certain	0.253*	-0.092	0.347**
	(0.143)	(0.078)	(0.155)
Risk aversion	-0.323***	-0.198***	-0.3***
	(0.076)	(0.048)	(0.09)
2001	0.063	0.029	0.1
	(0.161)	(0.104)	(0.181)
2004	-0.242	-0.022	-0.205
	(0.16)	(0.106)	(0.176)
2007	0.016	-0.286***	0.226
	(0.149)	(0.107)	(0.171)
Internet	0.348**	0.132	0.316**
	(0.137)	(0.086)	(0.152)
Pseudo R^2	0.229	0.126	0.139
ROC area	0.776	0.677	0.769
	(0.004)	(0.004)	(0.004)
Observations	18812	18812	23190

The table reports coefficients and standard errors estimates from separate probit models of stock ownership for U.S. households in the 1998, 2001, 2004, and 2007 Surveys of Consumer Finances. The dependent variables in columns one and two are binary variables that identify ownership of individual foreign stocks ("Foreign") and individual domestic stocks ("Domestic"), respectively. The dependent variable in the last column is a binary variables that identify ownership of individual foreign stocks ("Foreign") and the sample is constrained among holders of individual stocks. Coefficients followed by *** are significant at 1%, ** are significant at 5% level, and coefficients followed by * are significant at 10% level. The Survey of Consumer Finances implements a multiple imputation procedure to correct for missing data, and hence, standard errors are adjusted to account for this method. All data are weighted.

Table 7: Regression results – adjusting for the large share of nonholders

	Cloglog		Logit	
	Foreign	Domestic	Foreign	Domestic
Constant	-14.085***	-4.081***	-6.954***	-2.887***
	(1.946)	(0.874)	(1.033)	(0.661)
Assets	0.685***	0.394***	0.303***	0.313***
	(0.132)	(0.061)	(0.065)	(0.049)
Income	0.222**	0.117*	0.149**	0.091*
	(0.11)	(0.064)	(0.064)	(0.052)
Business	-0.188***	-0.103***	-0.088***	-0.082***
	(0.046)	(0.029)	(0.028)	(0.024)
Debt	-0.107*	-0.007	-0.064*	-0.008
	(0.055)	(0.034)	(0.033)	(0.026)
Age	0.073	-0.066**	0.032	-0.052**
	(0.065)	(0.031)	(0.033)	(0.023)
Age2	-0.001	0.001*	0	0**
	(0.001)	(0)	(0)	(0)
Married	0.082	-0.036	0.115	-0.051
	(0.316)	(0.188)	(0.21)	(0.136)
Female	0.872*	-0.418	0.469*	-0.307
	(0.445)	(0.292)	(0.264)	(0.188)
No High School	0.423	-0.717*	0.135	-0.369*
	(1.002)	(0.368)	(0.382)	(0.211)
College	0.896**	0.356***	0.423***	0.235***
	(0.353)	(0.122)	(0.149)	(0.086)
Self-employed	0.298	-0.166	0.195	-0.134
	(0.251)	(0.112)	(0.132)	(0.086)
Retired	0.224	0.055	-0.024	0.122
	(0.401)	(0.246)	(0.213)	(0.205)
Inc.Certain	0.544**	-0.133	0.203	-0.087
	(0.265)	(0.103)	(0.132)	(0.077)
Risk aversion	-0.565***	-0.249***	-0.247***	-0.189***
	(0.148)	(0.062)	(0.071)	(0.048)
2001	-0.057	0.052	0.051	0.01
	(0.303)	(0.136)	(0.152)	(0.103)
2004	-0.556*	-0.036	-0.243	-0.031
	(0.3)	(0.141)	(0.154)	(0.105)
2007	-0.071	-0.397***	-0.017	-0.298***
	(0.282)	(0.146)	(0.144)	(0.106)
Internet	0.655***	0.162	0.287**	0.13
	(0.233)	(0.109)	(0.132)	(0.086)
Pseudo R^2	-	-	0.224	0.125
ROC area	0.773	0.677	0.777	0.676
	(0.004)	(0.004)	(0.004)	(0.004)
Observations	18812	18812	18812	18812

The table reports coefficients and standard errors estimates from binary models of stock ownership for U.S. households in the 1998, 2001, 2004, and 2007 Surveys of Consumer Finances. The first and second columns report cloglog regression results for the binary dependent variables that identify ownership of individual foreign stocks ("Foreign"), and individual domestic stocks ("Domestic"), respectively. The third and fourth report logit regression estimates for the same two dependent variables. Coefficients followed by *** are significant at 1%, ** are significant at 5% level, and coefficients followed by * are significant at 10% level. The Survey of Consumer Finances implements a multiple imputation procedure to correct for missing data, and hence, standard errors are adjusted to account for this method. All data are weighted.

Table 8: Marginal effects of using the Internet as a main source of information

	Probit		Among holders of individual stocks	Wealth at top 10th percentile	
	Foreign	Domestic	Foreign	Foreign	Domestic
Unconstrained	0.028**	0.039	0.062**	0.045**	0.024
	(0.012)	(0.026)	(0.031)	(0.019)	(0.039)
Constrained	0.056*	0.035	0.101*	0.09**	0.024
	(0.029)	(0.024)	(0.052)	(0.042)	(0.039)

The table reports marginal effects and standard errors estimates of the use of Internet as a main source of information from binary models of stock ownership for U.S. households in the 1998, 2001, 2004, and 2007 Surveys of Consumer Finances. The first two column reports these marginal effects resulting from probit estimations when the binary dependent variable identify ownership of individual foreign stocks ("Foreign") and domestic individual stocks ("Domestic"), respectively. The third column results from a probit estimation for "Foreign" while constraining the sample among holders of individual stocks. The last two columns report marginal effects for "Foreign" and "Domestic" while constraining the sample among the top 10 percentile of the wealth distribution. In row "Unconstrained," marginal effects are estimated while holding other variables at their average value. In row "Constrained," marginal effects are estimated while holding "Female," "College," and "Inc. Certain" at one. Coefficients followed by *** are significant at 1%, ** are significant at 5% level, and coefficients followed by * are significant at 10% level. The Survey of Consumer Finances implements a multiple imputation procedure to correct for missing data, and hence, standard errors are adjusted to account for this method. All data are weighted.

A Appendix to "Foreign stock holdings: the role of information"

A.1 Complementary information on households' portfolios

Tables 9 and 10 complement the information on households' portfolio by summarizing their financial and nonfinancial asset holdings.[28] The tables report the mean holdings for each type of asset as a share of financial and nonfinancial assets, respectively, showing the evolution of the composition of households' portfolio of assets. Each row of Table 9, but the last one, presents the mean value of each type of asset as a share of financial assets. The last row of the table (row (14)) shows the mean value of financial assets as a share of total assets. Table 9 shows a decrease in the financial assets holdings for most of the categories reported on the table, with the exception of holdings of retirement accounts and mutual funds (rows (7) and (8)). These last two types of investment are almost steady over the first three years of the Survey and increase between 2004 and 2007, as a share of financial assets. For stock holdings as a share of financial assets, rows (5) and (6) show that households reduce their direct holdings between 2001 and 2004, while increasing their direct holdings of foreign stocks in the last survey year. In addition, to complement the analysis, row (13) of Table 9 present the path followed by equity holdings showing a small increase in such holdings in the last year. Finally, Table 9 row (14) shows that the share of financial assets in total assets held by households has increased between 1998 and 2001, but decreased from the latter year to 2007. This decrease suggests that despite the recent recovery of the financial markets after the crisis in 2001, there is a movement towards nonfinancial assets on agents' portfolios. As Table 10 indicates, the boom in the housing market appears to be the main driver of the shift towards nonfinancial assets. There is a continuous increase in real estate asset holdings as a share of nonfinancial assets until 2004, while in 2007 there is a decline of this same variable.

A.2 Participation by wealth, age and education

The household finance literature relies on three main variables to control for differences across stocks investors; wealth, age, and education. For these same variables, the asset-holding literature documents with little divergence three facts about equity ownership. Participation in equity markets is (*i*) increasing in wealth, (*ii*) increasing in education, and (*iii*) hump-shaped in age. Wealth is important since wealthier agents hold most of the assets available in the economy and thus, most of the action happens for this group (e.g., Bertaut and Starr-McCluer 2002). Age is related to life-cycle behavior and hence, one expects differences in holdings of assets for each age interval (e.g., Ameriks and Zeldes 2004). Finally, more educated agents are more aware of investment opportunities (e.g., Guiso and Jappelli 2005). This set of facts is shown to be robust to controlling for other variables, and also robust to different countries (e.g., Bertaut and Starr-McCluer 1995, and Calvet, Campbell, and Sodini 2007).

Figure 2 shows household ownership of each asset class across wealth percentiles. Wealth is measured as household total assets in 2007 dollars,[29] and participation refers to the percentage of households holding the asset. Figure 2 shows that participation is increasing in wealth for all different asset classes.

[28] These two Tables 9 and 10 closely replicate Tables 4 and 8 of the Federal Reserve Bank Bulletin of February 2009 that follows the data release. Small differences between the tables there reported and the numbers here presented are due to discrepancies between the data publicly available and the full survey data set. In addition, to closely obtain their results, these mean measures are *unconditional* on holding the asset.

[29] See footnote 12 for information about how to build aggregate measures of wealth.

In addition, for all years, participation in foreign stocks is much smaller than other asset classes and much more concentrated among the wealthiest percentiles. While participation in stock markets through investment funds start to be positive around the 10^{th} percentile of the wealth distribution, participation in direct holdings of domestic stocks is more prominent around the 30^{th} percentile of wealth and has slightly increased over the past few years for households in the higher end of the wealth distribution. Participation in foreign assets only increases at the highest 10^{th} percentile of the wealth distribution. Despite being much smaller than any other asset class, ownership of foreign assets has increased over the past few years and peaked in 2007 for the top 10^{th} wealth percentile.

The auxiliary Figure 3 reorganizes the information in Figure 2 to help visualize time trends. As a general remark, for all different wealth percentiles, when directly comparing data from 1998 and 2007, there is an increase in participation in indirect and foreign stock markets, while the same is not true for direct holdings of domestic stocks. These changes suggest that over time the composition of stock owners in the population has changed. A larger fraction of the population is participating in the stock market, and agents from different wealth levels compose the market.

The life-cycle theory applied to asset holdings predicts that households increase their holdings of equity over their lifetimes until closer to retirement age, when equity holdings start to decrease. Hence, it is common in the stock-holding literature to document that ownership is hump-shaped across age intervals. Figure 4 shows this hump-shape for equity and indirect holdings. This pattern is less evident, however, for direct holdings of domestic and foreign stocks. In addition, participation in domestic and foreign stock markets tend to peak after equity holdings, suggesting that agents start entering the stock market by experimenting through funds and then migrating to direct holdings.[30] The comparison between domestic and foreign holdings, however, does not give the same clear pattern. In addition, participation in foreign stocks is much more volatile with respect to age than either domestic direct or indirect holdings of stocks.

The households finance literature has argued that the higher is the education level, the larger would be overall participation rate in stock markets. The next table searches for this pattern among holders of individual stocks.

Table 11 shows how participation in stock markets varies with household head education level. The first and the fourth rows show the percentage of agents holding each of the four asset categories who have less than high school education level. The second and the fifth rows show the analogous numbers for those who have completed high school but have no college degree, and the third and last rows show the results for those who have at least a college degree. For all different years and types of assets, the higher the education level, the larger the participation in all different asset markets. Over the years, there is an increase in participation for both direct and indirect holdings for household heads with at least a high school diploma. More importantly, for foreign holdings, the increase in participation when one moves from high school to college education is relatively larger than for the other types of assets. This does not hold once one moves from no high school diploma to high school level.

[30] Since the SCF is not a panel, it is not possible to keep track of households portfolio over their lifetime, and hence, we cannot access the information on whether agents start experimenting with funds and move towards direct holdings. However, as described in Subsection 3.2, the ICI surveys indicate that agents start investing in stocks through funds and later migrating to direct holdings.

A.3 Robustness – additional results

Table 13 replicates the *probit* estimations reported in the first two columns of Table 6, and complement by also reporting the *probit* regressions when considering having stocks indirectly ("Indirect") and having any type of stocks ("Equity") as dependent variables.

Table 13 complements the robustness checks of Section 5 in the paper by replicating the *probit* estimations but constraining the sample to households whose asset levels are at the top 10 percentile of the wealth distribution. The table shows that the results do not change substantially indicating that even if the regression variables may be correlated to wealth, this relation is not affecting or biasing the results.

Tables 14 and 15 replicate Tables 2 and 3 from the paper while constraining the sample to the top 10 percentile of the wealth distribution. The results show that all patterns remain similar to the unconstrained analysis, even among the wealthier households.

Tables 16 and 17 provide cloglog regression results using alternative proxies for information.

A.4 The Model

In this Section, I depart from Abel, Eberly and Panageas (2007) in two directions; I first introduce foreign stocks on agents portfolio and then, in line with my previous results, I discuss the role of an entry cost in such market.

Consumer's wealth is held on an investment portfolio and in a riskless liquid asset for transactions. If she decides on entering the stock market, the investment portfolio is composed of a riskless bond and risky stocks, domestic and foreign. The consumer pays a fixed cost to observe their portfolio, proportional to the portfolio' contemporaneous value. Hence, it's optimal for the consumer to check her investment at equally spaced points in time, consuming from a riskless transactions account in the interim. A manager continuously rebalances the portfolio, at each period to guarantee a constant share is held in each type of asset within observation periods.

The consumer maximizes:

$$\begin{aligned} & E_t \int_0^\infty \frac{1}{1-\alpha} c_{t+s}^{1-\alpha} e^{-\rho s} ds, \\ 0 &< \alpha \neq 1 \\ \rho &> 0, \end{aligned}$$

where c stands for consumption, $0 < \alpha \neq 1$ is the inverse of the intertemporal elasticity of substitution and $\rho > 0$ is the intertemporal rate of discount.

The investment portfolio is composed of a riskless bond that pays rate of return $r > 0$, and of non-dividend-paying domestic and foreign stocks with prices D_t and F_t, respectively, with $P_t = \binom{D_t}{F_t}$ following a geometric Brownian motion:

$$\begin{aligned} \frac{dP_t}{P_t} &= \mu dt + \Omega^{1/2} dZ, \\ \mu &> R, \end{aligned}$$

where:

$$\mu = \begin{pmatrix} \mu_d \\ \mu_f \end{pmatrix}, R = \begin{pmatrix} r \\ r \end{pmatrix}$$
$$\Omega = \begin{pmatrix} \sigma_d^2 & \sigma_{df} \\ \sigma_{df} & \sigma_f^2 \end{pmatrix},$$

and Z is a Wiener process, μ_d and μ_f are the returns on domestic and foreign stocks, respectively, and Ω is the variance-covariance matrix of stocks returns.

The consumer can observe the investment portfolio by paying a fraction $\theta, 0 \leq \theta < 1$, of the contemporaneous value of the investment portfolio. She can only withdraw funds from the portfolio if she observes the value. She also holds a riskless liquid asset that pays r^L, with $0 \leq r^L < r$, to finance consumption.

Let t_j, $j = 1, 2, 3, ...$, be the times at which consumer observes the value of her portfolio. At time t_j, she chooses: the next "observation" date, $t_{j+1} = t + \tau$; the amount of the riskless liquid asset, $X_{t_j}(\tau)$ to finance consumption from t_j to t_{j+1}; and the fraction ϕ invested in domestic (ϕ_d) and foreign (ϕ_f) stocks:

$$\phi = \begin{pmatrix} \phi_d \\ \phi_f \end{pmatrix}$$

From time t_j to t_{j+1}, the amount of riskless asset to finance consumption is:

$$\phi = \begin{pmatrix} \phi_d \\ \phi_f \end{pmatrix}$$

From time t_j to t_{j+1}, the amount of riskless asset to finance consumption is:

$$X_{t_j}(\tau) = \int_0^{\tau} c_{t_{j+s}} e^{-r^L s} ds,$$

and since $r^L < r$, when "observation" time arrives, the value in the riskless asset will have reached zero, i.e., $X_{t_\tau} = 0$. At this time, the consumer pays the observation cost and the value of her wealth after paying such cost is:

$$W_{t_{j+\tau}} = (1-\theta)' \left(W_{t_j} - X_{t_j}\right) \mathcal{R}(t_j, t_j + \tau),$$

where $\mathcal{R}(t_j, t_j + \tau)$ is the gross rate of return to investment from time t_j and $t_j + \tau$, and $\mathcal{R}(t_j, t_j) = 1$.

Following the Abel et. al. (2007), for simplicity, I also assume that a portfolio manager continuously rebalances the portfolio to maintain fixed the proportion of assets invested in stocks. In this case, the portfolio return then follows a geometric Brownian motion;

$$\frac{d\mathcal{R}(t_j, t_j + s)}{\mathcal{R}(t_j, t_j + s)} = \left[r + \phi' (\mu - R)\right] ds + \phi' \Omega^{1/2} dZ.$$

To solve the consumer's problem, I divide the problem in four steps: the consumption choice within two consecutive observation periods; the choice of riskless asset and the share invested in stocks; and two final steps that uncover the value function and the optimal observational frequency.

1. Choosing consumption between t_j and $t_j + \tau$, given τ and X_{t_j}

$$\begin{aligned} U_{t_j}(\tau) &\equiv Max \int_0^\tau \frac{1}{1-\alpha} c_{t_j+s}^{1-\alpha} e^{-\rho s} ds \quad (9) \\ st &: \\ X_{t_j}(\tau) &= \int_0^\tau c_{t_j+s} e^{-r^L s} ds \quad (10) \end{aligned}$$

$$\begin{aligned} FOC &: \\ c_{t_j}^{-\alpha} &= \frac{dX_{t_j}}{dc_{t_j}} = \eta \\ c_{t_j+s}^{-\alpha} e^{-\rho s} &= \eta e^{-r^L s} \end{aligned}$$

This implies:

$$c_{t_j+s} = c_{t_j} e^{\frac{-\left(\rho - r^L\right)s}{\alpha}}, \; for \; 0 \le s < \tau \quad (11)$$

Substituting (11) into (10):

$$\begin{aligned} X_{t_j} &= \int_0^\tau c_{t_j} e^{\frac{-\left(\rho - r^L\right)s}{\alpha}} e^{-r^L s} ds \\ &= c_{t_j} h(\tau) \quad (12) \end{aligned}$$

where:

$$\begin{aligned} h(\tau) &= \int_0^\tau e^{-\omega s} ds = \frac{1 - e^{-\omega\tau}}{\omega} \quad (13) \\ \omega &= \frac{\left(\rho - (1-\alpha) r^L\right)}{\alpha} \end{aligned}$$

Assume $\omega > 0$.

Substitute (11) into (9) and using (12):

$$\begin{aligned} U_{t_j}(\tau) &\equiv Max \int_0^\tau \frac{1}{1-\alpha} \left[c_{t_j+s}^{1-\alpha}\right] e^{-\rho s} ds \\ &= \frac{1}{1-\alpha} \int_0^\tau \left[c_{t_j} e^{\frac{-\left(\rho - r^L\right)s}{\alpha}}\right]^{1-\alpha} e^{-\rho s} ds \\ &= \frac{1}{1-\alpha} c_{t_j}^{1-\alpha} \int_0^\tau \left[e^{\frac{-\left(\rho - r^L\right)s}{\alpha}}\right]^{1-\alpha} e^{-\rho s} ds \\ &= \frac{1}{1-\alpha} c_{t_j}^{1-\alpha} \int_0^\tau e^{\frac{-\left(\rho - (1-\alpha) r^L\right)}{\alpha} s} ds \\ &= \frac{1}{1-\alpha} \left(\frac{X_{t_j}}{h(\tau)}\right)^{1-\alpha} h(\tau) \\ &= \frac{1}{1-\alpha} X_{t_j}^{1-\alpha} h(\tau)^\alpha \quad (14) \end{aligned}$$

2. Choosing X_{t_j} and ϕ, given τ

   Given τ, the consumer problem is the same as in classic Samuelson (1969); at times when the consumer observes the portfolio, the value function equals:

$$V\left(W_{t_j}\right) = \max_{X_{t_j},\phi} U_{t_j}(\tau) + e^{-\rho\tau} E\left\{V\left[(1-\theta)\left(W_{t_j} - X_{t_j}\right) R\left(t_j, t_j+\tau\right)\right]\right\} \tag{15}$$

   Guess that:

$$V\left(W_{t_j}\right) = \frac{1}{1-\alpha}\gamma W_{t_j}^{1-\alpha} \tag{16}$$

   where γ is to be determined.

   Replacing (14) and (16) into (15):

$$\begin{aligned} \frac{1}{1-\alpha}\gamma W_{t_j}^{1-\alpha} &= \max_{X_{t_j},\phi} \frac{1}{1-\alpha} X_{t_j}^{1-\alpha} h(\tau)^{\alpha} \\ &\quad + e^{-\rho\tau} E_{t_j}\left\{\frac{1}{1-\alpha}\gamma\left[(1-\theta)\left(W_{t_j} - X_{t_j}\right) R\left(t_j, t_j+\tau\right)\right]^{1-\alpha}\right\} \\ &= \max_{X_{t_j},\phi} \frac{1}{1-\alpha} X_{t_j}^{1-\alpha} h(\tau)^{\alpha} \\ &\quad + e^{-\rho\tau}\frac{1}{1-\alpha}\gamma(1-\theta)^{1-\alpha}\left(W_{t_j} - X_{t_j}\right)^{1-\alpha} E_{t_j}\left\{\left[R\left(t_j, t_j+\tau\right)\right]^{1-\alpha}\right\} \end{aligned} \tag{17}$$

   The optimal allocation of the investment portfolio maximizes:

$$\begin{aligned} & \frac{1}{1-\alpha} E\left\{\left[R\left(t_j, t_j+\tau\right)\right]^{1-\alpha}\right\} \\ = & \frac{1}{1-\alpha}\exp\left\{(1-\alpha)\left(r + \phi'(\mu - R) - \frac{1}{2}\alpha\phi'\Omega\phi\right)\tau\right\} \end{aligned} \tag{18}$$

   Replacing the last equation in the maximization problem (17), the first order constraint with respect to ϕ is:

$$\begin{aligned} 0 &= \gamma(1-\theta)^{1-\alpha}\left(W_{t_j} - X_{t_j}\right)^{1-\alpha}\frac{1}{1-\alpha}\exp\left\{(1-\alpha)\left(r + \phi'(\mu - R) - \frac{1}{2}\alpha\phi'\Omega\phi\right)\tau\right\} * \\ & (1-\alpha)\tau\left[(\mu - R) - \alpha\phi'\Omega\right] \end{aligned}$$

$$\begin{aligned} \phi^* &= \frac{1}{\alpha}\Omega^{-1}(\mu - R) \\ \phi^{*\prime} &= \frac{1}{\alpha}(\mu - R)'\Omega^{-1} \end{aligned} \tag{19}$$

Substituting (19) into (18):

$$
\begin{aligned}
& \max_{\phi} \frac{1}{1-\alpha} \exp(-\rho\tau) E_{t_j} \left\{ [R(t_j, t_j+\tau)]^{1-\alpha} \right\} \\
= & \frac{1}{1-\alpha} \exp(-\rho\tau) \exp\left\{ (1-\alpha) \left(r + \phi'(\mu - R) - \frac{1}{2}\alpha\phi'\Omega\phi \right) \tau \right\} \\
= & \frac{1}{1-\alpha} \exp\left\{ -\rho\tau + (1-\alpha) \left(\begin{array}{c} r + \frac{1}{\alpha}(\mu - R)' \Omega^{-1} (\mu - R) \\ -\frac{1}{2}\alpha\frac{1}{\alpha}(\mu - R)' \Omega^{-1}\Omega\frac{1}{\alpha}\Omega^{-1}(\mu - R) \end{array} \right) \tau \right\} \\
= & \frac{1}{1-\alpha} \exp\left\{ -\rho\tau + (1-\alpha) \left(r + \frac{1}{2}\frac{1}{\alpha}(\mu - R)' \Omega^{-1} (\mu - R) \right) \tau \right\} \\
= & \frac{1}{1-\alpha} \exp\left\{ -\tau \left[\rho - (1-\alpha) \left(r + \frac{1}{2}\frac{1}{\alpha}(\mu - R)' \Omega^{-1} (\mu - R) \right) \right] \right\}
\end{aligned}
$$

Call:

$$
\begin{aligned}
\Omega(\alpha) & \equiv \left(r + \frac{1}{2}\frac{1}{\alpha}(\mu - R)' \Omega^{-1} (\mu - R) \right) > r^L \\
\lambda & = \frac{\rho - (1-\alpha)\Omega(\alpha)}{\alpha} > 0
\end{aligned}
$$

Then, we can rewrite:

$$
\begin{aligned}
& \max_{\phi} \frac{1}{1-\alpha} \exp(-\rho\tau) E_{t_j} \left\{ [R(t_j, t_j+\tau)]^{1-\alpha} \right\} \\
= & \frac{1}{1-\alpha} \exp\left\{ -\tau \left[\rho - (1-\alpha) \left(r + \frac{1}{2}\frac{1}{\alpha}(\mu - R)' \Omega^{-1} (\mu - R) \right) \right] \right\} \\
= & \frac{1}{1-\alpha} \exp\{-\alpha\lambda\tau\}
\end{aligned}
$$

Substitute this last equation into (17):

$$
\begin{aligned}
\frac{1}{1-\alpha}\gamma W_{t_j}^{1-\alpha} & = \max_{X_{t_j},\phi} \frac{1}{1-\alpha} X_{t_j}^{1-\alpha} h(\tau)^{\alpha} \\
& \quad + e^{-\rho\tau} \frac{1}{1-\alpha}\gamma(1-\theta)^{1-\alpha} \left(W_{t_j} - X_{t_j} \right)^{1-\alpha} E_{t_j} \left\{ [R(t_j, t_j+\tau)]^{1-\alpha} \right\} \\
& = \max_{X_{t_j},\phi} \frac{1}{1-\alpha} X_{t_j}^{1-\alpha} [h(\tau)]^{\alpha} \\
& \quad + \frac{1}{1-\alpha}\gamma(1-\theta)^{\frac{\alpha(1-\alpha)}{\alpha}} \left(W_{t_j} - X_{t_j} \right)^{1-\alpha} \exp\{-\alpha\lambda\tau\} \\
& = \max_{X_{t_j},\phi} \frac{1}{1-\alpha} X_{t_j}^{1-\alpha} [h(\tau)]^{\alpha} + \frac{1}{1-\alpha}\gamma \left(W_{t_j} - X_{t_j} \right)^{1-\alpha} \chi^{\alpha} e^{-\alpha\lambda\tau} \qquad (20)
\end{aligned}
$$

where $\chi = (1-\theta)^{\frac{(1-\alpha)}{\alpha}}$.

Differentiate the RHS of the above equation with respect to X_{t_j} and set the derivative equal to zero to obtain:

$$
\begin{aligned}
X_{t_j}^{-\alpha}\left[h\left(\tau\right)\right]^{\alpha} &= \gamma\left(W_{t_j}-X_{t_j}\right)^{-\alpha}\chi^{\alpha}e^{-\alpha\lambda\tau}\\
X_{t_j} &= h\left(\tau\right)\gamma^{-\frac{1}{\alpha}}\left(W_{t_j}-X_{t_j}\right)\chi^{-1}e^{\lambda\tau}
\end{aligned}
$$

Define

$$
A = h\left(\tau\right)\gamma^{-\frac{1}{\alpha}}\chi^{-1}e^{\lambda\tau} \tag{21}
$$

Then,

$$
\begin{aligned}
X_{t_j} &= A\left(W_{t_j}-X_{t_j}\right)\\
\left(1+A\right)X_{t_j} &= AW_{t_j}\\
X_{t_j} &= \frac{A}{\left(1+A\right)}W_{t_j}
\end{aligned}
$$

3. Given X_{t_j} and ϕ conditional on τ, the consumer computes the value function on τ

   Replace X_{t_j} into the value function (20), (or (3)) to obtain $\gamma\left(\tau\right)$:

$$
\begin{aligned}
\frac{1}{1-\alpha}\gamma W_{t_j}^{1-\alpha} &= \max_{X_{t_j},\phi}\frac{1}{1-\alpha}X_{t_j}^{1-\alpha}\left[h\left(\tau\right)\right]^{\alpha}+\frac{1}{1-\alpha}\gamma\left(W_{t_j}-X_{t_j}\right)^{1-\alpha}\chi^{\alpha}e^{-\alpha\lambda\tau}\\
\frac{1}{1-\alpha}\gamma\left[\frac{1+A}{A}X_{t_j}\right]^{1-\alpha} &= \frac{1}{1-\alpha}X_{t_j}^{1-\alpha}\left[h\left(\tau\right)\right]^{\alpha}+\frac{1}{1-\alpha}\gamma\left(\frac{X_{t_j}}{A}\right)^{1-\alpha}\chi^{\alpha}e^{-\alpha\lambda\tau}\\
\frac{1}{1-\alpha}\gamma\left(\frac{1+A}{A}\right)^{1-\alpha} &= \frac{1}{1-\alpha}\left[h\left(\tau\right)\right]^{\alpha}+\frac{1}{1-\alpha}\gamma\left(\frac{1}{A}\right)^{1-\alpha}\chi^{\alpha}e^{-\alpha\lambda\tau}\\
\gamma\left(\tau\right) &= \left(\frac{A}{1+A}\right)^{1-\alpha}\left[h\left(\tau\right)\right]^{\alpha}+\gamma\left(\tau\right)\left(\frac{1}{1+A}\right)^{1-\alpha}\chi^{\alpha}e^{-\alpha\lambda\tau} \qquad (22)
\end{aligned}
$$

   Equations (21) and (22) are two equations on $\gamma\left(\tau\right)$ and A. Using the definition of $h\left(\tau\right)$ in (13) and solving this system:

$$
\begin{aligned}
A &= \chi^{-1}e^{\lambda\tau}-1\\
\gamma\left(\tau\right) &= \left[\frac{1-e^{-\omega\tau}}{1-\chi e^{-\lambda\tau}}\right]^{\alpha}\omega^{-\alpha} \qquad (23)
\end{aligned}
$$

4. The consumer maximizes the value function and sets τ.

   To choose τ, the consumer maximizes (16), that is equivalent to maximizing:

$$
F\left(\tau\right) = \frac{\gamma\left(\tau\right)}{1-\alpha}
$$

$$
\begin{aligned}
Max_{\tau}\frac{\gamma(\tau)}{1-\alpha} &= \frac{\left[\frac{1-e^{-\omega\tau}}{1-\chi e^{-\lambda\tau}}\right]^{\alpha}\omega^{-\alpha}}{1-\alpha} \\
&\Rightarrow \\
\frac{\partial F(\tau)}{\partial\tau} &= \frac{\left[\frac{1-e^{-\omega\tau}}{1-\chi e^{-\lambda\tau}}\right]^{\alpha-1}\omega^{-\alpha}}{1-\alpha}\left(\frac{\left(\omega e^{-\omega\tau}\right)\left(1-\chi e^{-\lambda\tau}\right)-\left(\chi\lambda e^{-\lambda\tau}\right)\left(1-e^{-\omega\tau}\right)}{\left(1-\chi e^{-\lambda\tau}\right)^{2}}\right)=0
\end{aligned}
$$

$$
\begin{aligned}
\left(\omega e^{-\omega\tau}\right)\left(1-\chi e^{-\lambda\tau}\right)-\left(\chi\lambda e^{-\lambda\tau}\right)\left(1-e^{-\omega\tau}\right) &= 0 \\
\omega e^{-\omega\tau}-\omega\chi e^{-(\omega+\lambda)\tau}-\chi\lambda e^{-\lambda\tau}+\chi\lambda e^{-(\omega+\lambda)\tau} &= 0 \\
(-\omega\chi+\chi\lambda)\,e^{-(\omega+\lambda)\tau} &= -\omega e^{-\omega\tau}+\chi\lambda e^{-\lambda\tau}
\end{aligned}
$$

$$
(-\omega\chi+\chi\lambda)\,e^{-(\omega+\lambda)\tau}=-\omega e^{-\omega\tau}+\chi\lambda e^{-\lambda\tau}
$$

Divide by $\omega\chi e^{-\omega\tau}$:

$$
\begin{aligned}
\frac{(-\omega+\lambda)}{\omega}e^{-\lambda\tau} &= -\frac{1}{\chi}+\frac{\lambda}{\omega}e^{(\omega-\lambda)\tau} \\
\frac{(\omega-\lambda)}{\omega}e^{-\lambda\tau}+\frac{\lambda}{\omega}e^{(\omega-\lambda)\tau} &= \frac{1}{\chi}
\end{aligned}
$$

As in Abel et al. (2007), define:

$$
M(\tau)\equiv\frac{(\omega-\lambda)}{\omega}e^{-\lambda\tau}+\frac{\lambda}{\omega}e^{(\omega-\lambda)\tau}
$$

In Abel et al. (2007), it is proven that τ^* that maximizes $F(\tau)$ is such that $M(\tau^*)\,\chi=1$, i.e.:[31]

$$
\frac{(\omega-\lambda)}{\omega}e^{-\lambda\tau^*}+\frac{\lambda}{\omega}e^{(\omega-\lambda)\tau^*}-\frac{1}{\chi}=0
$$

A second order Taylor expansion to $M(\tau)$ around $\tau=0$ yields:

$$
\begin{aligned}
M(\tau) &\equiv \frac{(\omega-\lambda)}{\omega}+\frac{\lambda}{\omega}=1 \\
M'(\tau) &= \frac{-\lambda(\omega-\lambda)}{\omega}e^{-\lambda\tau}+\frac{\lambda(\omega-\lambda)}{\omega}e^{(\omega-\lambda)\tau} \\
M''(\tau) &= \left(\lambda^2\right)\frac{(\omega-\lambda)}{\omega}e^{-\lambda\tau}+\frac{\lambda(\omega-\lambda)^2}{\omega}e^{(\omega-\lambda)\tau}
\end{aligned}
$$

[31] For a proof that τ^* is a unique maximum of this function, I refer the reader to Lemma 1 of Abel et al. (2007).

$$
\begin{aligned}
M(0) &= \frac{(\omega-\lambda)}{\omega}e^{-\lambda\tau}+\frac{\lambda}{\omega}e^{(\omega-\lambda)\tau}\\
M'(0) &= \frac{-\lambda(\omega-\lambda)}{\omega}+\frac{\lambda(\omega-\lambda)}{\omega}=0\\
M''(0) &= \left(\lambda^2\right)\frac{(\omega-\lambda)}{\omega}+\frac{\lambda(\omega-\lambda)^2}{\omega}\\
&= \lambda(\omega-\lambda)\neq 0
\end{aligned}
$$

For any $f(x)$, a second order Taylor expansion gives:

$$
f(x)\simeq f(a)+(x-a)f'(a)+\frac{1}{2}(x-a)^2 f''(a)
$$

For $M(\tau)$, we get:

$$
M(\tau)\simeq 1+\tau*0+\frac{1}{2}(\tau)^2\lambda(\omega-\lambda)
$$

Let $\hat{\tau}$ be the approximately optimal value of τ. From Abel et al. (2007) it satisfies $M(\hat{\tau})\chi=1$, and that implies:

$$
\begin{aligned}
\frac{1}{2}(\hat{\tau})^2 &= \frac{\chi^{-1}-1}{\lambda(\omega-\lambda)}\\
\hat{\tau} &= \left(\frac{2\left(\chi^{-1}-1\right)}{(\omega-\lambda)\lambda}\right)^{\frac{1}{2}}
\end{aligned}
$$

A.5 The participation decision – entry-cost model

While the model of Section A.4 predicts that it is optimal for all agents to always invest in both types of stocks, empirical evidence points to a large fraction of households out of the domestic and foreign stock markets. Hence, I modify the previous model and look at agents' decisions to enter the foreign stock market. In particular, I consider the case where agents already invest in domestic stocks and decide whether to also invest in foreign ones.

To study the entry decision and to quantify the cost of nonparticipation, I assume that consumers pay a one-time entry cost K_d out of their initial wealth to enter the domestic stock market, and K_f to also invest in foreign stocks (in addition to the updating cost θ). These entry costs represent financial costs and time spent learning about investment opportunities, acquiring information about risks and returns, and any type of brokerage commissions.[32] I assess the minimum cost that would drive agents out of the foreign stock market (K_f) once they already invest in domestic stocks.

The exercise, hence, comprises the comparison of two value functions: the first corresponds to the value function attained by the investor who only invests in domestic stocks; and the second is the value function of a investor that invests in both domestic and foreign stocks.

[32] Jones (2002) documents a large decline in such commissions charged by brokerage firms.

A.5.1 The entry decision

Agents can opt not to enter the stock market. If the consumer decides to never enter this market and hold all its wealth in the riskless liquid asset, her overall rate of return equals r^L. From the definitions of λ and ω, the non-entry decision implies $\lambda = \omega$, and so, $\gamma = \omega^{-\alpha}$.

Hence, for such an agent, her value function equals:

$$V(W_0) = \omega^{-\alpha} \frac{W_0^{1-\alpha}}{1-\alpha} = g$$

I assume agents have to pay a fixed cost, K, out of initial wealth, W_0, at time 0, when entering the stock market. Let's first assume the agent enters the domestic market only and for that, he pays K_d.

If he enters the stock market, she pays K_d and her value function is:

$$V\left(W_0^+\right) = V\left(W_0\left(1-K_d\right)\right) = \gamma(\tau) \frac{\left(W_0\left(1-K_d\right)\right)^{1-\alpha}}{1-\alpha}$$

$$\gamma(\tau) = \left[\frac{1-e^{-\omega\tau}}{1-\left[(1-\theta)^{\frac{(1-\alpha)}{\alpha}}\right]e^{-\lambda\tau}}\right]^{\alpha} \omega^{-\alpha}$$

$$\tau = \left(\frac{2\left((1-\theta)^{-\frac{(1-\alpha)}{\alpha}}-1\right)}{(\omega-\lambda)\lambda}\right)^{\frac{1}{2}}$$

where:

$$\omega = \frac{\left(\rho-(1-\alpha)r^L\right)}{\alpha}$$

$$\begin{aligned}\Omega(\alpha) &\equiv \left(r + \frac{1}{2}\frac{1}{\alpha}(\mu-R)'\,\Omega^{-1}(\mu-R)\right) > r^L \\ \lambda &= \frac{\rho-(1-\alpha)\Omega(\alpha)}{\alpha} > 0\end{aligned}$$

1. How large K_d has to be to drive agents out of the domestic market, if this is the only available risky asset, as in Abel et al. (2007)?

   I identify the parameters of their model by a subscript d to distinguish from the parameters of the open economy model. For this case, K_d has to be such that equals the value function of consumers that invest and those who don't invest in stocks:

$$V\left(W_0^+\right) = V\left(W_0\left(1-K_d\right)\right) = \gamma_d(\tau) \frac{\left(W_0\left(1-K_d\right)\right)^{1-\alpha}}{1-\alpha} = g = \omega^{-\alpha}\frac{W_0^{1-\alpha}}{1-\alpha}$$

$$\gamma_d(\tau) \frac{\left(W_0\left(1-K_d\right)\right)^{1-\alpha}}{1-\alpha} = \omega^{-\alpha}\frac{W_0^{1-\alpha}}{1-\alpha}$$

$$
\begin{aligned}
1 &= \left[\frac{1-e^{-\omega\tau_d}}{1-\left[(1-\theta)^{\frac{(1-\alpha)}{\alpha}}\right]e^{-\lambda_d\tau_d}}\right]^{\alpha}(1-K_d)^{1-\alpha} \\
K_d &= 1-\left[\frac{1-e^{-\omega\tau_d}}{1-\left[(1-\theta)^{\frac{(1-\alpha)}{\alpha}}\right]e^{-\lambda_d\tau_d}}\right]^{-\frac{\alpha}{1-\alpha}}
\end{aligned}
$$

$$
K_d = 1-\left(\frac{1-e^{-\omega\tau_d}}{1-\left[(1-\theta)^{\frac{(1-\alpha)}{\alpha}}\right]e^{-\lambda_d\tau_d}}\right)^{\frac{-\alpha}{1-\alpha}}
$$

where

$$
\begin{aligned}
\phi_d &= \frac{1}{\alpha}\frac{(\mu_d-r)}{\sigma^2} \\
\Omega_d(\alpha) &\equiv \left(r+\frac{1}{2}\frac{1}{\alpha}\frac{(\mu_d-r)^2}{\sigma_d^2}\right)>r^L \\
\lambda_d &= \frac{\rho-(1-\alpha)\,\Omega_d(\alpha)}{\alpha}.
\end{aligned}
$$

2. How large K_f has to be to drive agents out of foreign market given they invest in domestic stocks?

   When agents enter only the domestic market, the problem is the same as presented in Abel et. al. (2007), and hence, the two equations to be compared are given by:

$$
\begin{aligned}
&\left[\frac{1-e^{-\omega\tau}}{1-\left[(1-\theta)^{\frac{(1-\alpha)}{\alpha}}\right]e^{-\lambda\tau}}\right]^{\alpha}\omega^{-\alpha}\frac{(W_0(1-K_f))^{1-\alpha}}{1-\alpha} \\
=&\left[\frac{1-e^{-\omega\tau_d}}{1-\left[(1-\theta_d)^{\frac{(1-\alpha)}{\alpha}}\right]e^{-\lambda_d\tau_d}}\right]^{\alpha}\omega^{-\alpha}\frac{W_0^{1-\alpha}}{1-\alpha}
\end{aligned}
$$

$$
K_f = 1-\left(\frac{\frac{1-e^{-\omega\tau_d}}{1-\left[(1-\theta_d)^{\frac{(1-\alpha)}{\alpha}}\right]e^{-\lambda_d\tau_d}}}{\frac{1-e^{-\omega\tau}}{1-\left[(1-\theta)^{\frac{(1-\alpha)}{\alpha}}\right]e^{-\lambda\tau}}}\right)^{\frac{\alpha}{1-\alpha}}
$$

A.6 Proofs of Propositions

Proposition 1 The solution to the consumer's problem implies that:

a. The value function is such that:

$$
V(W)=\gamma(\tau)\frac{W^{1-\alpha}}{1-\alpha},
$$

where:

$$
\gamma(\tau)=\left[\frac{1-e^{-\omega\tau}}{1-\chi e^{-\lambda\tau}}\right]^{\alpha}\omega^{-\alpha}
$$

b. The optimal shares held in domestic and foreign stocks equal:

$$\phi^* = \frac{1}{\alpha}\Omega^{-1}(\mu - R)$$

c. And the consumer optimally chooses to observe and update her portfolio at time τ^*, obtained from solving:

$$\frac{(\omega-\lambda)}{\omega}e^{-\lambda\tau^*} + \frac{\lambda}{\omega}e^{(\omega-\lambda)\tau^*} - \frac{1}{\chi} = 0$$

A second order approximation to this equation yields:

$$\hat{\tau}^* = \left(\frac{2\left(\chi^{-1}-1\right)}{(\omega-\lambda)\lambda}\right)^{\frac{1}{2}}$$

where $\chi = (1-\theta)^{\frac{(1-\alpha)}{\alpha}}$, $\omega = \frac{\left(\rho-(1-\alpha)r^L\right)}{\alpha}$ and $\lambda = \frac{\rho-(1-\alpha)\left(r+\frac{1}{2}\frac{1}{\alpha}(\mu-R)'\Omega^{-1}(\mu-R)\right)}{\alpha}$.

Proof. Following steps 1-4 of the detailed model derivation described in Subsection A.4 provides the proof for the proposition and extensively describe how to obtain the above equations. ■

Proposition 2 If $\alpha > 1$, the (approximately) optimal level of inattention is smaller once foreign stock holdings is introduced into the model., i.e.:

$$\hat{\tau}^* < \tau_d^*.$$

Proof. We are trying to check if:

$$\begin{aligned}
\left(\frac{2\left(\chi^{-1}-1\right)}{(\omega-\lambda)\lambda}\right)^{\frac{1}{2}} &< \left(\frac{2\left(\chi^{-1}-1\right)}{(\omega-\lambda_d)\lambda_d}\right)^{\frac{1}{2}} \\
\frac{\left(\chi^{-1}-1\right)}{(\omega-\lambda)\lambda} &< \frac{\left(\chi^{-1}-1\right)}{(\omega-\lambda_d)\lambda_d},
\end{aligned}$$

i.e., if

$$(\omega-\lambda_d)\lambda_d > (\omega-\lambda)\lambda.$$

Recall that because $0 < \theta < 1$, and I assume $\omega < \lambda$ and $\omega < \lambda_d$, the above expression is the correct one to be verified.

Recall that:

$$\begin{aligned}
\lambda &= \frac{\rho-(1-\alpha)\left(r+\frac{1}{2}\frac{1}{\alpha}(\mu-R)'\Omega^{-1}(\mu-R)\right)}{\alpha} \\
\lambda_d &= \frac{\rho-(1-\alpha)\left(r+\frac{1}{2}\frac{1}{\alpha}\frac{(\mu_d-r)^2}{\sigma_d^2}\right)}{\alpha}
\end{aligned}$$

One wants to check if $(\omega-\lambda_d)\lambda_d > (\omega-\lambda)\lambda$. Rewriting this expression:

$$\begin{aligned}
&= (\omega-\lambda_d)\lambda_d - (\omega-\lambda)\lambda = \\
&= \omega(\lambda_d-\lambda) - \left(\lambda_d^2-\lambda^2\right) \\
&= \omega(\lambda_d-\lambda) - (\lambda_d-\lambda)(\lambda_d+\lambda) \\
&= (\lambda_d-\lambda)(\omega-\lambda_d-\lambda)
\end{aligned}$$

$$\begin{aligned}
&= \left[\begin{array}{c} \frac{\rho-(1-\alpha)\left(r+\frac{1}{2}\frac{1}{\alpha}\frac{(\mu_d-r)^2}{\sigma_d^2}\right)}{\alpha} \\ -\frac{\rho-(1-\alpha)\left(r+\frac{1}{2}\frac{1}{\alpha}(\mu-R)'\Omega^{-1}(\mu-R)\right)}{\alpha} \end{array}\right](\omega-\lambda_d-\lambda) \\
&= \left[\begin{array}{c} \frac{\rho}{\alpha}-\frac{(1-\alpha)}{\alpha}\left(r+\frac{1}{2}\frac{1}{\alpha}\frac{(\mu_d-r)^2}{\sigma_d^2}\right)-\frac{\rho}{\alpha} \\ +\frac{(1-\alpha)}{\alpha}\left(r+\frac{1}{2}\frac{1}{\alpha}(\mu-R)'\Omega^{-1}(\mu-R)\right) \end{array}\right](\omega-\lambda_d-\lambda)
\end{aligned}$$

$$\begin{aligned}
&= \frac{(1-\alpha)}{\alpha}\left[-r-\frac{1}{2}\frac{1}{\alpha}\frac{(\mu_d-r)^2}{\sigma_d^2}+r+\frac{1}{2}\frac{1}{\alpha}(\mu-R)'\Omega^{-1}(\mu-R)\right](\omega-\lambda_d-\lambda) \\
&= \frac{1}{2}\frac{1}{\alpha}\frac{(1-\alpha)}{\alpha}\left[-\frac{(\mu_d-r)^2}{\sigma_d^2}+(\mu-R)'\Omega^{-1}(\mu-R)\right](\omega-\lambda_d-\lambda) \\
&= \frac{1}{2}\frac{1}{\alpha}\frac{(1-\alpha)}{\alpha}\left[\frac{\begin{array}{c}\left(\mu_f-r\right)^2\sigma_d^4+(\mu_d-r)^2\sigma_{df} \\ -2(\mu_d-r)\left(\mu_f-r\right)\sigma_{df}\sigma_d^2\end{array}}{\left(\sigma_d^2\sigma_f^2-\sigma_{df}^2\right)\sigma_d^2}\right]\left(\frac{\rho-(1-\alpha)r^L}{\alpha}-\lambda_d-\lambda\right)
\end{aligned}$$

The denominator of the term in the brackets is positive since it corresponds to the determinant of the variance-covariance matrix. The numerator is such that:

$$\begin{aligned}
&\left(\mu_f-r\right)^2\sigma_d^4+(\mu_d-r)^2\sigma_{df}-2(\mu_d-r)\left(\mu_f-r\right)\sigma_{df}\sigma_d^2 \\
&= \sigma_d^2\left(\mu_f-r\right)\left(\left(\mu_f-r\right)\sigma_d^2-(\mu_d-r)\sigma_{df}\right)+\sigma_{df}(\mu_d-r)\left((\mu_d-r)\sigma_{df}-\left(\mu_f-r\right)\sigma_d^2\right) \\
&= \left(\left(\mu_f-r\right)\sigma_d^2-(\mu_d-r)\sigma_{df}\right)\left(\left(\mu_f-r\right)\sigma_d^2-(\mu_d-r)\sigma_{df}\right) \\
&= \left(\left(\mu_f-r\right)\sigma_d^2-(\mu_d-r)\sigma_{df}\right)^2 > 0
\end{aligned}$$

The term in parenthesis equals:

$$
\begin{aligned}
&= \left(\begin{array}{c} \frac{\rho-(1-\alpha)r^L}{\alpha} - \frac{\rho-(1-\alpha)\left(r+\frac{1}{2}\frac{1}{\alpha}\frac{(\mu_d-r)^2}{\sigma_d^2}\right)}{\alpha} \\ -\frac{\rho-(1-\alpha)\left(r+\frac{1}{2}\frac{1}{\alpha}(\mu-R)'\Omega^{-1}(\mu-R)\right)}{\alpha} \end{array} \right) \\
&= -\frac{\rho}{\alpha} + \frac{(1-\alpha)}{\alpha}\left(-r^L + 2r + \frac{1}{2}\frac{1}{\alpha}\left(\frac{(\mu_d-r)^2}{\sigma_d^2} + (\mu-R)'\,\Omega^{-1}(\mu-R)\right)\right) \\
&= -\frac{\rho}{\alpha} - \frac{(1-\alpha)\,r^L}{\alpha} + 2\frac{(1-\alpha)\,r}{\alpha} + \left[\frac{1}{2}\frac{1}{\alpha}\frac{(1-\alpha)}{\alpha}\left(\frac{(\mu_d-r)^2}{\sigma_d^2} + (\mu-R)'\,\Omega^{-1}(\mu-R)\right)\right]
\end{aligned}
$$

For $\alpha > 1$, the above term in brackets is negative. For the remainder of the expression:

$$
\begin{aligned}
& -\frac{\rho}{\alpha} - \frac{(1-\alpha)\,r^L}{\alpha} + 2\frac{(1-\alpha)\,r}{\alpha} \\
= \ & \frac{\rho}{\alpha} - \frac{(1-\alpha)\,r^L}{\alpha} - 2\left(\frac{\rho}{\alpha} - \frac{(1-\alpha)\,r}{\alpha}\right) \\
< \ & \frac{\rho}{\alpha} - \frac{(1-\alpha)\,r^L}{\alpha} - 2\left(\frac{\rho}{\alpha} - \frac{(1-\alpha)\,r^L}{\alpha}\right) \\
= \ & -\left(\frac{\rho}{\alpha} - \frac{(1-\alpha)\,r^L}{\alpha}\right) = -\omega \\
< \ & 0
\end{aligned}
$$

Therefore, $(\omega - \lambda_d)\,\lambda_d - (\omega - \lambda)\,\lambda$ equals:

$$
\begin{aligned}
&= (\lambda_d - \lambda)\,(\omega - \lambda_d - \lambda) \\
&= \frac{1}{2}\frac{1}{\alpha}\underbrace{\frac{(1-\alpha)}{\alpha}}_{<0}\underbrace{\left[\frac{\begin{array}{c}(\mu f - r)^2\,\sigma_d^4 + (\mu_d - r)^2\,\sigma_{df} \\ -2\,(\mu_d - r)\,(\mu_f - r)\,\sigma_{df}\sigma_d^2\end{array}}{\left(\sigma_d^2\sigma_f^2 - \sigma_{df}^2\right)\sigma_d^2}\right]}_{>0}\underbrace{\left(\frac{\rho - (1-\alpha)\,r^L}{\alpha} - \lambda_d - \lambda\right)}_{<0}
\end{aligned}
$$

Hence:

$$
\begin{aligned}
(\omega - \lambda_d)\,\lambda_d &> (\omega - \lambda)\,\lambda \\
&\Rightarrow \hat{\tau}^* < \tau_d^*
\end{aligned}
$$

■

A.6.1 Additional model results

Proposition 3 *As long as $0 < \mu - R < 1$, the total share invested in stocks is positive, even though the share invested in one or the other can be negative.*

$$\phi_d + \phi_f > 0$$

Proof.

$$
\begin{aligned}
& (\mu_d - r)\,\sigma_f^2 - (\mu_d - r)\,\sigma_{df} + \left(\mu_f - r\right)\sigma_d^2 - \left(\mu_f - r\right)\sigma_{df} \\
> \; & (\mu_d - r)\,\sigma_f^2 - (\mu_d - r)\,\sigma_d\sigma_f + \left(\mu_f - r\right)\sigma_d^2 - \left(\mu_f - r\right)\sigma_d\sigma_f \\
> \; & (\mu_d - r)\left(\sigma_f^2 - \sigma_d\sigma_f\right) + \left(\mu_f - r\right)\left(\sigma_d^2 - \sigma_d\sigma_f\right) \\
> \; & (\mu_d - r)\,\sigma_f\,(\sigma_f - \sigma_d) + \left(\mu_f - r\right)\sigma_d\,(\sigma_d - \sigma_f) \\
= \; & (\sigma_f - \sigma_d)\left[(\mu_d - r)\,\sigma_f - \left(\mu_f - r\right)\sigma_d\right] \\
> \; & (\sigma_f - \sigma_d)\left[(\mu_d - r)\,\sigma_f - \sigma_d\right]
\end{aligned}
$$

And $0 < (\mu_d - r) < 1$. If $((\mu_d - r)\,\sigma_f - \sigma_d) > 0 \Rightarrow (\sigma_f - \sigma_d) > 0$. If $((\mu_d - r)\,\sigma_f - \sigma_d) < 0 \Rightarrow \sigma_f < \frac{\sigma_d}{(\mu_d - r)} < \sigma_d$. And hence, the above expression is positive. ■

Proposition 4 *Irrespective of the availability of foreign stocks, the following assessments are still true that:*

$$
\frac{\partial \tau^*}{\partial \theta} > 0, \frac{\partial \tau^*}{\partial r^L} > 0
$$

Proof. Following Abel et al. (2007):

$$
\begin{aligned}
M(\tau) &\equiv \frac{(\omega - \lambda)}{\omega} e^{-\lambda\tau} + \frac{\lambda}{\omega} e^{(\omega - \lambda)\tau} \\
M(\tau^*)\,\chi &= 1 \\
\chi &= (1 - \theta)^{\frac{(1-\alpha)}{\alpha}} \\
\omega &= \frac{\left(\rho - (1 - \alpha)\,r^L\right)}{\alpha}
\end{aligned}
$$

Total differentiating the above equation:

$$
\frac{dM}{d\tau^*}\frac{d\tau^*}{d\theta}\chi + \frac{d\chi}{d\theta}M(\tau^*) = 0
$$

$$
\begin{aligned}
\frac{d\chi}{d\theta} &= -\frac{(1 - \alpha)}{\alpha}(1 - \theta)^{\frac{(1-\alpha)}{\alpha} - 1} \\
&= -\chi\,(1 - \alpha)\,[\alpha\,(1 - \theta)]^{-1}
\end{aligned}
$$

And:

$$
\begin{aligned}
\frac{\partial M}{\partial \tau^*} &= -\lambda\frac{(\omega - \lambda)}{\omega} e^{-\lambda\tau} + \frac{(\omega - \lambda)\,\lambda}{\omega} e^{(\omega - \lambda)\tau} \\
&= -\lambda\frac{(\omega - \lambda)}{\omega} e^{-\lambda\tau} + \frac{(\omega - \lambda)\,\lambda}{\omega} e^{\omega\tau} e^{-\lambda\tau} \\
&= \frac{(\omega - \lambda)\,\lambda}{\omega}\left(e^{\omega\tau} - 1\right) e^{-\lambda\tau}
\end{aligned}
$$

Hence:

$$\begin{aligned}
\frac{d\tau^*}{d\theta} &= \frac{-M\left(\tau^*\right)\frac{d\chi}{d\theta}}{\chi\frac{dM}{d\tau^*}} \\
&= \frac{M\left(\tau^*\right)\chi\left(1-\alpha\right)\left[\alpha\left(1-\theta\right)\right]^{-1}}{\chi\frac{(\omega-\lambda)\lambda}{\omega}\left(e^{\omega\tau}-1\right)e^{-\lambda\tau}} \\
&= \frac{\frac{(1-\alpha)}{\alpha}\left[\left(1-\theta\right)\right]^{-1}}{\chi\frac{\frac{1-\alpha}{\alpha}\left[\Omega(\alpha)-r^L\right]\lambda}{\omega}\left(e^{\omega\tau}-1\right)e^{-\lambda\tau}} \\
&= \frac{\omega\left[\left(1-\theta\right)\right]^{-1}}{\chi\left[\Omega\left(\alpha\right)-r^L\right]\lambda\left(e^{\omega\tau}-1\right)e^{-\lambda\tau}} > 0
\end{aligned}$$

That can be obtained by replacing $M\left(\tau^*\right)\chi = 1$ and by using the expression as:

$$\omega - \lambda = \frac{1-\alpha}{\alpha}\left[\Omega\left(\alpha\right) - r^L\right]$$

Finally, applying the implicit function theorem to the expression for M(τ^*), one obtains:

$$\frac{\partial\tau^*}{\partial r^L} = -\frac{\frac{\partial M}{\partial\omega}\frac{\partial\omega}{\partial r^L}}{\frac{\partial M}{\partial\tau^*}}$$

$$\begin{aligned}
\frac{\partial M}{\partial\omega} &= \left[1-\left(1-\tau\omega\right)e^{\tau\omega}\right]\frac{\lambda e^{-\lambda\tau}}{\omega^2} \\
\frac{\partial\omega}{\partial r^L} &= -\frac{(1-\alpha)}{\alpha} \\
\frac{\partial M}{\partial\tau^*} &= \frac{\left(\omega-\lambda\right)\lambda}{\omega}\left(e^{\omega\tau}-1\right)e^{-\lambda\tau}
\end{aligned}$$

$$\begin{aligned}
\frac{\partial\tau^*}{\partial r^L} &= \frac{\left[1-\left(1-\tau\omega\right)e^{\tau\omega}\right]\frac{\lambda e^{-\lambda\tau}}{\omega^2}\frac{(1-\alpha)}{\alpha}}{\frac{1-\alpha}{\alpha}\left[\Omega\left(\alpha\right)-r^L\right]\frac{\lambda}{\omega}\left(e^{\omega\tau}-1\right)e^{-\lambda\tau}} \\
&= \frac{1-\left(1-\tau\omega\right)e^{\tau\omega}}{\omega\left[\Omega\left(\alpha\right)-r^L\right]\left(e^{\omega\tau}-1\right)} > 0 \; for \; \omega\tau > 0
\end{aligned}$$

■

Proposition 5 *If $\alpha > 1$, and a non-short-selling constraint is assumed, i. e., $\phi_d > 0$ and $\phi_f > 0$, the optimal level of inattention is negatively correlated with mean returns on domestic and foreign stocks, positively correlated to the volatility of those assets' returns, and positively correlated to the covariance* *of such returns:*

$$\begin{aligned}
\frac{\partial \tau^*}{\partial \mu_d} &< 0, \frac{\partial \tau^*}{\partial \mu_f} < 0 \\
\frac{\partial \tau^*}{\partial \sigma_d^2} &> 0, \frac{\partial \tau^*}{\partial \sigma_f^2} > 0 \\
\frac{\partial \tau^*}{\partial \sigma_{df}} &> 0
\end{aligned}$$

Proof. First, looking at the returns:

$$\begin{aligned}
\frac{(\omega-\lambda)}{\omega} e^{-\lambda \tau^*} + \frac{\lambda}{\omega} e^{(\omega-\lambda)\tau^*} - \frac{1}{\chi} &= 0 \\
&\textit{or} \\
M(\tau^*)\chi &= 1
\end{aligned}$$

Using the implicit function theorem:

$$\begin{aligned}
\frac{\partial \tau^*}{\partial \mu_f} &= -\frac{\frac{\partial M}{\partial \mu_f}}{\frac{\partial M}{\partial \tau^*}} = -\frac{\left(\frac{\partial M}{\partial \lambda}\frac{\partial \lambda}{\partial \Omega(\alpha)}\frac{\partial \Omega(\alpha)}{\partial \mu_f}\right)}{\frac{\partial M}{\partial \tau^*}} \\
\frac{\partial \tau^*}{\partial \mu_d} &= -\frac{\frac{\partial M}{\partial \mu_d}}{\frac{\partial M}{\partial \tau^*}} = -\frac{\left(\frac{\partial M}{\partial \lambda}\frac{\partial \lambda}{\partial \Omega(\alpha)}\frac{\partial \Omega(\alpha)}{\partial \mu_d}\right)}{\frac{\partial M}{\partial \tau^*}}
\end{aligned}$$

The common three terms in the previous two derivatives are such that:

$$\frac{\partial M}{\partial \lambda} = \frac{1}{\lambda} M(\tau^*) e^{-\lambda\tau^*}\left[-M(\tau^*)^{-1} + (1-\lambda\tau^*) e^{\lambda\tau^*}\right]$$

Since $M(\tau^*)\chi = 1$, $(1-\lambda\tau^*) e^{\lambda\tau^*} < 1$, for $\lambda\tau > 0$, and $M(\tau^*) > 0$, it is true that $\frac{\partial M}{\partial \lambda} < \frac{1}{\lambda} M(\tau^*) e^{-\lambda\tau^*}[-\chi + 1]$.

If $\alpha > 1$, $\chi > 1$, and hence, $\frac{\partial M}{\partial \lambda} < 0$.

In addition, it's easy to obtain that:

$$\begin{aligned}
\frac{\partial \lambda}{\partial \Omega(\alpha)} &= -\frac{(1-\alpha)}{\alpha} > 0, \text{ for } \alpha > 1 \\
\frac{\partial \Omega(\alpha)}{\partial \mu_f} &= \frac{1}{\alpha}\frac{-(\mu_d - r)\sigma_{df} + (\mu_f - r)\sigma_d^2}{\sigma_d^2\sigma_f^2 - \sigma_{df}^2} \\
\frac{\partial M}{\partial \tau^*} &= \frac{(\omega-\lambda)\lambda}{\omega}(e^{\omega\tau} - 1) e^{-\lambda\tau} \\
&= \frac{1-\alpha}{\alpha}\left[\Omega(\alpha) - r^L\right]\frac{\lambda}{\omega}(e^{\omega\tau} - 1) e^{-\lambda\tau} < 0, \text{ for } \alpha > 1
\end{aligned}$$

However, the term for $\frac{\partial\Omega(\alpha)}{\partial\mu_f}$ and $\frac{\partial\Omega(\alpha)}{\partial\mu_d}$ can be positive or negative. Recall that:

$$
\begin{aligned}
\Omega(\alpha) &\equiv \left(r + \frac{1}{2}\frac{1}{\alpha}(\mu - R)'\,\Omega^{-1}(\mu - R)\right) \\
&= \left(r + \frac{1}{2}\frac{1}{\alpha}\left(\frac{(\mu_d - r)^2\sigma_f^2 - 2(\mu_d - r)\left(\mu_f - r\right)\sigma_{df} + \left(\mu_f - r\right)^2\sigma_d^2}{\sigma_d^2\sigma_f^2 - \sigma_{df}^2}\right)\right)
\end{aligned}
$$

$$
\begin{aligned}
\frac{d\Omega(\alpha)}{d\mu} &= \frac{1}{\alpha}(\mu - R)'\,\Omega^{-1} = \phi^{*\prime} \\
&= \frac{1}{\alpha}\frac{1}{\sigma_d^2\sigma_f^2 - \sigma_{df}^2}\begin{pmatrix} (\mu_d - r)\sigma_f^2 - \left(\mu_f - r\right)\sigma_{df} \\ -(\mu_d - r)\sigma_{df} + \left(\mu_f - r\right)\sigma_d^2 \end{pmatrix}
\end{aligned}
$$

Hence:

$$
\frac{d\Omega(\alpha)}{d\mu_f} = \frac{1}{\alpha}\frac{-(\mu_d - r)\sigma_{df} + \left(\mu_f - r\right)\sigma_d^2}{\sigma_d^2\sigma_f^2 - \sigma_{df}^2} \lesseqgtr 0
$$

The analogous derivation follows for the domestic stock market:

$$
\frac{d\Omega(\alpha)}{d\mu_d} = \frac{1}{\alpha}\frac{(\mu_d - r)\sigma_f^2 - \left(\mu_f - r\right)\sigma_{df}}{\sigma_d^2\sigma_f^2 - \sigma_{df}^2} \lesseqgtr 0
$$

Although the answers to the last derivative is straightforward for the one-asset only case, the analogous is not true for the case with foreign and domestic stocks. In principle, nothing prevents the investor from short selling, and if this is so, $\frac{d\Omega(\alpha)}{d\mu_f}$ or $\frac{d\Omega(\alpha)}{d\mu_d}$ can attain a negative sign.

Assuming there is no short selling:

$$
\begin{aligned}
(\mu_d - r)\sigma_f^2 - \left(\mu_f - r\right)\sigma_{df} &> 0 \\
-(\mu_d - r)\sigma_{df} + \left(\mu_f - r\right)\sigma_d^2 &> 0,
\end{aligned}
$$

and therefore, $\frac{\partial\Omega(\alpha)}{\partial\mu_f} > 0$ and $\frac{\partial\Omega(\alpha)}{\partial\mu_d} > 0$, implying:

$$
\frac{\partial\tau^*}{\partial\mu_f} = -\frac{\frac{\partial M}{\partial\mu_f}}{\frac{\partial M}{\partial\tau^*}} = -\frac{\left(\overbrace{\frac{\partial M}{\partial\lambda}}^{<0}\overbrace{\frac{\partial\lambda}{\partial\Omega(\alpha)}}^{>0}\overbrace{\frac{\partial\Omega(\alpha)}{\partial\mu_f}}^{>0}\right)}{\underbrace{\frac{\partial M}{\partial\tau^*}}_{<0}} < 0
$$

$$\frac{\partial\tau^*}{\partial\mu_d}=-\frac{\frac{\partial M}{\partial\mu_f}}{\frac{\partial M}{\partial\tau^*}}=-\frac{\left(\overbrace{\frac{\partial M}{\partial\lambda}}^{<0}\overbrace{\frac{\partial\lambda}{\partial\Omega\left(\alpha\right)}}^{>0}\overbrace{\frac{\partial\Omega\left(\alpha\right)}{\partial\mu_d}}^{>0}\right)}{\underbrace{\frac{\partial M}{\partial\tau^*}}_{<0}}<0$$

Now, for the variances:

$$\begin{aligned}\frac{\partial\tau^*}{\partial\sigma_f^2} &= -\frac{\frac{\partial M}{\partial\sigma_f^2}}{\frac{\partial M}{\partial\tau^*}}=-\frac{\left(\frac{\partial M}{\partial\lambda}\frac{\partial\lambda}{\partial\Omega(\alpha)}\frac{\partial\Omega(\alpha)}{\partial\sigma_f^2}\right)}{\frac{\partial M}{\partial\tau^*}}>0\\ \frac{\partial\tau^*}{\partial\sigma_d^2} &= -\frac{\frac{\partial M}{\partial\mu_f}}{\frac{\partial M}{\partial\tau^*}}=-\frac{\left(\frac{\partial M}{\partial\lambda}\frac{\partial\lambda}{\partial\Omega(\alpha)}\frac{\partial\Omega(\alpha)}{\partial\sigma_d^2}\right)}{\frac{\partial M}{\partial\tau^*}}>0\end{aligned}$$

Again, the term for $\Omega\left(\alpha\right)$ is such that:

$$\Omega\left(\alpha\right)\equiv\left(r+\frac{1}{2}\frac{1}{\alpha}\left(\frac{\left(\mu_d-r\right)^2\sigma_f^2-2\left(\mu_d-r\right)\left(\mu_f-r\right)\sigma_{df}+\left(\mu_f-r\right)^2\sigma_d^2}{\sigma_d^2\sigma_f^2-\sigma_{df}^2}\right)\right)$$

$$\begin{aligned}\frac{d\Omega\left(\alpha\right)}{d\sigma_f^2} &= \frac{1}{2}\frac{1}{\alpha}\left(\frac{2\left(\mu_d-r\right)^2\sigma_f\left(\sigma_d^2\sigma_f^2-\sigma_{df}^2\right)-\begin{pmatrix}\left(\mu_d-r\right)^2\sigma_f^2\\ -2\left(\mu_d-r\right)\left(\mu_f-r\right)\sigma_{df}\\ +\left(\mu_f-r\right)^2\sigma_d^2\end{pmatrix}2\sigma_d^2\sigma_f}{\left(\sigma_d^2\sigma_f^2-\sigma_{df}^2\right)^2}\right)\\ &= \frac{1}{2}\frac{1}{\alpha}\left(\frac{2\left(\mu_d-r\right)^2\sigma_f\left(\sigma_d^2\sigma_f^2-\sigma_{df}^2\right)-\begin{pmatrix}\left(\mu_d-r\right)^2\sigma_f^2\\ -2\left(\mu_d-r\right)\left(\mu_f-r\right)\sigma_{df}\\ +\left(\mu_f-r\right)^2\sigma_d^2\end{pmatrix}2\sigma_d^2\sigma_f}{\left(\sigma_d^2\sigma_f^2-\sigma_{df}^2\right)^2}\right)\end{aligned}$$

One, hence, has to test the sign of the numerator of the above expression. Rearranging the terms:

$$
\begin{aligned}
& (\mu_d - r)^2 \sigma_f \left(\sigma_d^2 \sigma_f^2 - \sigma_{df}^2\right) - \left(\begin{array}{c} \sigma_d^2 \sigma_f (\mu_d - r)^2 \sigma_f^2 - 2\sigma_d^2 \sigma_f (\mu_d - r) \left(\mu_f - r\right) \sigma_{df} \\ + \sigma_d^2 \sigma_f \left(\mu_f - r\right)^2 \sigma_d^2 \end{array} \right) \\
= & (\mu_d - r) \sigma_f \sigma_{df} \left(\left(\mu_f - r\right) \sigma_d^2 - (\mu_d - r) \sigma_{df} \right) \\
& + \sigma_d^2 \sigma_f \left(\mu_f - r\right) \left((\mu_d - r) \sigma_{df} - \left(\mu_f - r\right) \sigma_d^2 \right) \\
= & \sigma_f \left(\left(\mu_f - r\right) \sigma_d^2 - (\mu_d - r) \sigma_{df} \right) \left((\mu_d - r) \sigma_{df} - \left(\mu_f - r\right) \sigma_d^2 \right) \\
= & -\sigma_f \left(\left(\mu_f - r\right) \sigma_d^2 - (\mu_d - r) \sigma_{df} \right)^2 \\
< & \; 0
\end{aligned}
$$

The analogous follows for the domestic stock:

$$
\begin{aligned}
\frac{d\Omega(\alpha)}{d\sigma_d^2} & = \frac{1}{2} \frac{1}{\alpha} \left(\frac{ 2 \left(\mu_f - r\right)^2 \sigma_d \left(\sigma_d^2 \sigma_f^2 - \sigma_{df}^2\right) - \left(\begin{array}{c} (\mu_d - r)^2 \sigma_f^2 \\ -2 (\mu_d - r) \left(\mu_f - r\right) \sigma_{df} \\ + \left(\mu_f - r\right)^2 \sigma_d^2 \end{array} \right) 2\sigma_f^2 \sigma_d }{ \left(\sigma_d^2 \sigma_f^2 - \sigma_{df}^2\right)^2 } \right) \\
& = \frac{1}{2} \frac{1}{\alpha} \left(\frac{ 2 \left(\mu_f - r\right)^2 \sigma_d \left(\sigma_d^2 \sigma_f^2 - \sigma_{df}^2\right) - \left(\begin{array}{c} (\mu_d - r)^2 \sigma_f^2 \\ -2 (\mu_d - r) \left(\mu_f - r\right) \sigma_{df} \\ + \left(\mu_f - r\right)^2 \sigma_d^2 \end{array} \right) 2\sigma_f^2 \sigma_d }{ \left(\sigma_d^2 \sigma_f^2 - \sigma_{df}^2\right)^2 } \right)
\end{aligned}
$$

The numerator is such that:

$$
\begin{aligned}
& \left(\mu_f - r\right)^2 \sigma_d \left(\sigma_d^2 \sigma_f^2 - \sigma_{df}^2\right) - \left((\mu_d - r)^2 \sigma_f^2 - 2 (\mu_d - r) \left(\mu_f - r\right) \sigma_{df} + \left(\mu_f - r\right)^2 \sigma_d^2 \right) \sigma_f^2 \sigma_d \\
= & \left(\mu_f - r\right)^2 \sigma_d \sigma_d^2 \sigma_f^2 - \left(\mu_f - r\right)^2 \sigma_d \sigma_{df}^2 - \sigma_f^2 \sigma_d (\mu_d - r)^2 \sigma_f^2 \\
& + 2\sigma_f^2 \sigma_d (\mu_d - r) \left(\mu_f - r\right) \sigma_{df} - \sigma_f^2 \sigma_d \left(\mu_f - r\right)^2 \sigma_d^2 \\
= & (\mu_d - r) \left(\mu_f - r\right) \sigma_f^2 \sigma_d \sigma_{df} - \left(\mu_f - r\right)^2 \sigma_d \sigma_{df}^2 \\
& + (\mu_d - r) \left(\mu_f - r\right) \sigma_f^2 \sigma_d \sigma_{df} - (\mu_d - r)^2 \sigma_f^4 \sigma_d \\
= & \sigma_d \left((\mu_d - r) \sigma_f^2 - \left(\mu_f - r\right) \sigma_{df} \right) \left(\left(\mu_f - r\right) \sigma_{df} - (\mu_d - r) \sigma_f^2 \right) \\
= & -\sigma_d \left((\mu_d - r) \sigma_f^2 - \left(\mu_f - r\right) \sigma_{df} \right)^2 \\
< & \; 0
\end{aligned}
$$

Therefore:

$$\frac{\partial \tau^*}{\partial \sigma_f^2} = -\frac{\frac{\partial M}{\partial \sigma_f^2}}{\frac{\partial M}{\partial \tau^*}} = -\frac{\left(\overbrace{\frac{\partial M}{\partial \lambda}}^{<0}\overbrace{\frac{\partial \lambda}{\partial \Omega(\alpha)}}^{>0}\overbrace{\frac{\partial \Omega(\alpha)}{\partial \sigma_f^2}}^{<0}\right)}{\underbrace{\frac{\partial M}{\partial \tau^*}}_{<0}} > 0$$

$$\frac{\partial \tau^*}{\partial \sigma_d^2} = -\frac{\frac{\partial M}{\partial \mu_f}}{\frac{\partial M}{\partial \tau^*}} = -\frac{\left(\overbrace{\frac{\partial M}{\partial \lambda}}^{<0}\overbrace{\frac{\partial \lambda}{\partial \Omega(\alpha)}}^{>0}\overbrace{\frac{\partial \Omega(\alpha)}{\partial \sigma_d^2}}^{<0}\right)}{\underbrace{\frac{\partial M}{\partial \tau^*}}_{<0}} > 0$$

Observe that for the variance case, there is no need for the restriction on non-short-selling. Finally, for the covariance, the optimal level of inattention is increasing in the covariance of the asset returns. Applying the Implicit Function Theorem:

$$\frac{\partial \tau^*}{\partial \sigma_{df}} = -\frac{\frac{\partial M}{\partial \sigma_{df}}}{\frac{\partial M}{\partial \tau^*}} = -\frac{\left(\frac{\partial M}{\partial \lambda}\frac{\partial \lambda}{\partial \Omega(\alpha)}\frac{\partial \Omega(\alpha)}{\partial \sigma_{df}}\right)}{\frac{\partial M}{\partial \tau^*}}$$

As previously obtained:

$$\frac{\partial M}{\partial \lambda} = \frac{1}{\lambda} M(\tau^*) e^{-\lambda \tau^*}\left[-M(\tau^*)^{-1} + (1-\lambda\tau^*) e^{\lambda\tau^*}\right] < 0, \text{ for } \alpha > 1$$

$$\begin{aligned}
\frac{\partial \lambda}{\partial \Omega(\alpha)} &= -\frac{(1-\alpha)}{\alpha} \\
\frac{\partial M}{\partial \tau^*} &= \frac{1-\alpha}{\alpha}\left[\Omega(\alpha) - r^L\right]\frac{\lambda}{\omega}\left(e^{\omega\tau} - 1\right) e^{-\lambda\tau}
\end{aligned}$$

$$\begin{aligned}
\frac{\partial \Omega(\alpha)}{\partial \sigma_{df}} &= \frac{1}{2}\frac{1}{\alpha}\left(\frac{\left[\begin{array}{c} -2(\mu_d - r)(\mu_f - r)\left(\sigma_d^2\sigma_f^2 - \sigma_{df}^2\right) - \\ (-2\sigma_{d,f})\left((\mu_d - r)^2\sigma_f^2 - 2(\mu_d - r)(\mu_f - r)\sigma_{df} + (\mu_f - r)^2\sigma_d^2\right) \end{array}\right]}{\left(\sigma_d^2\sigma_f^2 - \sigma_{df}^2\right)^2}\right) \\
&= \frac{1}{2}\frac{1}{\alpha}\left(\frac{\left[\begin{array}{c} -2(\mu_d - r)(\mu_f - r)\sigma_d^2\sigma_f^2 + 2(\mu_d - r)(\mu_f - r)\sigma_{df}^2 \\ +2\sigma_{df}(\mu_d - r)^2\sigma_f^2 - 4(\mu_d - r)(\mu_f - r)\sigma_{df} + 2\sigma_{df}(\mu_f - r)^2\sigma_d^2 \end{array}\right]}{\left(\sigma_d^2\sigma_f^2 - \sigma_{df}^2\right)^2}\right)
\end{aligned}$$

Since the denominator is positive, it lacks to test the numerator:

$$\begin{aligned}
&= -\left(\mu_d - r\right)\left(\mu_f - r\right)\sigma_d^2\sigma_f^2 + \left(\mu_d - r\right)\left(\mu_f - r\right)\sigma_{df}^2 + \sigma_{df}\left(\mu_d - r\right)^2\sigma_f^2 \\
&\quad -2\left(\mu_d - r\right)\left(\mu_f - r\right)\sigma_{df} + \sigma_{df}\left(\mu_f - r\right)^2\sigma_d^2 \\
&< -\left(\mu_d - r\right)\left(\mu_f - r\right)\sigma_d^2\sigma_f^2 + \left(\mu_d - r\right)\left(\mu_f - r\right)\sigma_{df} - 2\left(\mu_d - r\right)\left(\mu_f - r\right)\sigma_{df} \\
&\quad +\sigma_{df}\left(\mu_d - r\right)^2\sigma_f^2 + \sigma_{df}\left(\mu_f - r\right)^2\sigma_d^2 \\
&= -\left(\mu_d - r\right)\left(\mu_f - r\right)\sigma_d^2\sigma_f^2 - \left(\mu_d - r\right)\left(\mu_f - r\right)\sigma_{df} \\
&\quad +\sigma_{df}\left(\mu_d - r\right)^2\sigma_f^2 + \sigma_{df}\left(\mu_f - r\right)^2\sigma_d^2 \\
&= \left(\mu_d - r\right)\sigma_f^2\left(\left(\mu_d - r\right)\sigma_{df} - \left(\mu_f - r\right)\sigma_d^2\right) + \sigma_{df}\left(\mu_f - r\right)\left(\left(\mu_f - r\right)\sigma_d^2 - \left(\mu_d - r\right)\sigma_{df}\right) \\
&= \underbrace{\left(\left(\mu_d - r\right)\sigma_{df} - \left(\mu_f - r\right)\sigma_d^2\right)}_{<0}\underbrace{\left(\left(\mu_d - r\right)\sigma_f^2 - \sigma_{df}\left(\mu_f - r\right)\right)}_{>0} < 0
\end{aligned}$$

and hence, $\frac{d\Omega(\alpha)}{d\sigma_{df}} < 0$. Therefore, one gets:

$$\begin{aligned}
\frac{\partial\tau^*}{\partial\sigma_{df}} &= -\frac{\frac{\partial M}{\partial\sigma_{df}}}{\frac{\partial M}{\partial\tau^*}} = -\frac{\left(\overbrace{\frac{\partial M}{\partial\lambda}}^{<0}\left(-\frac{(1-\alpha)}{\alpha}\right)\overbrace{\frac{\partial\Omega\left(\alpha\right)}{\partial\sigma_{df}}}^{<0}\right)}{\frac{1-\alpha}{\alpha}\left[\Omega\left(\alpha\right) - r^L\right]\frac{\lambda}{\omega}\left(e^{\omega\tau} - 1\right)e^{-\lambda\tau}} \\
&= \frac{\left(\overbrace{\frac{\partial M}{\partial\lambda}}^{<0}\overbrace{\frac{\partial\Omega\left(\alpha\right)}{\partial\sigma_{df}}}^{<0}\right)}{\underbrace{\left[\Omega\left(\alpha\right) - r^L\right]\frac{\lambda}{\omega}\left(e^{\omega\tau} - 1\right)e^{-\lambda\tau}}_{>0}} > 0
\end{aligned}$$

Observe that had I not imposed the non-short-selling condition, the sign of

$$-\left(\left(\mu_f - r\right)\sigma_d^2 - \left(\mu_d - r\right)\sigma_{df}\right)\left(\left(\mu_d - r\right)\sigma_f^2 - \sigma_{df}\left(\mu_f - r\right)\right)$$

would be undetermined, since the two terms in the parameters have to either have opposite signs or be both positive (for the non-short-selling condition case). ■

References

[1] Calvet, Laurent, John Y. Campbell, and Paolo Sodini (2007), "Down or out: Assessing the welfare costs of household investment mistakes," *Journal of Political Economy* 115(5): 707-747.

[2] Jones, Charles (2002), "A Century of Stock Market Liquidity and Trading Costs," working paper available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=313681.

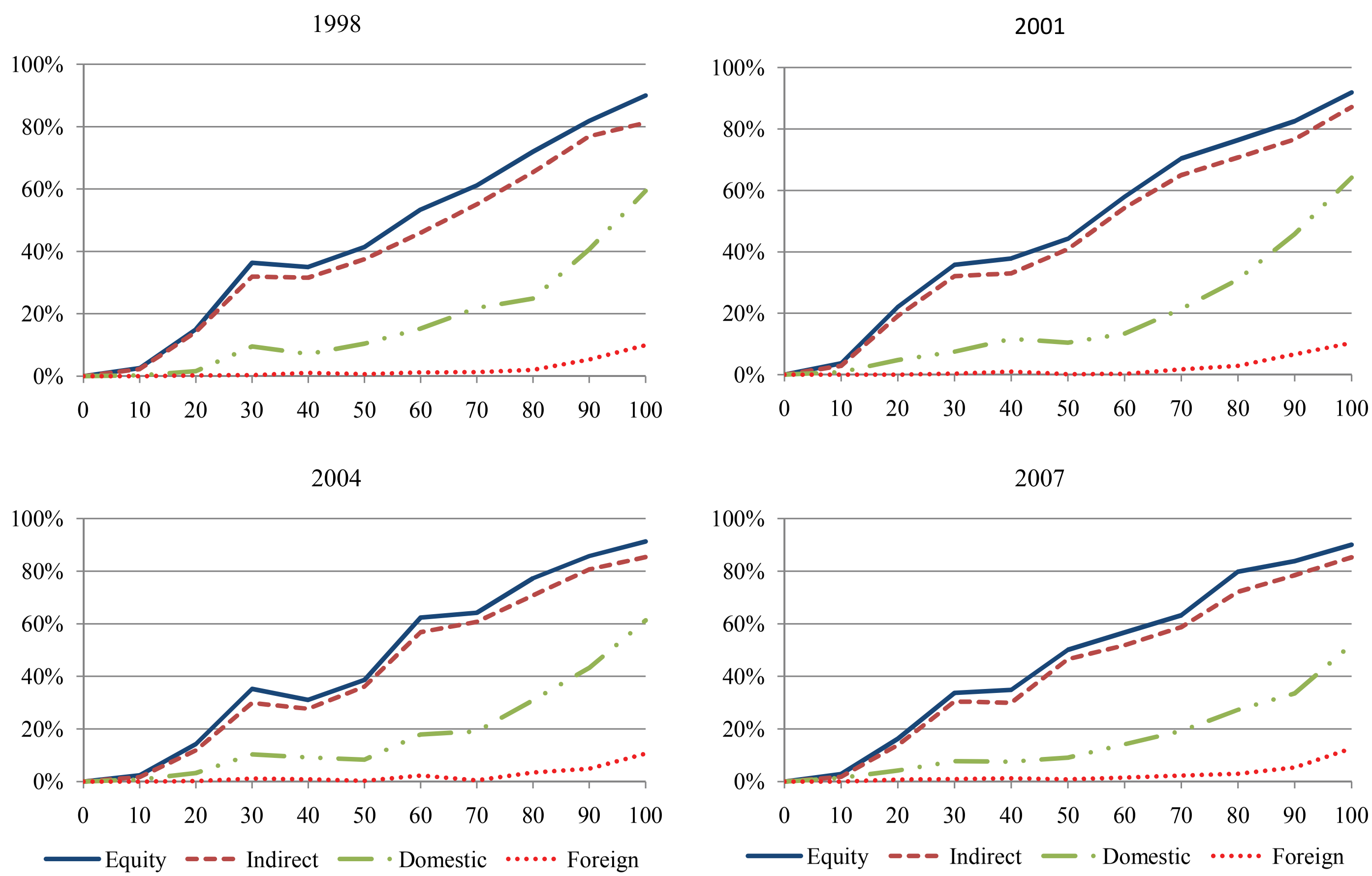

Figure 2: Household participation rates by asset class across wealth percentiles

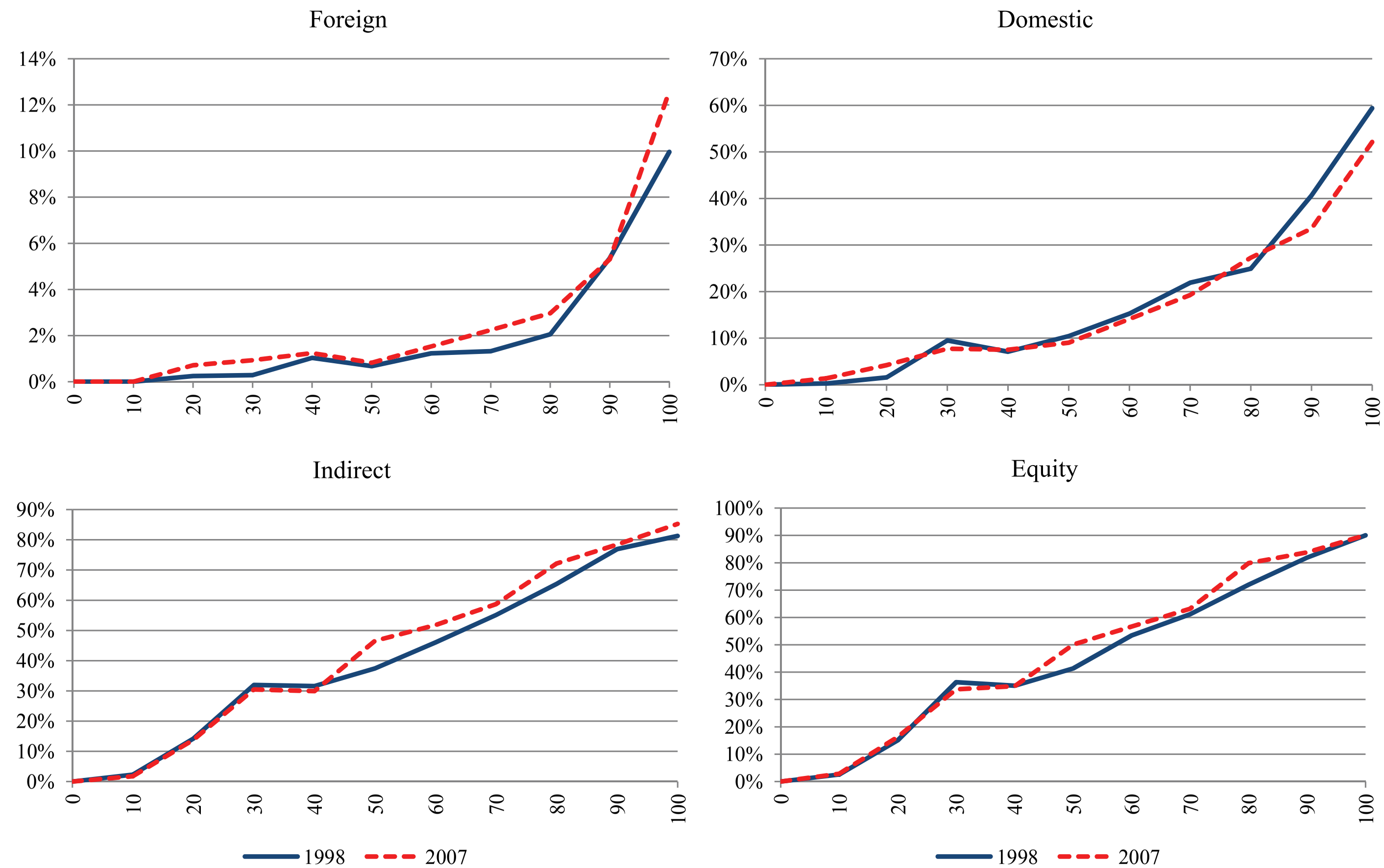

Figure 3: Household participation rates by asset class across wealth percentiles – comparing 1998 and 2007

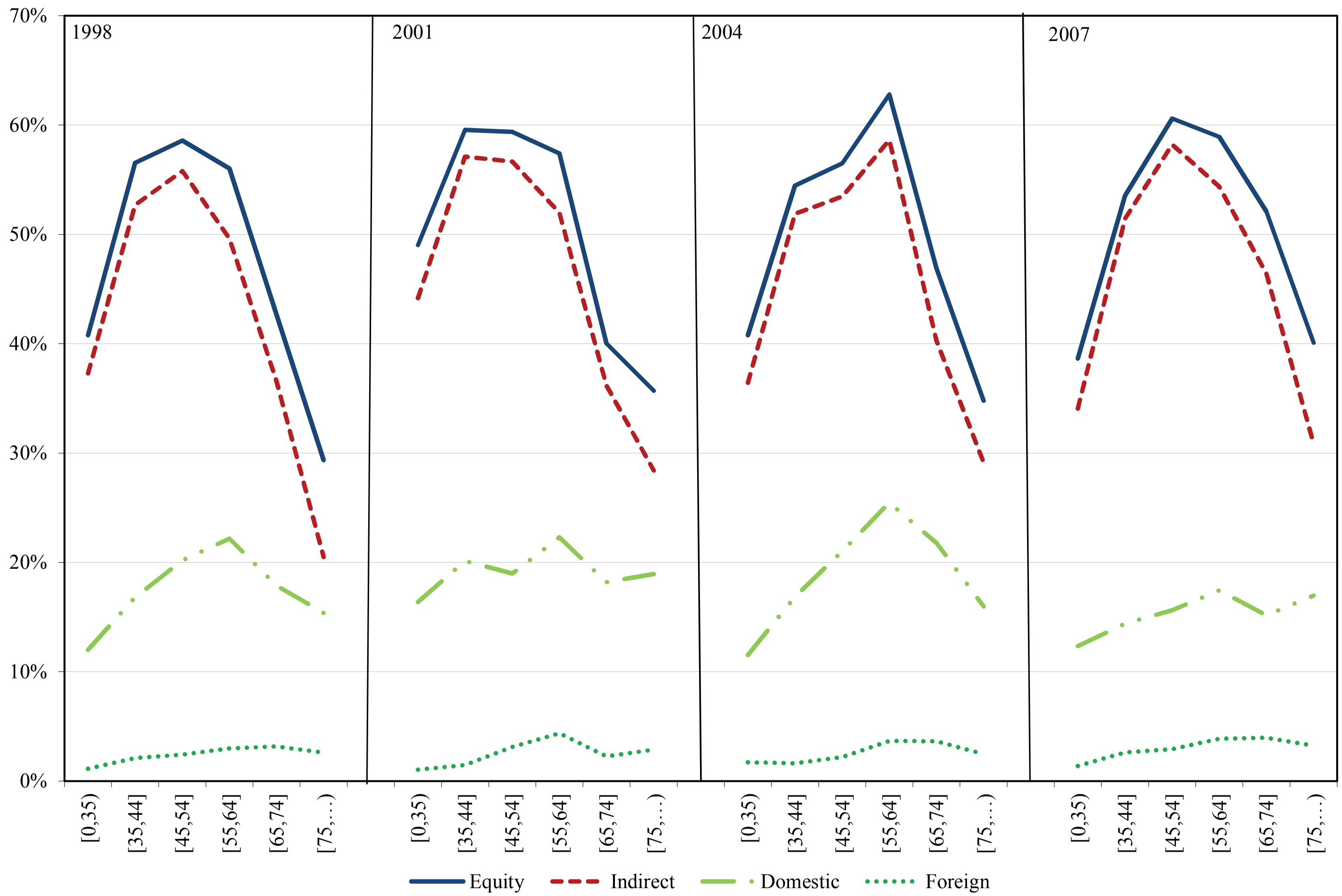

Figure 4: Household participation rates by age

Table 9: Holdings of financial assets

	Type of Asset[a]:	1998	2001	2004	2007
(1)	Transaction accounts	11.30	11.58	13.18	10.95
(2)	Certificate of deposit	4.27	3.05	3.70	4.03
(3)	Saving bonds	0.67	0.68	0.54	0.44
(4)	Bonds	4.28	4.50	5.28	4.14
(5)	Domestic stocks	15.85	15.12	11.88	11.00
(6)	Foreign stocks	0.86	0.63	0.66	1.14
(7)	Mutual Funds	12.34	12.09	14.64	15.80
(8)	Retirement accounts	27.38	28.64	32.01	34.48
(9)	Cash in life insurance	6.31	5.25	2.96	3.22
(10)	Other managed assets	8.88	10.78	7.98	6.47
(11)	Other financial	1.94	2.11	2.17	2.73
	Total:	100	100	100	100
	Additional stats:				
(12)	Indirect	31.01	34.55	33.65	35.16
(13)	Equity	53.71	55.86	51.18	52.90
(14)	Financial share[b]	40.86	42.55	35.71	34.14

[a] In 2007 dollars (shares of financial assets)
[b] Share of financial assets in total assets

Table 10: Holdings of nonfinancial assets

	Type of Asset[a]:	1998	2001	2004	2007
(1)	Vehicles	6.46	5.99	5.12	4.46
(2)	Real Estate	47.03	47.26	50.31	48.32
(3)	Other real estate	8.73	8.22	10.18	11.20
(4)	Nonresidential RE	7.58	8.22	7.12	5.38
(5)	Business	28.64	28.78	25.79	29.63
(6)	Other nonfinancial	1.56	1.53	1.48	1.02
	Total	100	100	100	100
	Additional stats:				
(7)	Nonfinancial share[b]	59.14	57.45	64.29	65.86

[a]In 2007 dollars (shares of nonfinancial assets)
[b] Share of nonfinancial assets in total assets

Table 11: Household participation by education*

	1998				2001			
	Equity	Indirect	Domestic	Foreign	Equity	Indirect	Domestic	Foreign
No High S.	17.86	15.55	4.69	0.34	16.24	13.51	5.28	0.32
High S.	45.76	40.64	14.4	1.41	47.62	43.45	14.08	1.52
College	68.95	63.84	27.04	4.37	76.06	71.43	32.69	4.46
	2004				2007			
	Equity	Indirect	Domestic	Foreign	Equity	Indirect	Domestic	Foreign
No High S.	14.32	11.96	4.56	0.09	18.67	17.65	3.15	0.74
High S.	43.93	40.24	12.95	1.47	43.8	38.78	11.03	1.21
College	72.8	67.54	30.8	4.5	74.17	69.8	25.81	5.97

*Percentage of households by highest degree attained.

Table 12: Regression results – foreign, domestic, indirect and overall holdings of stocks

	Foreign	Domestic	Indirect	Equity
Constant	-7.484***	-2.963***	-6.933***	-6.372***
	(1.12)	(0.665)	(0.738)	(0.774)
Assets	0.381***	0.318***	0.327***	0.41***
	(0.076)	(0.05)	(0.06)	(0.066)
Income	0.166**	0.1*	0.289***	0.318***
	(0.067)	(0.053)	(0.057)	(0.064)
Business	-0.108***	-0.084***	-0.113***	-0.137***
	(0.032)	(0.024)	(0.033)	(0.038)
Debt	-0.075**	-0.01	0.009	0
	(0.036)	(0.026)	(0.029)	(0.031)
Age	0.023	-0.054**	0.064***	0.016
	(0.033)	(0.023)	(0.023)	(0.024)
Age2	0	0.001**	-0.001***	0
	(0)	(0)	(0)	(0)
Married	-0.005	-0.065	0.151	0.113
	(0.203)	(0.137)	(0.128)	(0.137)
Female	0.409	-0.313	-0.132	-0.134
	(0.259)	(0.191)	(0.164)	(0.171)
No High School	0.159	-0.36*	-0.502***	-0.531***
	(0.402)	(0.212)	(0.186)	(0.184)
College	0.399***	0.229***	0.213**	0.164*
	(0.154)	(0.086)	(0.087)	(0.094)
Self-employed	0.16	-0.137	-0.416***	-0.449***
	(0.142)	(0.085)	(0.092)	(0.1)
Retired	0.045	0.101	-0.338	-0.172
	(0.212)	(0.208)	(0.21)	(0.244)
Inc.Certain	0.253*	-0.092	0.175**	0.133
	(0.143)	(0.078)	(0.08)	(0.084)
Risk aversion	-0.323***	-0.198***	-0.242***	-0.307***
	(0.076)	(0.048)	(0.051)	(0.056)
2001	0.063	0.029	0.068	0.036
	(0.161)	(0.104)	(0.121)	(0.125)
2004	-0.242	-0.022	0.025	-0.015
	(0.16)	(0.106)	(0.117)	(0.127)
2007	0.016	-0.286***	-0.227**	-0.266**
	(0.149)	(0.107)	(0.109)	(0.117)
Internet	0.348**	0.132	0.199**	0.137
	(0.137)	(0.086)	(0.101)	(0.113)
Pseudo R^2	0.229	0.126	0.229	0.255
ROC area	0.776	0.677	0.771	0.847
	(0.004)	(0.004)	(0.004)	(0.004)
Observations	18812	18812	18812	18812

The table reports coefficients and standard errors estimates from separate probit models of stock ownership for U.S. households in the 1998, 2001, 2004, and 2007 Surveys of Consumer Finances. The dependent variables in columns one to four are binary variables that identify ownership of individual foreign stocks ("Foreign"), individual domestic stocks ("Domestic"), indirect holdings of stocks ("Indirect"), and total equity ("Equity"), respectively. Coefficients followed by *** are significant at 1%, ** are significant at 5% level, and coefficients followed by * are significant at 10% level. The Survey of Consumer Finances implements a multiple imputation procedure to correct for missing data, and hence, standard errors are adjusted to account for this method. All data are weighted.

Table 13: Holdings of stocks at the tenth highest wealth percentile

	Probit		Among holders of individual stocks	Cloglog	
	Foreign	Domestic	Foreign	Foreign	Domestic
Constant	-14.085***	-3.071**	-5.837***	-14.085***	-4.081***
	(1.946)	(1.327)	(1.279)	(1.946)	(0.874)
Assets	0.685***	0.175**	0.268***	0.685***	0.394***
	(0.132)	(0.089)	(0.095)	(0.132)	(0.061)
Income	0.222**	0.206***	0.112	0.222**	0.117*
	(0.11)	(0.069)	(0.079)	(0.11)	(0.064)
Business	-0.188***	-0.076**	-0.083**	-0.188***	-0.103***
	(0.046)	(0.035)	(0.038)	(0.046)	(0.029)
Debt	-0.107*	-0.027	-0.076*	-0.107*	-0.007
	(0.055)	(0.035)	(0.045)	(0.055)	(0.034)
Age	0.073	-0.023	0.045	0.073	-0.066**
	(0.065)	(0.044)	(0.037)	(0.065)	(0.031)
Age2	-0.001	0	0	-0.001	0.001*
	(0.001)	(0)	(0)	(0.001)	(0)
Married	0.082	-0.031	-0.074	0.082	-0.036
	(0.316)	(0.226)	(0.22)	(0.316)	(0.188)
Female	0.872*	-0.061	0.549*	0.872*	-0.418
	(0.445)	(0.357)	(0.3)	(0.445)	(0.292)
No High School	0.423	-0.134	0.259	0.423	-0.717*
	(1.002)	(0.518)	(0.502)	(1.002)	(0.368)
College	0.896**	0.419***	0.298	0.896**	0.356***
	(0.353)	(0.158)	(0.183)	(0.353)	(0.122)
Self-employed	0.298	-0.177	0.185	0.298	-0.166
	(0.251)	(0.14)	(0.162)	(0.251)	(0.112)
Retired	0.224	-0.228	0.008	0.224	0.055
	(0.401)	(0.283)	(0.241)	(0.401)	(0.246)
Inc.Certain	0.544**	-0.43***	0.347**	0.544**	-0.133
	(0.265)	(0.114)	(0.155)	(0.265)	(0.103)
Risk aversion	-0.565***	-0.193***	-0.3***	-0.565***	-0.249***
	(0.148)	(0.074)	(0.09)	(0.148)	(0.062)
2001	-0.057	-0.025	0.1	-0.057	0.052
	(0.303)	(0.169)	(0.181)	(0.303)	(0.136)
2004	-0.556*	-0.126	-0.205	-0.556*	-0.036
	(0.3)	(0.179)	(0.176)	(0.3)	(0.141)
2007	-0.071	-0.452***	0.226	-0.071	-0.397***
	(0.282)	(0.168)	(0.171)	(0.282)	(0.146)
Internet	0.655***	0.063	0.316**	0.655***	0.162
	(0.233)	(0.129)	(0.152)	(0.233)	(0.109)
Pseudo R^2	0.154	0.078	0.119	-	-
ROC area	0.775	0.669	0.761	0.773	0.668
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
Observations	14064	14064	8904	14064	14064

The table reports coefficients and standard errors estimates from binary models of stock ownership for U.S. households in the 1998, 2001, 2004, and 2007 Surveys of Consumer Finances. For all regressions, the sample is constrained to the top 10 percentile of the wealth distribution. The dependent variable in columns one and two are binary and identify ownership of individual foreign stocks ("Foreign"), and individual domestic stocks ("Domestic"), respectively. The binary dependent variable in column three identifies ownership of individual foreign stocks ("Foreign") and the sample is constrained among holders of individual stocks. The last two columns report cloglog regression results for the binary dependent variables that identify ownership of individual foreign stocks ("Foreign"), and individual domestic stocks ("Domestic"), respectively. Coefficients followed by *** are significant at 1%, ** are significant at 5% level, and coefficients followed by * are significant at 10% level. The Survey of Consumer Finances implements a multiple imputation procedure to correct for missing data, and hence, standard errors are adjusted to account for this method. All data are weighted.

Table 14: Stock holders versus nonholders at the tenth highest wealth percentile - financial characteristics (in 2007 thousand dollars)

	1998			2001		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Income	158.2	269.7	323.7	249.6	351.1	382.9
Fin. Wealth	629.9	1,405.3	2,506.8	974.7	1,757.5	2,940.3
RE Wealth	405.0	417.6	467.7	478.5	576.8	636.4
Bus. Wealth	509.8	694.5	984.8	820.1	738.3	936.2
Debt	166.8	196.7	202.3	161.5	195.9	232.0
	2004			2007		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Income	676.4	305.8	400.5	1,152.7	384.0	583.7
Fin. Wealth	932.1	1,612.9	2,671.7	300.7	1,831.0	3,272.0
RE Wealth	271.9	760.8	846.3	686.4	930.0	1,047.0
Bus. Wealth	168.9	807.7	910.8	1,152.7	1,094.0	1,595.8
Debt	132.9	277.2	248.1	300.7	334.3	333.3

Table 15: Stock holders versus nonholders at the tenth highest wealth percentile – demographic characteristics

	1998			2001		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Age	55.9	55.1	55.8	57.1	56.0	60.5
Education	14.6	15.6	15.6	15.2	15.6	15.9
Married	0.8	0.8	0.7	0.8	0.9	0.8
Risk Aversion	2.9	2.6	2.3	2.8	2.6	2.7
	2004			2007		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Age	56.5	58.3	60.4	56.3	56.6	57.6
Education	15.1	15.7	15.7	14.9	15.7	16.0
Married	0.8	0.8	0.8	0.8	0.8	0.8
Risk Aversion	2.9	2.7	2.6	2.8	2.6	2.5

Table 16: Additional information variables

	Times		Shop		Paper		Banker	
	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic
Constant	-7.418***	0.236	-13.667***	-4.039***	-13.801***	-4.024***	-13.552***	-4.068***
	(2.124)	(1.145)	(1.88)	(0.878)	(1.89)	(0.866)	(1.868)	(0.875)
Assets	0.368**	0.132	0.664***	0.396***	0.658***	0.382***	0.665***	0.395***
	(0.158)	(0.083)	(0.129)	(0.062)	(0.129)	(0.062)	(0.13)	(0.061)
Income	0.102	-0.041	0.241**	0.12*	0.242**	0.121*	0.238**	0.12*
	(0.126)	(0.076)	(0.111)	(0.064)	(0.111)	(0.064)	(0.111)	(0.064)
Business	-0.127**	-0.03	-0.194***	-0.107***	-0.19***	-0.101***	-0.191***	-0.107***
	(0.053)	(0.035)	(0.045)	(0.029)	(0.045)	(0.029)	(0.045)	(0.028)
Debt	-0.082	0.024	-0.106*	-0.007	-0.101*	-0.003	-0.107*	-0.006
	(0.065)	(0.041)	(0.055)	(0.034)	(0.056)	(0.034)	(0.055)	(0.034)
Age	0.016	-0.042	0.072	-0.065**	0.073	-0.067**	0.073	-0.065**
	(0.066)	(0.039)	(0.065)	(0.031)	(0.064)	(0.031)	(0.065)	(0.031)
Age2	0	0	-0.001	0.001*	-0.001	0.001*	-0.001	0.001*
	(0.001)	(0)	(0.001)	(0)	(0.001)	(0)	(0.001)	(0)
Married	-0.091	-0.071	0.012	-0.046	0.001	-0.053	0.015	-0.046
	(0.322)	(0.197)	(0.304)	(0.189)	(0.305)	(0.189)	(0.305)	(0.189)
Female	0.868**	-0.965**	0.759*	-0.428	0.763*	-0.436	0.749*	-0.426
	(0.44)	(0.422)	(0.432)	(0.292)	(0.43)	(0.293)	(0.432)	(0.292)
No High School	1.524*	0.282	0.313	-0.722**	0.349	-0.724**	0.316	-0.722**
	(0.844)	(0.54)	(0.995)	(0.366)	(1.001)	(0.368)	(0.99)	(0.367)
College	1.396***	0.076	0.951***	0.374***	0.916***	0.358***	0.944***	0.375***
	(0.361)	(0.148)	(0.345)	(0.121)	(0.347)	(0.122)	(0.346)	(0.121)
Self-employed	0.158	-0.092	0.289	-0.171	0.291	-0.167	0.288	-0.172
	(0.255)	(0.144)	(0.253)	(0.112)	(0.253)	(0.112)	(0.252)	(0.112)
Retired	0.208	0.004	0.223	0.048	0.261	0.052	0.212	0.051
	(0.422)	(0.262)	(0.398)	(0.246)	(0.399)	(0.246)	(0.395)	(0.246)
Inc.Certain	0.571**	-0.182	0.567**	-0.129	0.558**	-0.133	0.559**	-0.128
	(0.264)	(0.12)	(0.267)	(0.103)	(0.266)	(0.103)	(0.266)	(0.103)
Risk aversion	-0.435***	-0.04	-0.608***	-0.257***	-0.582***	-0.246***	-0.6***	-0.259***
	(0.153)	(0.085)	(0.153)	(0.061)	(0.148)	(0.062)	(0.15)	(0.061)
2001	-0.276	0.104	-0.004	0.063	0.024	0.075	0.011	0.06
	(0.304)	(0.159)	(0.31)	(0.136)	(0.301)	(0.136)	(0.31)	(0.136)
2004	-0.255	0.204	-0.485	-0.019	-0.459	-0.01	-0.463	-0.022
	(0.317)	(0.166)	(0.298)	(0.141)	(0.292)	(0.14)	(0.299)	(0.14)
2007	0.316	-0.43**	0.078	-0.361**	0.087	-0.356**	0.122	-0.366**
	(0.292)	(0.171)	(0.272)	(0.143)	(0.268)	(0.143)	(0.275)	(0.144)
Information Var.	0.003**	0	0.028	-0.006	0.395**	0.21*	-0.303	0.037
	(0.002)	(0.001)	(0.084)	(0.036)	(0.2)	(0.11)	(0.236)	(0.107)
ROC area	0.655	0.54	0.77	0.677	0.771	0.677	0.77	0.677
	(0.006)	(0.005)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)
Observations	12724	12724	23190	23190	23190	23190	23190	23190

The table reports coefficients and standard errors estimates from a cloglog model of ownership of foreign ("Foreign") and domestic stocks ("Domestic") for U.S. households in the 1998, 2001, 2004 and 2007 Surveys of Consumer Finances. Coefficients followed by *** are significant at 1%, ** are significant at 5% level, while coefficients followed by * are significant at 10% level. The Survey of Consumer Finances implements a multiple imputation procedure to correct for missing data, and hence, standard errors are adjusted by averaging the dependent and independent values across implicates. All data are weighted.

Table 17: Additional information variables - cont.

	Broker		Fin. Planner		Friends	
	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic
Constant	-13.38***	-3.981***	-13.554***	-4.102***	-13.223***	-4.145***
	(1.924)	(0.877)	(1.88)	(0.871)	(1.907)	(0.872)
Assets	0.663***	0.391***	0.666***	0.398***	0.648***	0.398***
	(0.13)	(0.061)	(0.131)	(0.061)	(0.133)	(0.061)
Income	0.229**	0.115*	0.226**	0.125**	0.245**	0.121*
	(0.114)	(0.064)	(0.111)	(0.064)	(0.11)	(0.064)
Business	-0.193***	-0.106***	-0.192***	-0.108***	-0.189***	-0.108***
	(0.045)	(0.029)	(0.045)	(0.029)	(0.046)	(0.029)
Debt	-0.115**	-0.008	-0.106*	-0.007	-0.105*	-0.007
	(0.057)	(0.034)	(0.056)	(0.034)	(0.056)	(0.034)
Age	0.073	-0.065**	0.073	-0.065**	0.069	-0.066**
	(0.065)	(0.032)	(0.064)	(0.031)	(0.064)	(0.031)
Age2	-0.001	0.001*	-0.001	0.001*	-0.001	0.001*
	(0.001)	(0)	(0.001)	(0)	(0.001)	(0)
Married	0.026	-0.039	-0.002	-0.051	0.001	-0.039
	(0.303)	(0.188)	(0.307)	(0.188)	(0.302)	(0.19)
Female	0.766*	-0.424	0.709	-0.418	0.787*	-0.435
	(0.432)	(0.292)	(0.437)	(0.291)	(0.427)	(0.293)
No High School	0.32	-0.711*	0.315	-0.73**	0.275	-0.714*
	(0.988)	(0.367)	(1.002)	(0.367)	(0.988)	(0.366)
College	0.94***	0.368***	0.929***	0.383***	0.973***	0.371***
	(0.344)	(0.121)	(0.349)	(0.121)	(0.348)	(0.121)
Self-employed	0.302	-0.168	0.278	-0.169	0.25	-0.163
	(0.25)	(0.112)	(0.251)	(0.112)	(0.257)	(0.112)
Retired	0.238	0.05	0.203	0.058	0.192	0.05
	(0.399)	(0.246)	(0.399)	(0.245)	(0.41)	(0.247)
Inc.Certain	0.567**	-0.129	0.564**	-0.131	0.573**	-0.135
	(0.267)	(0.103)	(0.268)	(0.102)	(0.268)	(0.103)
Risk aversion	-0.613***	-0.257***	-0.608***	-0.259***	-0.603***	-0.257***
	(0.151)	(0.061)	(0.15)	(0.061)	(0.148)	(0.061)
2001	-0.015	0.058	0.009	0.063	0.021	0.054
	(0.308)	(0.136)	(0.307)	(0.136)	(0.303)	(0.136)
2004	-0.469	-0.018	-0.488	-0.017	-0.476	-0.015
	(0.299)	(0.14)	(0.297)	(0.14)	(0.294)	(0.14)
2007	0.069	-0.363**	0.049	-0.349**	0.121	-0.374***
	(0.27)	(0.143)	(0.275)	(0.145)	(0.269)	(0.144)
Information Var.	0.262	0.122	0.239	-0.111	-0.393*	0.13
	(0.227)	(0.105)	(0.211)	(0.105)	(0.236)	(0.099)
ROC area	0.77	0.678	0.769	0.677	0.77	0.678
	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)
Observations	23190	23190	23190	23190	23190	23190

The table reports coefficients and standard errors estimates from a cloglog model of ownership of foreign ("Foreign") and domestic stocks ("Domestic") for U.S. households in the 1998, 2001, 2004 and 2007 Surveys of Consumer Finances. Coefficients followed by *** are significant at 1%, ** are significant at 5% level, while coefficients followed by * are significant at 10% level. The Survey of Consumer Finances implements a multiple imputation procedure to correct for missing data, and hence, standard errors are adjusted by averaging the dependent and independent values across implicates. All data are weighted.