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WORKING PAPER SERIES

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(Last version: May 2011)

August 2011

Working Paper 2010-26
http://www.frbsf.org/publications/economics/papers/2010/wp10-26bk.pdf

Foreign Stock Holdings: The Role of Information*

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Abstract

Foreign stock ownership is known to be very limited across households. This paper studies the role of information acquisition on agents' decisions to invest in foreign stocks. Using the Survey of Consumer Finances, I show that foreign stock holders, when compared to those who hold only domestic stocks, are substantially wealthier, more educated, have a different age profile, and more importantly, are more sophisticated in their sources of information. Households that participate in foreign stock markets are better informed about their financial investment choices; they shop more for investments, update their investment portfolios more frequently, and use the Internet more often as a source of information. To account for the two main features of the data – that foreign stock owners are scarce but better-informed – the paper considers a model where information is costly, and investors decide whether to enter the domestic and foreign stock markets. In the model, investors pay a fixed cost to update their information set, implying infrequent updating. To account for the low participation, the model also features an entry cost paid when agents first invest in stocks. The model predicts that those who invest in foreign stocks update their information set more frequently. A version of the model calibrated to match returns and volatility for U.S. and foreign stock investments shows that, once agents already invest in domestic stock markets, the minimum entry cost needed to drive agents out of foreign stock markets is potentially small helping to explain the large nonparticipation.

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

*For comments and suggestions I thank seminar participants at the WEAI 2011, Dallas Fed, EEA 2010, USC, Princeton University, and San Francisco Fed. I am also grateful to Anna Crespo, Nobu Kiyotaki, Pierre-Olivier Gourinchas, Galina Hale, Ricardo Reis, Helene Rey and Chris Sims for comments and suggestions. The views expressed in this paper are those of the author and do not necessarily reflect the position of the Federal Reserve Bank of San Francisco or the Federal Reserve System. E-mail: fernanda.nechio@sf.frb.org.

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 what drivers household holdings of domestic stocks, the knowledge about household holdings of *foreign* stocks is more limited. On the one hand, the household finance literature describes the decision to invest in stocks as a two-step process, in which households first decide whether to enter the stock market and subsequently decide on the share of assets to hold in their portfolios. On the other hand, the international finance literature has focused on the *share* of foreign assets households hold in their portfolios, documenting a large home bias on households' portfolio holdings. However, preceding investors' choice of the share of foreign assets to hold is the decision on whether to own foreign assets, in particular, foreign stocks. While the recent international finance literature points toward the role of information in explaining agents' share of foreign assets (e.g., Veldkamp and Van Nieuwerburgh (2010) and Mondria and Wu (2010)), I move one step back and look at the role of information in explaining the first step, i.e., the decision to enter the foreign stock market. Is there a role for information acquisition in the entry decision? Are foreign stock holders more attentive?

To study the role of information acquisition on investors' decisions, the paper provides an empirical analysis of agents' ownership of foreign stocks and compares the ownership decision for foreign and domestic stocks. The data show that holders of foreign stocks are somewhat different from holders of domestic ones, being more sophisticated in their information acquisition process and more attentive. Driven by these results, the paper presents a model that accounts for the two main features of the data: low participation in foreign stock markets and information acquisition.

Using the Survey of Consumer Finances I disentangle *direct* holders of foreign and domestic stocks, i.e., households that hold individual stocks outside of investment funds mainly through brokers and banks. I follow the participation puzzle literature and first focus on the effects of wealth, age, and education on participation. For both asset classes – foreign and domestic – participation increases with the level of wealth. Foreign stocks holders are largely concentrated at the highest wealth percentiles, while the share of domestic stock holders is spread across percentiles of wealth. As for the age profile, the documented hump shape over age intervals does not appear when the sample is restricted to holdings of foreign stocks. In line with the equity holdings literature, having more years of schooling increases participation in both asset classes, and households whose head has at least a college degree diversify their portfolio more. The data also detail various financial, nonfinancial, and demographic characteristics. Compared to households who hold domestic stocks only, foreign stock investors have higher incomes, financial, real estate, and business wealths. Foreign stock holders also have larger debt levels. Among the demographic characteristics, the data highlight that foreign stock investors report themselves to be

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

more willing to take financial risks than investors that hold domestic stocks only. Finally, and more importantly for this paper, foreign stock holders are better informed regarding their financial choices: they shop more for investments, talk more frequently to their brokers, and use the Internet more often as a main source of information.

The regression estimates confirm the unconditional analysis. The benchmark regressions estimate probability models (*probit* regressions) on the ownership of foreign and domestic stocks. The results reinforce that foreign stock investors are distinct from those who hold domestic stocks only (and from households who hold stocks through investment funds). Holders of foreign stocks are more sophisticated in their information acquisition process; using the Internet as the main source of information has a positive and statistically significant effect for holdings of foreign stocks, while the same does not hold true for domestic holders. The regressions also highlight the role of risk aversion by showing a negative correlation between ownership and willingness to take risk. In addition, having a college degree correlates positively with ownership as expected, adding to the inference on the role of information. Finally, the regressions point to the role of background risks arising from other investments, by showing that households with larger private business wealth have a smaller probability of holding any type of stocks. The robustness checks highlight the role of wealth on agents' stock holdings and show evidence of a joint ownership decision. In addition, the regression results are robust to different estimation techniques and different informational variable choices.

The main limitation of the Survey of Consumer Finances is the lack of 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 on direct holders of stocks. The data show that a little less than 3% of agents hold foreign stocks directly in their portfolio. This same figure stays near 17% when looking at domestic stock holders.[2] While this data limitation constrains my analysis, it is potentially a good source for inference on household choice of investments, since for direct holdings there is no portfolio manager making the decision for the household. Nevertheless, to overcome the data limitation, 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.[3]

The data analysis shows that for given set of demographic characteristics, foreign stock holders are more attentive. To capture this feature, this paper presents a model where agents can invest in both domestic and foreign stocks. I depart from the Abel et al. (2007) model by introducing foreign stocks as an additional risky asset. In the model, consumers can invest in both domestic and foreign

[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. The data show that around 46% of households hold stocks through investment funds (indirect holdings) and the percentage of holders of equity (both directly and indirectly) reaches 50%.

[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).

stocks and pay an "observation cost" to update their portfolios, which implies that they optimally choose to do so infrequently. To account for the large share of the population that is out of the stock market, I also introduce a one-time entry cost to be paid when investors first enter the stock market. This cost represents financial costs and time spent learning about investment opportunities and acquiring information about risks and returns. The model shows that agents who invest in foreign stocks are more attentive, updating their portfolios more frequently. Intuitively, although it is costly to obtain information, once increasing the overall share of stocks in their total portfolio, risk averse agents gain from diversification but also face larger risks, and hence, they update their information set more frequently. After calibrating the model to match returns and volatility for the U.S. economy and several foreign stock investments, I assess the minimum cost that would drive investors out of the foreign market once they have already invested in domestic stocks. The calibrated model predicts that this minimum cost is potentially small and decreasing in risk aversion and updating costs. Variations on risk aversion or uncertainty about foreign stock returns can make this minimum entry cost fairly small to justify the large nonparticipation in foreign stock markets.

This paper relates to the literature on household' 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 role 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; and Huang and Liu (2007) assume that agents can extract a signal from asset returns and analyze how information processing affects their portfolio decisions. Finally, 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. It 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).

Section 2 presents the data and unconditional analysis about household holdings of stocks. Section 3 shows the regression estimates, followed by robustness results in Section 4. The model is described in Section 5. Finally, Section 6 concludes.

2 The Data

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

The Survey of Consumer Finances (SCF), conducted by the Federal Reserve Board, fulfills the first two properties. It consists of a triennial household survey on asset holdings in the United States. In most recent years, the survey interviews 3000 households randomly selected and some additional 1500 high-wealth households selected from tax records. 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 characteristics of the SCF makes survey weights important to uncover statistics for the U.S. population. Throughout this paper, all data and statistics from the SCF are weighted.

Besides covering a large enough sample, information provided by the SCF is vast and covers most aspects of household wealth, asset holdings, and liabilities.[4] The SCF, however, is not a panel but a cross-section of randomly selected individuals every three years. For this paper, the data set consists of the SCF for years 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.[5] 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.[6]

Although the level of information disaggregation in the SCF has increased over the past few years, the survey still lacks enough information to address portfolio diversification, since it poorly addresses holdings of individual assets. 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 indirect holdings of foreign and domestic stocks, inquiring only if agents hold stocks through different types of funds, but not if they hold one type and/or the other. Therefore, detailed information on what may be a large part of agents' portfolios is missing.[7]

[4] 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.

[5] 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.

[6] For more details on this method and on its implications for the results of this paper, see footnote 33.

[7] In addition to jeopardizing a complete analysis of household participation decisions, this missing information precludes

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 for indirect holdings of foreign assets.

While the SCF covers a large enough 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. 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.

2.1 Household Finances - Evidence from the Survey of Consumer Finances

The 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,[8] (*ii*) increasing in education,[9] and (*iii*) hump-shaped in age.[10]

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. Age is related to life-cycle behavior and hence, one expects differences in holdings of assets for each age interval. Finally, education is a proxy for information and more informed agents are expected to better diversify their portfolio. This set of facts is shown to be robust to controlling for other variables, and also robust to different countries.

As shown by previous empirical works (e.g., Bertaut and Starr-McCluer (1995) and Calvet, Campbell, and Sodini (2007)), the recent increase in stock market participation is widely spread across different countries. Technological innovations and the greater liberalization and integration of financial markets have brought more attention to the availability of different types of assets, in particular, foreign stocks. Across countries, agents have increased their participation in stock markets and also the degree of diversification in their portfolios. Hence, this Section starts by documenting the recent trends for holdings of foreign and domestic stocks. Subsequently, I examine other variables that determine direct holdings of stocks, in particular foreign ones.

My main goal is to describe household stock portfolios, focusing on *ownership* decisions in domestic and foreign stock markets.[11] For each table and figure, I focus my analysis on two main variables: *direct*

one from addressing the well-known home bias in agents' portfolios.

[8] Bertaut and Starr-McCluer (2002).

[9] Guiso and Jappelli (2005).

[10] See Ameriks and Zeldes (2004) for more about age effects.

[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.

holdings of foreign stocks and *direct holdings of domestic stocks*. I also add information about *indirect holdings of stocks* through investment and retirement funds. Finally, to make my results comparable to the participation puzzle literature, I report statistics for overall equity holdings. Because this data set compiles quite disaggregated measures of different types of liquid and illiquid assets, I follow the guidelines of the Federal Reserve Board publications and codes to build aggregate measures, such as total equity holdings, total wealth, and income.[12]

Table 1 presents participation and the mean invested for four classes of assets: direct holdings of foreign stocks, direct holdings of domestic stocks, indirect holdings of stocks, and equity holdings. *Foreign* and *Domestic* correspond to direct holdings of foreign and domestic stocks outside investment funds, respectively. *Foreign* stock holders are those who answered positively to the question, "*Among your direct holdings of stocks, do you have stocks from a company headquartered outside the United States?*". *Domestic* refers to agents who hold only domestic stocks outside investment funds, and do not hold individual foreign stocks. To build the *Domestic* sample, I exclude from direct holders of stocks those who answered positively to the question about holdings of stocks from a company headquartered outside the United States. In principle, those two sets of investors can also hold domestic stocks or foreign stocks through investment funds.[13] *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 be direct owners.[14] Finally, *Equity* is an aggregate measure of stocks holdings that includes both direct and indirect holdings of domestic and foreign stocks (which is the usual measure reported in the participation puzzle literature). Throughout the paper, *Participation* refers to the percentage of households out of the population (weighted data) holding the asset.

Rows (1) and (5) of Table 1 confirm previous findings in the participation puzzle literature by showing that participation in equity markets have increased substantially since 1998. The large increase in participation in equity markets across the first triennium reported in Table 1 is followed by an almost stable rate of participation in the following years. Row (2) indicates that the bulk of the increase in participation comes from indirect holdings of stocks. There is a steep increase in indirect holdings of stocks but a relatively less-pronounced increase in direct holdings (rows $(3) + (4)$). Participation in domestic stock markets ranges from 14% to 15%, peaking in 2001 at 19%.

Participation in foreign markets is limited for all years, and from 2001 onwards, the percentage of people holding foreign stocks increased only slightly. At odds with the pattern of the previous years,

[12] The code to build aggregate measures is available on the Survey of Consumer Finance website: http://www.federalreserve.gov/PUBS/oss/oss2/bulletin.macro.txt

[13] The SCF does not distinguish whether holders of foreign stocks are also holders of domestic ones. The ICI data set, however, indicates that this is indeed the case, and roughly every investor who holds foreign stocks directly also holds domestic ones, both directly and indirectly.

[14] To build this measure, I follow the guidelines of the Federal Reserve Board publications and codes. Households are asked if they own stocks among their holdings of investment funds. They are then asked if their portfolio for each type of investment fund is composed of mostly stocks, bonds, or split in both types of investment, and about the share invested in bonds and stocks. The Board considers that 50% of the portfolio is held in stocks when agents report holdings funds split between bonds and stocks. For more detailed information in building such a measure, see http://www.federalreserve.gov/PUBS/oss/oss2/bulletin.macro.txt.

Table 1: Participation and mean holdings for different asset classes

		1998	2001	2004	2007
	Participation[a]				
(1)	Equity	48.87	52.26	50.22	51.12
(2)	Indirect	44.21	48.27	46.15	46.86
(3)	Domestic	17.00	18.99	18.27	15.07
(4)	Foreign	2.21	2.32	2.38	2.83
	Mean Holdings[b]				
(5)	Equity	3,085.4	3,416.8	3,436.8	4,763.6
(6)	Indirect	984.4	1,044.2	1,320.8	2,214.6
(7)	Domestic	3,271.3	2,839.0	2,892.3	3,670.1
(8)	Foreign	869,0	1,611.3	895.5	1,490.6

[a]Fraction of population holding the asset.

[b]Conditional on holding (in 2007 thousand dollars).

however, in 2007 participation in foreign stock markets increased, while the same figure for domestic stocks diminished. There is also a small increase in indirect holdings of stocks. As Section 2.2 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 increased substantially over this period, while after 2005 holdings of domestic stocks dropped.

The second half of Table 1 show to the mean value of holdings of each type of asset *conditional* on holding the asset in 2007 thousand dollars. Rows (5) to (8) show that for all classes of assets, there is a sharp increase in mean holdings. Row (8) shows that the increase in participation in foreign markets is followed by an increase in average holdings of this same asset. As a general statement, however, for all years documented, both participation and mean holdings are much smaller for foreign stocks than domestic ones.[15]

2.1.1 Participation and asset allocation by wealth

Figure 1 shows household ownership of each asset class across wealth percentiles.[16] Wealth is measured as household total assets in 2007 dollars,[17] and participation refers to the percentage of households holding the asset. Figure 1 shows that participation is increasing in wealth for all different asset classes. 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 wealth percentile.

[15]Tables 11 and 12 in the Appendix provide complementary information on recent developments of household financial and nonfinancial assets.

[16]Analogous information about the share of assets in household portfolios is provided in the Appendix.

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

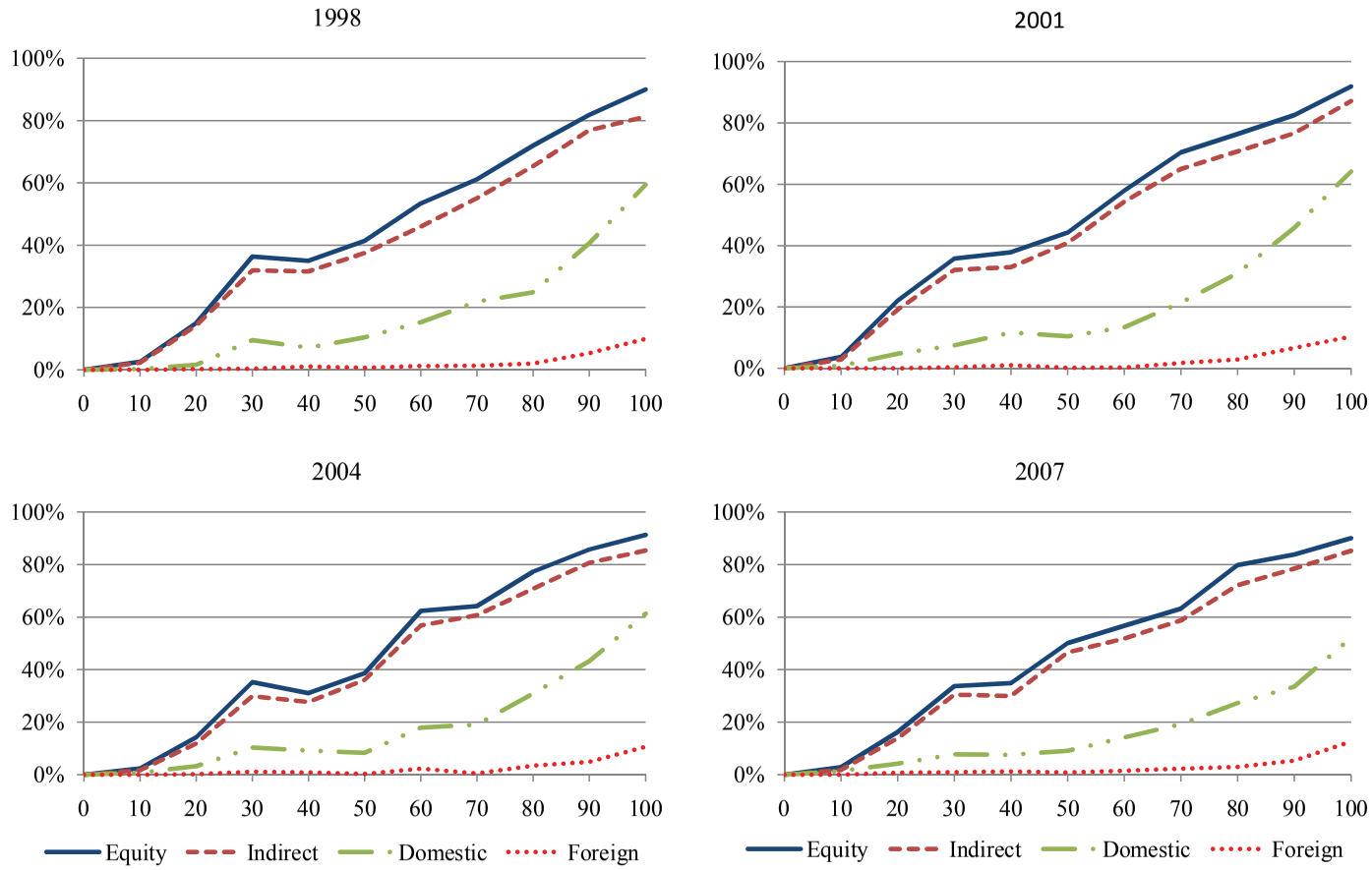

Figure 1: Participation rates by asset class across wealth percentiles

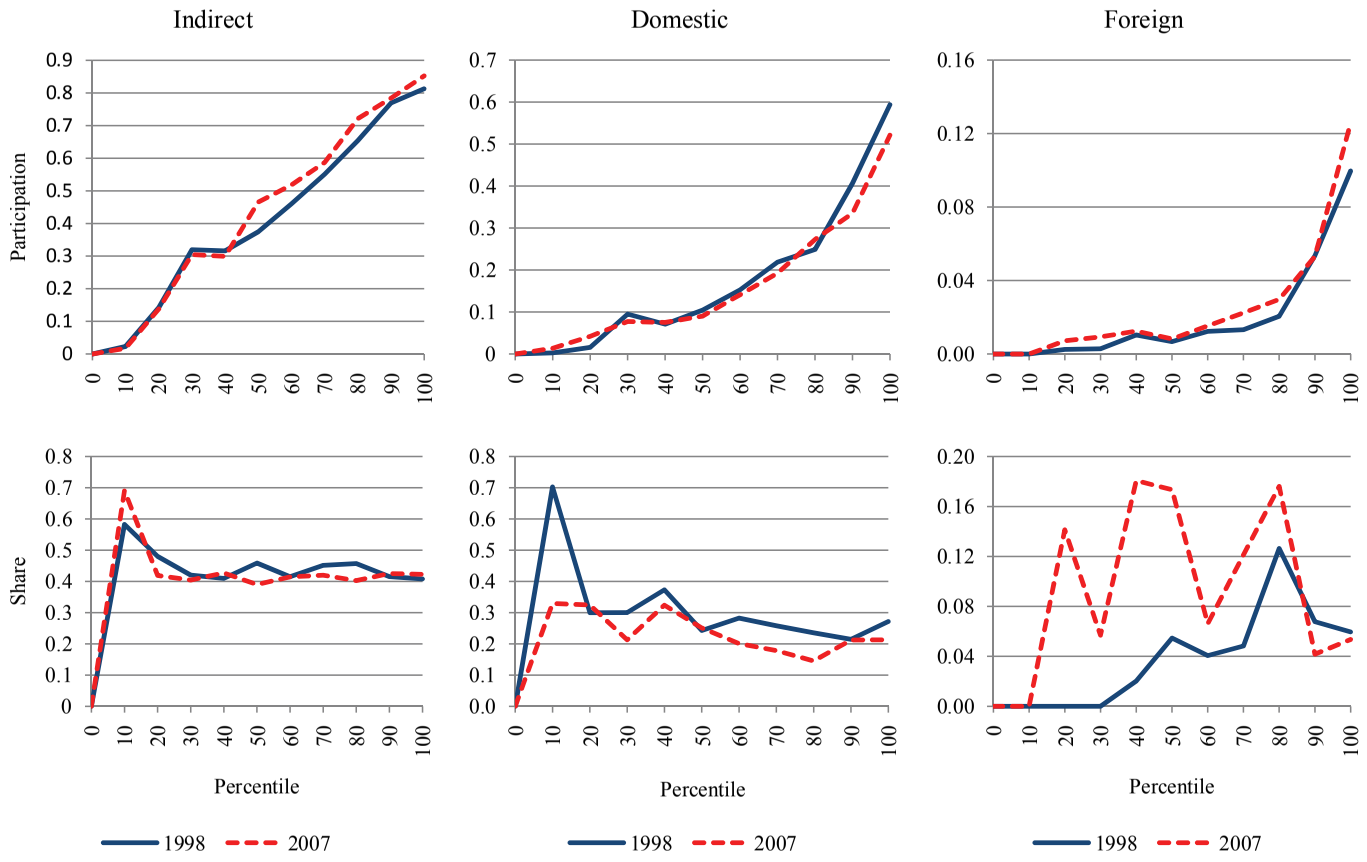

Figure 2: Participation and asset class shares in household portfolios across wealth percentiles - comparing 1998 and 2007

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 auxiliary Figure 2 reorganizes the information in Figure 1 to help visualize these time trends.

2.1.2 Participation and asset allocation by age

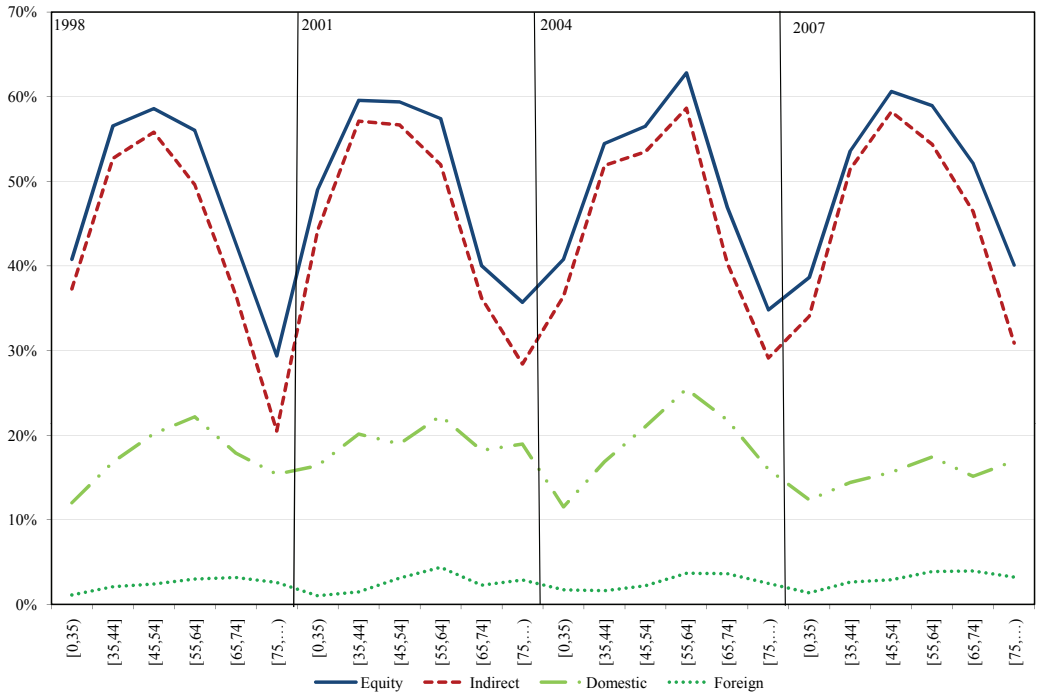

Figure 3: Household Asset Ownership by Age

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 3 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.[18] The comparison

[18] 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 2.2, the ICI surveys indicate that agents start investing in stocks through funds and

between domestic and foreign holdings, however, does not give the same clear pattern.[19] Besides, for most years, participation in foreign stock markets peaks after domestic holdings of stocks.

2.1.3 Participation and asset allocation by education

Education is a good proxy for information. Households with more years of schooling tend to be more informed, and if information is the variable precluding agents from taking advantage of the opportunities in the stock market, the higher the education level, the larger the participation rate in domestic and foreign stock markets.

Table 2 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 the 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. The analogous is not necessarily true once one moves from no high school diploma to high school level.

Table 2: Household Asset Ownership 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.

2.1.4 Participation and allocation: financial and demographic variables

Tables 3 and 4 compare nonholders and holders of domestic and foreign stocks. Table 3 summarizes household financial characteristics. For each year, this table reports the mean values of household income, financial wealth, real estate wealth, business wealth, and debt for nonholders of stocks versus direct holders of domestic and foreign stocks (mean values in 2007 thousand dollars).[20]

Stockholders have more income and larger financial, real estate, and business wealths. Their larger indebtedness indicates that they also have more access to credit. Households who hold foreign stocks,

later migrating to direct holdings.

[19] In addition, participation in foreign stocks is much volatile with respect to age than domestic direct or indirect holdings of stocks.

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

however, are considerably wealthier than holders of solely domestic stocks. For all years, income, financial, real estate, and business wealths are much larger for agents who participate in the foreign stock market. Throughout the years, the gap between domestic and foreign stock holders has shrunk while it enlarged when comparing holders to nonholders. Nevertheless, 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.

Table 3: Stock Holders versus Nonholders - Financial Characteristics*

	1998			2001		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Income	35.0	133.1	186.9	37.9	161.9	224.2
Fin. Wealth	29.7	506.9	1,239.4	33.4	618.5	1,454.5
RE Wealth	65.3	216.1	276.0	68.4	279.2	387.0
Bus. Wealth	21.9	211.2	445.6	23.0	221.5	421.0
Debt	29.2	110.9	111.0	29.7	113.7	151.9
	2004			2007		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Income	37.6	145.4	214.9	38.9	159.6	294.3
Fin. Wealth	26.8	565.3	1,308.5	25.1	603.2	1,558.7
RE Wealth	90.1	356.7	500.1	99.7	409.0	558.3
Bus. Wealth	22.7	236.6	407.0	37.6	304.6	712.2
Debt	42.8	147.1	153.4	49.4	171.4	186.5

*Mean values of household wealth (in 2007 thousand dollars)

Table 4 complements Table 3 by presenting demographic characteristics of nonholders and holders of stocks. 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 mean years of education for all different years, even though the difference between domestic and foreign holders is not very large. While the percentage of married people is higher among domestic stock investors than among nonholders, this share is smaller among foreign holders than for domestic ones.

Households are also asked how much risk they are willing to take on a scale from 1 (substantial financial risk) to 4 (no risk). For all years, participants in the stock market self-report as being less averse to risk. Foreign stock holders are even less risk averse than domestic stock investors.

A final interesting variable is the percentage of Hispanic people across each category. As posed in Lewis (1999), agents with foreign backgrounds could be more informed about foreign assets, and hence, be more exposed to such investments. The share of the population that is descent of Hispanic, however, shows no clear pattern when comparing holders of domestic and foreign stocks. As Section 3 will show, when controlling for different variables, being Hispanic actually decreases the probability of holding foreign and domestic stocks directly.

Since the holders of stocks are mostly concentrated at the higher percentiles of the wealth distribution, I replicate Tables 3 and 4 while limiting my sample to the top 10 percent of the wealth distribution.[21] 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 non-holders, and again, much larger for those who

[21] These tables are presented in the Appendix as Tables 14 and 15.

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.[22]

Table 4: Stock Holders versus Non-holders - Demographic Characteristics

	1998			2001		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Age[a]	49.48	50.62	52.65	50.37	49.88	54.87
Education[b]	12.03	14.48	14.98	11.87	14.58	15.25
Hispanic[c]	11.12	2.42	3.07	11.94	2.81	1.24
Married[c]	48.47	72.79	60.80	48.56	74.76	76.90
Risk aversion[d]	3.44	2.66	2.46	3.51	2.64	2.63
	2004			2007		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Age[a]	49.52	52.04	54.52	49.27	51.51	54.71
Education[b]	12.14	14.78	15.35	12.15	14.85	15.51
Hispanic[c]	14.64	1.75	1.15	14.60	2.59	1.48
Married[c]	46.51	72.36	66.94	48.71	70.09	68.34
Risk aversion[d]	3.53	2.77	2.63	3.50	2.80	2.57

[a] Mean age of household heads

[b] Mean years of education of household heads

[c] Share of agents for each characteristic

[d] Self-reported willingness to take risk on a scale from 1(low) to 4(high)

2.1.5 Participation decision: informational variables

The SCF provides several proxies for household information acquisition when deciding on their investments. The data show that the main sources of information are quite different for the different types of investors. Foreign stock holders appear to consult the Internet more frequently but also use newspapers and brokers as major sources, while domestic stock holders and indirect holders often cite friends and family as main sources of information. Table 5 provides the main sources of information for households when deciding about their investments. In particular, households are asked,"*What sources of information do you (and your family) use to make decisions about saving and investments?*" Respondents can list several sources, and Table 5 presents the percentage of households that cite each source. As an example, in 2007, "*Internet*" is cited as a main source of information by 19% 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, indicating a higher level of sophistication in their information acquisition process. Foreign holders also more frequently cite newspapers, bankers, brokers, and financial planners as main sources.

Households are also asked about the amount of "*Shop Around*" they do when making investment

[22] 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. In fact, when restricting the sample to the top 10% of the wealth distribution, the mean value of business wealth is larger for nonholders than for holders of stocks, but the difference between these last two variables is smaller when comparing the mean value difference of foreign holders versus nonholders than domestic holders versus nonholders. For evidence on these correlations and implications, see Heaton and Lucas (2000a, 2000b) and Baxter and Jermann (1997).

Table 5: Stock Holders versus Nonholders - Main Sources of Information*

	1998			2001		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Internet	4.26	15.18	24.32	7.96	26.43	29.20
Newspapers	13.08	30.67	43.29	11.52	24.74	34.83
Call Around	21.73	19.87	13.53	19.47	17.30	15.70
Friends/Relatives	35.38	39.12	26.52	33.46	35.34	37.75
Banker	25.80	22.29	18.88	28.42	22.50	29.52
Broker	4.29	22.08	40.98	4.37	28.08	31.99
Fin. Planner	8.71	28.40	36.44	9.53	25.28	24.62
	2004			2007		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Internet	12.20	30.42	35.64	19.19	39.67	57.32
Newspapers	12.39	25.30	27.79	13.17	25.93	34.05
Call Around	17.83	14.68	21.28	18.16	18.49	16.68
Friends/Relatives	33.07	34.18	37.39	39.30	40.13	41.73
Banker	26.26	26.60	20.50	32.83	28.69	31.82
Broker	3.76	23.18	27.66	4.95	20.12	34.26
Fin. Planner	9.22	28.07	32.73	10.36	30.91	31.90

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

decisions in a scale from 1 (almost no shopping) to 5 (a great deal of shopping). Table 6 shows that, once more, the same pattern follows: foreign stock holders shop around the most, followed by domestic investors and nonholders. Households 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 6, showing that holders of foreign assets trade substantially more often than nonholders and holders of domestic stocks only.[23] 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 stocks also have accounts in a larger number of institutions (variable "*Institutions*"). Finally, households that hold stocks directly, most frequently do so 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 1-6 are still worth noting. Households who invest in stocks directly target longer term investments and savings more frequently. In particular, among foreign stock holders, a higher percentage of households have a investment time frame of 10 years or more while domestic stock holders have a smaller time frame. Foreign stock holders also gain more often with their investments and lose less often. The magnitude of gains is at least twice as much as for households who have foreign stocks than for agents who only

[23] 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.

Table 6: Stock Holders versus Nonholders - Information Acquisition Variables

	1998			2001		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Shop Around[a]	2.60	3.37	3.57	2.67	3.17	3.37
Times[b]	3.10	8.45	11.35	4.59	9.70	15.68
Institutions[c]	2.24	4.95	5.71	2.06	4.83	5.97
Brokerage Acc.[d]	1.78	8.87	16.83	1.79	11.51	20.35
	2004			2007		
	Nonholder	Domestic	Foreign	Nonholder	Domestic	Foreign
Shop Around	2.78	3.15	3.46	2.74	3.19	3.29
Times	7.50	7.66	9.59	1.87	7.27	17.12
Institutions	2.24	4.86	5.75	2.32	4.67	5.33
Brokerage Acc.	1.34	9.73	19.51	1.15	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.

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 am looking at unconditional probabilities. It is also interesting to look at some cross-conditional probabilities. Among direct holders of stocks, the percentage of households who also hold foreign stocks ranges from 12% in 1998 to 15% in 2007.[24] Moreover, households who hold foreign stocks directly are also indirect holders of stocks. The percentage of agents holding stocks indirectly given that they directly hold foreign stocks 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% across the different years.

Holding foreign assets is important for diversification. The previous tables suggest that agents are underdiversifying quite significantly with respect to foreign holdings. This interpretation should be taken with caution, since the SCF has only detailed information about direct holdings of foreign assets. Households could be diversifying by holding mutual funds that invest in foreign assets, which is not captured in the aggregate measure for funds reported in the Survey of Consumer of Finances. Hence, in the next subsection, I look at a different data source to infer about indirect holdings.

2.2 Indirect Holdings - Evidence 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.

[24]As Section 2.2 will show, these participation shares are consistent with reports from the ICI.

A recent survey conducted jointly by the ICI and the Securities Industry Association shows 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. The survey shows that among individual stock investors, 15% held foreign stocks directly in 1999, 18% in 2002, and 21% in 2005.[25] 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.[26]

In addition, the 2009 Investment Company Fact Book 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. For 2006 and 2007, in particular, there is 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. This same pattern of investment flows verifies among the other different types of funds that the ICI tracks.[27,28] 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.

Regarding the role of information on investors' portfolio choices, a 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 Internet usage, an ICI survey among mutual fund holders reports that since 2006, 90% of mutual fund investors have Internet access. In addition, 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 mutual funds.[29]

3 Econometric Analysis

In this Section, I follow the participation puzzle literature and look at the same four asset classes while controlling for a set of variables. For each regression, I pool the data from 1998, 2001, 2004 and 2007 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 for the four classes of assets above, where the dependent variable in all four regressions corresponds to a categorical variable valued one if the household owns the asset and zero otherwise.[30]

[25] Despite the limited sample, statistics that emerge from the ICI seem consistent with the SCF. Regarding foreign stock ownership, for example, according to the ICI, in 1999, 15% of individual stock investors held foreign stocks. Table 1 shows that according to the SCF, in 1998, 12% of individual stock investors held foreign stocks ($\frac{2\%}{2\%+17\%}$).

[26] The survey, Equity Ownership in America, was conducted in the first quarter of 2005 with 2414 equity investors (defined as owners of any type of equity). For more details see Investment Company Institute and the Securities Industry Association (2005).

[27] See Investment Company Institute (2009*a*).

[28] 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.

[29] For more on this survey, see Investment Company Institute (2009*b*).

[30] 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

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

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

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.[31] 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.[32]

To control for age and year, I include the household head age ("*Age*") and its square ("*Age2*"), and dummies for the different years excluding 1998, "*2001*", "*2004*" and "*2007*". 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.

I include dummy variables for households headed by female ("*Female*") or headed by a married individual ("*Married*"). As for race characteristics, I include a dummy for self-reporting Hispanic ("*Hispanic*"). 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. To capture income variability, I include dummies for households headed by a self-employed person ("*Self-employed*"), or retired ("*Retired*"). I also add a dummy variable to measure income uncertainty ("*ICertain*"), 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?*" Finally, to control for risk characteristics, I include a self-reported measure of risk aversion ("*Risk aversion*") which corresponds

detailed information about indirect holdings, I instead 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 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).

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

[32] See Footnote 22 for references.

to households' answer to the question: "*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)?*"

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, I add a dummy variable for whether households report the Internet as an information source when shopping for investments ("*Internet*"), which corresponds to agents' answer to the question: "*What sources of information do you (and your family) use to make decisions about saving and investments?*" The "*Internet*" dummy variable attains a value of 1 if the Internet was one of the sources, and zero otherwise. In Section 4, I discuss the role of other sources of information.

3.1 Estimation results

Tables 7 and 8 show the benchmark regression results for foreign and domestic holdings, and for indirect and equity holdings, respectively. In each table, standard deviations are reported in parentheses, next to their respective coefficients.[33]

The first two columns of Table 7 present the *probit* estimation results for ownership of foreign stocks, while the last two columns show the equivalent results for ownership of domestic stocks.

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. As expected, confirming the findings of Figure 3, the hump shape in age does not hold true for these two regressions and instead, the regression results show an inverse pattern for holdings of domestic stocks. Self-identifying as Hispanic correlates negatively with holdings of both types of assets. The regressions also show that having a college degree correlates positively with both holdings of stocks. As expected, risk aversion has a negative correlation with holdings of domestic and foreign stocks, and in line with the evidence from Table 1 and the ICI reports, the percentage of people holding domestic stocks decreases, in 2007.

Finally, having the Internet as a main source of information has a positive correlation with both holdings of stocks, although this variable is only statistically significant for holdings of foreign stocks. As Section 4 will discuss, this last result is robust to several changes in the regression specification.

Table 8 presents analogous results for equity holdings and indirect holdings of stocks. The regressions show that the results are somewhat alike for these two classes of assets and are in line with the literature predictions for equity holdings. The levels of assets and income have positive and significant effects, while business and indebtness levels have negative effects. Age and education have the expected signs. The hump shape for age effects is significant for indirect holdings, while more years of education have a positive correlation with indirect and equity holdings. The risk aversion coefficient is negative and significant, and 2007 shows a decrease in stock holdings. Finally, the information acquisition variables

[33] 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.

Table 7: Regression Results - Foreign and Domestic Holdings of Stocks

	Foreign Stocks		Domestic Stocks	
Constant	-7.446***	(1.123)	-2.874***	(0.667)
Assets	0.377***	(0.077)	0.312***	(0.05)
Income	0.163**	(0.067)	0.099*	(0.053)
Business	-0.106***	(0.032)	-0.082***	(0.024)
Debt	-0.076**	(0.036)	-0.011	(0.026)
Age	0.025	(0.033)	-0.053**	(0.023)
Age2	0	(0)	0**	(0)
Married	-0.005	(0.204)	-0.059	(0.137)
Female	0.398	(0.259)	-0.326*	(0.191)
Hispanic	-0.824***	(0.259)	-0.677***	(0.227)
No High School	0.189	(0.402)	-0.328	(0.212)
College	0.401***	(0.155)	0.234***	(0.086)
Self-employed	0.157	(0.142)	-0.141	(0.086)
Retired	0.042	(0.212)	0.09	(0.207)
ICertain	0.255*	(0.142)	-0.092	(0.078)
Risk aversion	-0.322***	(0.077)	-0.199***	(0.048)
2001	0.067	(0.161)	0.036	(0.104)
2004	-0.238	(0.16)	-0.015	(0.106)
2007	0.025	(0.15)	-0.272**	(0.107)
Internet	0.347**	(0.137)	0.127	(0.087)
R-squared	0.231		0.131	

The table reports coefficients and standard deviation estimates from two separate probit models of ownership of foreign and domestic stocks 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, andcoefficients 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 8: Regression Results - Indirect and total Equity Holdings of stocks

	Indirect Holdings		Equity Holdings	
Constant	-6.915***	(0.741)	-6.348***	(0.776)
Assets	0.325***	(0.06)	0.406***	(0.066)
Income	0.288***	(0.057)	0.317***	(0.064)
Business	-0.113***	(0.033)	-0.136***	(0.038)
Debt	0.009	(0.029)	0	(0.031)
Age	0.065***	(0.023)	0.017	(0.024)
Age2	-0.001***	(0)	0	(0)
Married	0.152	(0.128)	0.115	(0.137)
Female	-0.137	(0.164)	-0.143	(0.171)
Hispanic	-0.12	(0.199)	-0.211	(0.198)
No High School	-0.494***	(0.185)	-0.518***	(0.183)
College	0.215**	(0.087)	0.166*	(0.094)
Self-employed	-0.417***	(0.092)	-0.451***	(0.1)
Retired	-0.341	(0.21)	-0.178	(0.243)
ICertain	0.176**	(0.08)	0.134	(0.084)
Risk aversion	-0.243***	(0.051)	-0.309***	(0.056)
2001	0.069	(0.12)	0.038	(0.124)
2004	0.026	(0.117)	-0.013	(0.127)
2007	-0.222**	(0.11)	-0.258**	(0.118)
Internet	0.199**	(0.101)	0.139	(0.114)
R-squared	0.229		0.256	

The table reports coefficients and standard deviation estimates from two separate probit models of ownership of indirect and total stock onwership 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, andcoefficients 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.

show a positive sign for both regressions but are only significant for indirect holdings of stocks.

While the regression estimates in both tables present most of the results in line with the previous literature and similar across different regressors, some new features are worth highlighting. First, this set of results points to the role of information and risk aversion in determining agents' participation in stock markets. Besides education as a proxy for information, these regressions show that having the Internet as a main source of information when deciding on investment opportunities correlates positively with all types of stock holdings but have significant results for foreign holdings (and indirect holdings) of stocks only. Second, the results also highlight the role of risk aversion in all four regressions, with negative and statistically significant coefficients for all regressions. While the size of probit coefficients are not easily interpreted, unreported results show that the marginal effects of risk aversion are the smallest for foreign holdings of stocks, which is in line the predictions of Table 4.

4 Robustness

4.1 Joint decision

A first natural concern about the estimated results is that households' participation decisions are not independent, and hence, coefficient estimates could be biased if one does not allow for correlation between error terms. Bertaut and Starr-McCluer (2002) and Christellis and Georgarakos (2009) raise this possibility when looking at the choice among different financial assets and show these error terms to be correlated. If this is the case, it is preferable to estimate the regressions jointly instead of running separate regressions.

I test this hypothesis by jointly estimating the entry decision on domestic and foreign direct stock markets. In particular, I estimate a *bivariate probit* regression ("*biprobit")* on the ownership decision of domestic and foreign stocks and present the results in Table 9. The Wald test for independent equations presents strong evidence for a joint decision on entering foreign and domestic stock markets. The residuals from a joint decision of holding domestic and foreign stocks are highly correlated, indicating that the results of the joint estimation are preferable from the separate probit ones. The estimated coefficients, however, confirm the results on Tables 7 and 8.[34]

4.2 The role of wealth

Figures 1 and 2 show that participation in stock markets is highly concentrated at the high percentiles of the wealth distribution, especially for foreign stock holdings. This concentration indicates that controlling for wealth is very important, and that at lower percentiles of wealth there is a large concentration of nonholders (value zero for the dependent variable).

While the regressions of Tables 7 and 8 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

[34] I also estimate a *multivariate probit* ("*mvprobit*") testing for the joint ownership decision of direct holdings of foreign and domestic stocks and indirect holdings of stocks. The coefficients and significance results are mostly unchanged. The estimation results point toward a joint decision on the ownership of foreign and domestic stocks, and of domestic and indirect holdings, but no correlation between ownership of foreign and indirect holdings.

Table 9: Regression Results - Biprobit

	Foreign		Domestic	
Constant	-6.919***	(1.036)	-2.798***	(0.664)
Assets	0.299***	(0.066)	0.307***	(0.049)
Income	0.147**	(0.065)	0.09*	(0.053)
Business	-0.087***	(0.029)	-0.081***	(0.024)
Debt	-0.065**	(0.033)	-0.009	(0.026)
Age	0.034	(0.033)	-0.052**	(0.023)
Age2	0	(0)	0**	(0)
Married	0.119	(0.209)	-0.046	(0.136)
Female	0.463*	(0.263)	-0.32*	(0.188)
Hispanic	-0.771***	(0.24)	-0.673***	(0.226)
No High School	0.169	(0.381)	-0.337	(0.211)
College	0.421***	(0.15)	0.241***	(0.086)
Self-employed	0.197	(0.132)	-0.139	(0.086)
Retired	-0.021	(0.212)	0.112	(0.204)
ICertain	0.202	(0.132)	-0.087	(0.077)
Risk aversion	-0.244***	(0.071)	-0.19***	(0.048)
2001	0.052	(0.152)	0.016	(0.103)
2004	-0.24	(0.154)	0.112	(0.204)
2007	0.202	(0.132)	-0.284***	(0.106)
Internet	0.284**	(0.132)	0.124	(0.086)
Wald test of independent equations:			rho=0: chi2 = 1201.7	
			Prob > chi2 = 0.000	

The table reports coefficients and standard deviation estimates from a bivariate probit model of ownership of foreign and domestic stocks 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, andcoefficients 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.

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 7 and 8 can be biased. Hence, to further control for wealth and disentangle the effects of informational variables, I re-estimate the regressions of Tables 7 and 8 while restricting the sample across each of the 10 wealth deciles and at the top 5 percentile of wealth distribution.

For all cases, the role of the Internet persists when the dependent variable is foreign stock holdings, and is still not significant for domestic holdings of stocks. In particular, when restricting the wealth at the top 10% of the wealth distribution, most of the results are qualitatively unchanged, with the majority of the variables keeping their previously estimated sign, although some become insignificant or only significant at 10%. However, the effect of consulting the Internet remains unchanged only for foreign holdings.[35]

For indirect holdings, most of the variables keep the previously estimated signs and their statistical significance remains at least at 10%. Once more, however, "*Internet*" loses its significance as it does for domestic holdings. If I further restrict the sample to households who have at least a college degree and are at the top 10% of the wealth distribution, the results are similar to the ones obtained in the previous exercise. In all cases, the sign and statistical significance of "*Internet*" is only sustained for foreign asset holdings. I report these results in the Appendix, which includes the regression estimates after restricting the sample to the top 10% of wealth distribution.[36]

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 re-estimate the regressions of Tables 7 and 8, 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 and small changes in the size of coefficients, their signs and statistical significance are unchanged. For brevity, I omit a table with these results.

Together with the above described results, the sample characteristics help to conclude that endogeneity of wealth is likely minor in this paper. In particular, evidence from Section 2.2 shows that agents tend to start their investments with indirect holdings and then migrate to direct holdings, and hence, for this sample, households who hold foreign stocks are most probably already wealthy.

Finally, the benchmark regressions of Section 3 include the logarithm of business wealth. Business owners already face risks in their investments, and if business returns are positively correlated to stock returns, one expects a negative correlation between the value of their business and holdings of stocks. In fact, the results of all regressions show that this intuition verifies. However, it is worth noting that the "*Business*" variable corresponds to the logarithm of the value of household business, hence, if the household does not own a business or if the net value of its business is zero, the logarithm of the business value does not exist. Therefore, in practice, by including this variable, the sample is restricted to those

[35] Given the large concentration of nonholders at low levels of wealth distribution, the regression can only be re-estimated for wealth levels above the 50% decile.

[36] 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, unchanged if the 1^{st} and the 99^{th} percentiles of wealth are removed.

who own a positive value of private business (and hence, are possibly wealthier). To overcome this sample restriction, I look at an alternative estimation that includes instead a dummy variable accounting for business ownership that is 1 if the household owns a business and zero otherwise. The results show that information is still an important variable in determining foreign stock holdings, qualitatively replicating the results for the foreign holdings regression. In addition, the effect of the "*Internet*" becomes positive and statistically significant for the other classes of stock investment. However, this newly obtained significance for domestic stock holdings is not robust to several tests, such as restricting the sample across wealth deciles or including other proxies of information. Finally, Heaton and Lucas (2000) make the case for the value of private business and its correlation with stock holdings, and the regressions of Tables 7 and 8 confirm their predictions.

4.3 Alternative information variables

The SCF is rich enough to provide many variables that could affect ownership. Although some of these variables are promising in their expected results, some are not available for all years of the survey or are not significant across all the different regressions estimated. As an example of the latter case, the SCF asks participants about their expectations for the economy and their expectations for interest rates movements. However, none of these variables are significant in any of the regressions estimated or change the effects of the remaining regressors.

The SCF also provides several proxies for information acquisition variables. Tables 5 and 6 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 re-estimate the same regressions in Table 7 using all these alternative measures of information acquisition to replace the Internet. The results do not change qualitatively. While "*Times*" and "*Newspaper*" are statistically significant for foreign holdings of stocks, the same variables are not significant for domestic holdings except for "*Newspaper*", which is also statistically significant at 10% for domestic holdings. The remaining variables "*Broker*", "*Banker*" and "*Fin. Planner*" have the expected sign but are not statistically significant. Finally, I also test the same regressions including all information proxies at once. This results in once more having "*Internet*" significant only for foreign holdings. Results are also robust to limiting the sample at wealth deciles as described in the previous subsection.

4.4 Alternative estimation methods

The results of this paper look at the correlation between informational variables and stock holdings, but do not account for causation. Hence, it is possible that households who hold foreign stocks acquire more information, or vice versa, that households who are better informed hold foreign stocks. To briefly explore causation, I perform a propensity score matching for holdings of foreign stocks when controlling for usage of the Internet as a main source of information. In particular, I re-estimate the benchmark regressions of Tables 7 and 8, restricting the sample to the common support obtained from regressing "*Internet*" on the same independent variables of the benchmark regressions. The results are again unchanged.

As for the estimation method, the dependent variables show several nonholders. This skewness on the distribution suggests testing for other estimation methods such as *logit* or *cloglog*. Hence, I estimate *logits* and *cloglogs* instead of probits and replicate all robustness checks, and obtain unchanged results.

Finally, as reported in Section 2.2, 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 she some light about the effects of indirect holdings, I reestimate the *biprobit* regression of Table 9 while adding indirect stocks ownership as an explanatory variable. In fact, this variable is positive and statistically significant for both domestic and foreign holdings. In addition, the sign and magnitudes of the remaining variables do not change. The results of this regression are presented in the Appendix.

The evidence that information is an important variable for households' decisions regarding ownership of foreign stocks is confirmed by the benchmark regressions and the robustness checks. In addition, the lower participation in foreign stock markets suggests that households may face an entry cost when deciding to invest in this market.[37] The section that follows introduces a model that tries to capture what role these two features, information and entry cost, play in explaining investors' participation in foreign stock markets and attentiveness. The model builds an interpretation for some of the data features while controlling for household demographic characteristics.

5 Costly Information

Abel et al. (2007) build a model where consumers must pay a cost to observe the value of their wealth and to update their portfolio of investments. Hence, consumers/investors optimally choose to update their information set infrequently and to consume from a transaction account between observation periods. The authors show that even a cost as small as 0.01% of wealth is enough to generate an eight-month decision interval. I depart from their work in two directions: I first introduce foreign stocks to agents' portfolio choice, and next I discuss the roles of information and an entry cost in such market.

5.1 The model

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, 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 non-dividend-paying domestic and foreign stocks with prices D_t and F_t, respectively. Stock prices

[37] The presence of participation costs is also found by Chirstelis and Georgaralos (2009), who investigate foreign asset ownership using the SCF data, and compare the decision 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.

$P_t = \binom{D_t}{F_t}$ are assumed to follow a geometric Brownian motion:

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

where

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

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.[38]

The consumer can observe the investment portfolio by paying a fraction θ, $0 \leq \theta < 1$, of the contemporaneous value of the wealth.[39] 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:

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

and 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:

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

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 $\mathcal{R}(t_j, t_j) = 1$.

For simplicity, I follow Abel et al. (2007) and also assume that a portfolio manager continuously rebalances the portfolio to maintain a fixed proportion of assets invested in stocks.[40] In this case, the

[38] 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.

[39] Assuming the observation cost as a fraction of the value of the portfolio 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.

[40] 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.

portfolio return follows a geometric Brownian motion:

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

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 from the model's solution. 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*

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

where

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

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

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

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

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

where $\chi = (1-\theta)^{\frac{(1-\alpha)}{\alpha}}$, $\omega = \frac{\left(\rho-(1-\alpha)r^L\right)}{\alpha}$ *and* $\lambda = \frac{\rho-(1-\alpha)\left(r+\frac{1}{2}\frac{1}{\alpha}(\mu-R)'\Omega^{-1}(\mu-R)\right)}{\alpha}$.[41]

5.2 The participation decision – entry-cost model

While the model of Section 5.1 predicts that it is optimal for all agents to always invest in stocks, empirical evidence points to a large fraction of households out of the stock market.

Hence, I look at agents' decisions to enter the domestic and foreign stock markets. I consider two cases; first I look at the decision to enter the domestic stock market, when foreign stocks are not available, and next I consider the case where agents already invest in domestic stocks and decide whether to also invest in foreign ones.[42]

[41] I follow Abel et al. (2007) and assume both $\omega > 0$ and $\lambda > 0$ to obtain a unique solution.

[42] The empirical evidence shows that it is almost never the case that agents invest directly in foreign stocks but not in domestic ones.

To account for the nonparticipation observed in the household data, I assume that in addition to the updating cost θ, consumers pay a one-time entry cost K out of their initial wealth to enter the stock market. This entry cost represents financial costs and time spent learning about investment opportunities, acquiring information about risks and returns, and any type of brokerage commissions.[43] I consider the two cases described above and assess the two minimum costs that would drive agents out of the domestic market (K_d), or out of the foreign market (K_f) once they already invest in domestic stocks.

The exercise, hence, comprises the comparison of three value functions: the first arises from the case where agents do not invest in stocks; the second corresponds to the value function attained by the investor who only invests in domestic stocks; and the third is the value function of a investor that invests in both domestic and foreign stocks.

5.3 No participation in stock markets

If agents opt not to enter the stock market and hold all their wealth in riskless liquid assets, their overall rate of return equals r^L. From the definitions of λ, ω and $\gamma(\tau)$ in Proposition 1, the non-entry decision implies $\lambda = \omega$ and $\gamma(\tau) = \omega^{-\alpha}$.[44] Hence, the value function, at time 0, equals

$$V(W_0) = \omega^{-\alpha} \frac{W_0^{1-\alpha}}{1-\alpha}. \tag{7}$$

5.4 Participation in domestic stock markets only

Now assume agents can also invest in domestic stocks. For doing so, they pay an entry cost K out of their first-period wealth. I then ask what minimum value of the entry cost, K_d, would drive agents out of the domestic market.

To answer this question, I exclude foreign stocks from the model. The solution of such a model is similar to the one obtained in Proposition 1 and replicates exactly the one extensively described in Abel et al. (2007). Since most of the equations of models both with and without foreign stocks are isomorphic, to refer to the case where agents invest only in domestic stocks, I add a subscript "d" to all variables that correspond to this case.[45]

Hence, when consumers invest only in domestic stocks, the value function, the optimal share invested

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

[44] Recall that under the assumptions imposed in the parameters of Section 5.1, it is optimal for the investor to enter the stock market and invest in both types of stocks. It is also optimal to observe and update the portfolio at equally spaced points of time.

[45] The following equations can be obtained by eliminating foreign stocks from the model presented in Section 5.1. Refer to Abel et al. (2007) for a full description of their solution.

in stocks, and the optimal inattention are such that

$$\begin{aligned} V(W) &= \gamma_d(\tau)\frac{W_0^{1-\alpha}}{1-\alpha}, \\ \phi &= \phi_d = \frac{1}{\alpha}\frac{(\mu_d - r)}{\sigma^2}, \\ \hat{\tau}_d^* &= \left(\frac{2\left(\chi^{-1}-1\right)}{(\omega-\lambda_d)\lambda_d}\right)^{\frac{1}{2}}, \end{aligned} \tag{8}$$

where

$$\begin{aligned} \gamma_d(\tau) &= \left[\frac{1-e^{-\omega\tau_d}}{1-\chi e^{-\lambda_d\tau_d}}\right]^{\alpha}\omega^{-\alpha}, \quad \text{and} \\ \lambda_d &= \frac{\rho - \left[(1-\alpha)\left(r + \frac{1}{2}\frac{1}{\alpha}\frac{(\mu_d-r)^2}{\sigma_d^2}\right)\right]}{\alpha}. \end{aligned} \tag{9}$$

Therefore, the minimum K_d needed to drive agents out of the domestic stock market equals the value functions of consumers who invest in domestic stocks (equation 8 after paying the entry cost) and consumers who do not invest in stocks at all (equation 7), i.e.,

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

which yields

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

5.5 Participation in foreign stock market

The empirical evidence shows that an even smaller share of agents choose to invest in foreign stocks, even among those who already invest in domestic stocks. Hence, I ask what would be the minimum entry cost, K_f, that would drive agents out of the foreign market, once they already invest in domestic stocks. For this case, I assume agents pay no entry cost to invest in domestic stocks, but to also invest in foreign markets they pay an extra entry cost. The minimum entry cost K_f that would drive agents out of foreign markets is obtained by equating the value functions in equations (3) and (8), yielding

$$K_f = 1 - \left(\frac{\frac{1-e^{\omega\tau_d}}{1-\left[(1-\theta_d)^{\frac{(1-\alpha)}{\alpha}}\right]e^{-\lambda_d\tau_d}}}{\frac{1-e^{\omega\tau}}{1-\left[(1-\theta)^{\frac{(1-\alpha)}{\alpha}}\right]e^{-\lambda\tau}}}\right)^{\frac{\alpha}{1-\alpha}}. \tag{10}$$

Note that when there is no observation cost, $\theta = 0$, the investor can update at every period with no cost. In this case, the investor optimally chooses to do so, and from the definition of χ, one obtains $\theta = 0 \Rightarrow \hat{\tau} = 0$. In this case, we are back to the classic Merton (1969) model where agents have no cost of observing or adjusting their portfolio and choose the share invested in stocks to be constant and

independent of wealth. The optimal share invested in each type of stock is same as derived in his model when generalized for many assets. In addition, since in the absence of updating costs it is optimal to invest in both stocks, the minimum costs K_f and K_d are equal to unit.

5.6 Analytical results: optimal level of inattention

The two models above, including and excluding the option to invest in foreign stocks, allows for a 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 (assuming $\alpha > 1$). 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, these risk averse investors will update more frequently. As Table 6 shows, this theoretical result also has empirical support; households who hold foreign stocks more frequently talk to their broker to update their portfolio.

Section 5.7 complements the model predictions by calibrating the parameters and drawing inference from the relation between such parameters, the cost K_f, and the optimal information adjustment process.

5.7 Quantitative results: level of inattention and fixed costs

To parameterize the model and quantify the effects of foreign stocks on optimal inattention τ and K_f, I follow Abel et al. (2007), and assume $\alpha = 4$, $\rho = 0.01$, $r^L = 0.01$, and $r = 0.02$. To calibrate for asset returns and correlations, I use data from Morgan Stanley Capital International (MSCI) which provide stock market returns for different countries and regions besides the United States.[46]

For all indices, I use before-tax returns on stocks at a monthly frequency, which are further annualized. In particular for the U.S., I obtain return and volatility of the S&P500, that correspond respectively to $\mu_d = 0.086$ and $\sigma_d^2 = (0.17)^2$. Under these assumptions for return and volatility of domestic stocks, the optimal inattention predicted by a version of the model with only domestic stocks (as in Section 5.4 and Abel et al. (2007)) equals $\hat{\tau}_d^* = 0.47$ years, and the share invested in stocks equals 0.43. Under this version of the model, the entry cost necessary to drive agents out of the domestic stock market is $K_d = 0.78$; i.e., to justify nonparticipation in domestic stock markets, the minimum entry cost needed reaches 78% of agents' initial wealth.

Once consumers have the option to also invest in foreign stocks, one has to make a stand about returns and volatilities of such a market and about the covariance of foreign stocks with domestic ones. As a proxy for foreign returns, I look at several foreign stock indices: the "$EAFE$" includes returns to

[46] In particular, I use gross total returns of MSCI Global Standard Indices, which aggregate large and mid-capitalized company returns from January 1970 to January 2010.

stocks in Europe, Australasia and Far East;[47] "*Europe*" corresponds to stocks in developed economies in Europe;[48] "*Japan*" and "*Canada*" are composed of stocks from these two countries, respectively; and "*Emerging Markets*" includes stocks from emerging market economies.[49]

Table 10 reports annualized logarithmic returns, volatilities and covariances for foreign country indices underneath the column "*Parameters*". Under "*Model Predictions*", the table also provides the results obtained for the optimal inattention $\hat{\tau}^*$, the minimum entry cost K_f, and the implied shares invested in each type of index, ϕ_d, ϕ_f.

Table 10: Illustrative Calculations

	Parameters			Model Predictions		
	μ_f	σ_f^2	σ_{df}	$\hat{\tau}^*$	K_f	$\frac{\phi_f}{\phi_d+\phi_f}$
$EAFE$	0.096	$(0.172)^2$	0.016	0.37	0.24	0.61
$Europe$	0.101	$(0.175)^2$	0.018	0.36	0.25	0.67
$Japan$	0.093	$(0.217)^2$	0.012	0.40	0.17	0.38
$Canada$	0.097	$(0.203)^2$	0.024	0.43	0.09	0.43
$EmergingM.$	0.126	$(0.249)^2$	0.025	0.39	0.19	0.49

Confirming Proposition 2, Table 10 shows that inattention is smaller when agents also invest in foreign stocks as the column labeled as $\hat{\tau}^*$ indicates – agents who also invest in foreign stocks optimally choose to update their portfolios at a higher frequency. The column labeled K_f shows that when compared to $K_d = 0.78$, the minimum entry cost needed to drive agents out of the foreign market, once they already invest in domestic stocks, is relativelly smaller but possibly as large as 25%.

The large number attained by K_d is in line with the equity premium puzzle predictions. The finance literature showed that to obtain a smaller entry cost K_d, this type of model should either include other sources of investment frictions, or include a high level of risk aversion.[50] The possibly high entry cost needed to drive agents out of the foreign stock market, however, is an intriguing new fact, given the substantial nonparticipation in foreign markets.

To test for the sensitivity of the results, in the next section, I vary some of the main parameters and observe the effects on the entry cost and the inattention levels.

[47] The MSCI EAFE Index consists of the following 21 developed countries' indices: Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom.

[48] MSCI Europe Index consists of the following 16 developed countries' indices: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

[49] The MSCI Emerging Markets Index consists of the following 22 emerging market indices: Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand, and Turkey.

[50] See Mehra and Prescott (1985) and Mankiw and Zeldes (1991).

5.7.1 Sensitivity analysis

Table 10 shows that the entry cost needed to drive agents out of foreign stock markets once they already invest in domestic stocks is much smaller than $K_d = 0.78$, and ranges from 9% for Canadian stocks to 25% for European stocks in the examples above. The inattention level also varies from 0.36 to 0.46 for the same stock indices.

In this section I test for the sensitivity of these results by assuming stock returns are the same for domestic and foreign stocks (and equal to the U.S. stocks) and by varying, one at a time, the asset correlation $\left(\rho_{df}\right)$, the updating cost (θ), and risk aversion (α). This venue builds on the findings of Calvet et al. (2007), who show that agents invest inefficiently, obtaining returns that are smaller than those indicated by stock indices. In addition, Table 10 shows that the average returns on the different stock indices are generally not statistically different from each other, and hence, assuming equal returns in both foreign and domestic stock markets does not seem as a big stretch.

Figure 4 presents the results of this exercise. In particular, I keep $\mu_d = \mu_f = 0.086$, and $\sigma_d^2 = \sigma_f^2 = (0.17)^2$, while varying the asset correlation, ρ_{df}, from -0.9 to 0.9, the updating cost, θ, from 0.01% to 2%, and the risk aversion, α, from 2 to 6.[51] In addition to the results for optimal inattention and minimum entry cost, for ease of comparison each chart of Figure 4 also marks the points that correspond to the benchmark parameter choices, i.e., $\theta = 0.01\%$, $\alpha = 4$ and $\sigma_{df} = 0.018$.

The first two charts in the top panel of Figure 4 show that while the correlation of assets ranges from -0.9 to 0.9, the gains from diversification reduce substantially, and when correlation is the same as in the data, $\sigma_{df} = 0.018$ (marked as a point in both charts), the entry cost needed to drive agents out of foreign stocks once they already invest in domestic ones drops by half, from 25% to 13%.

The middle panel of Figure 4 looks at the effects on $\hat{\tau}^*$ and K_f when varying θ. Foreign stock investors have to inform themselves not only about the domestic stock market but also about the foreign market. Hence, in this exercise, I deviate slightly from the model by assuming that agents who hold only domestic stocks pay $\theta = 0.01\%$ of their portfolio value to update their information set, and vary θ paid by investors who also hold foreign stocks.[52] The two charts show that the larger the updating cost (θ), the larger is the optimal inattention and the smaller is K_f. In addition, when both foreign and domestic assets yield the same return and volatility, a 1% updating cost and an entry cost of 1% of initial wealth are already enough to justify nonparticipation in foreign stock markets.

The theoretical literature presents little agreement on the level for the risk aversion parameter. While several papers assume logarithmic utility (approximating α to unity), several others assume larger values for this parameter. The two charts in the bottom panel of Figure 4 test for the sensitivity of the results to the risk aversion parameter. The risk-premium puzzle literature argues that the risk aversion needed to justify the large nonparticipation in stock assets has to be quite large. This exercise sets asset returns and volatilities equal to the the U.S. ones, and varies the risk aversion parameter α from 2 to 6. The charts show that the larger the risk aversion (larger α), the larger the optimal inattention. While this may look counterintuitive at first, the positive relation comes from the effect of α on the optimal share

[51] I set $\sigma_{df} = 0.018$, when varying θ and α.

[52] More specifically, when building K_f, as in equation (10), one compares the value associated with holdings of domestic stocks only with holdings of foreign ones. In this exercise, I am fixing the updating costs for domestic-only stock holders (θ_d in the numerator of the term in parentheses of equation 10), and varying the updating cost associated with holdings of both foreign and domestic stocks (θ in the denominator of the term in parentheses of equation 10).

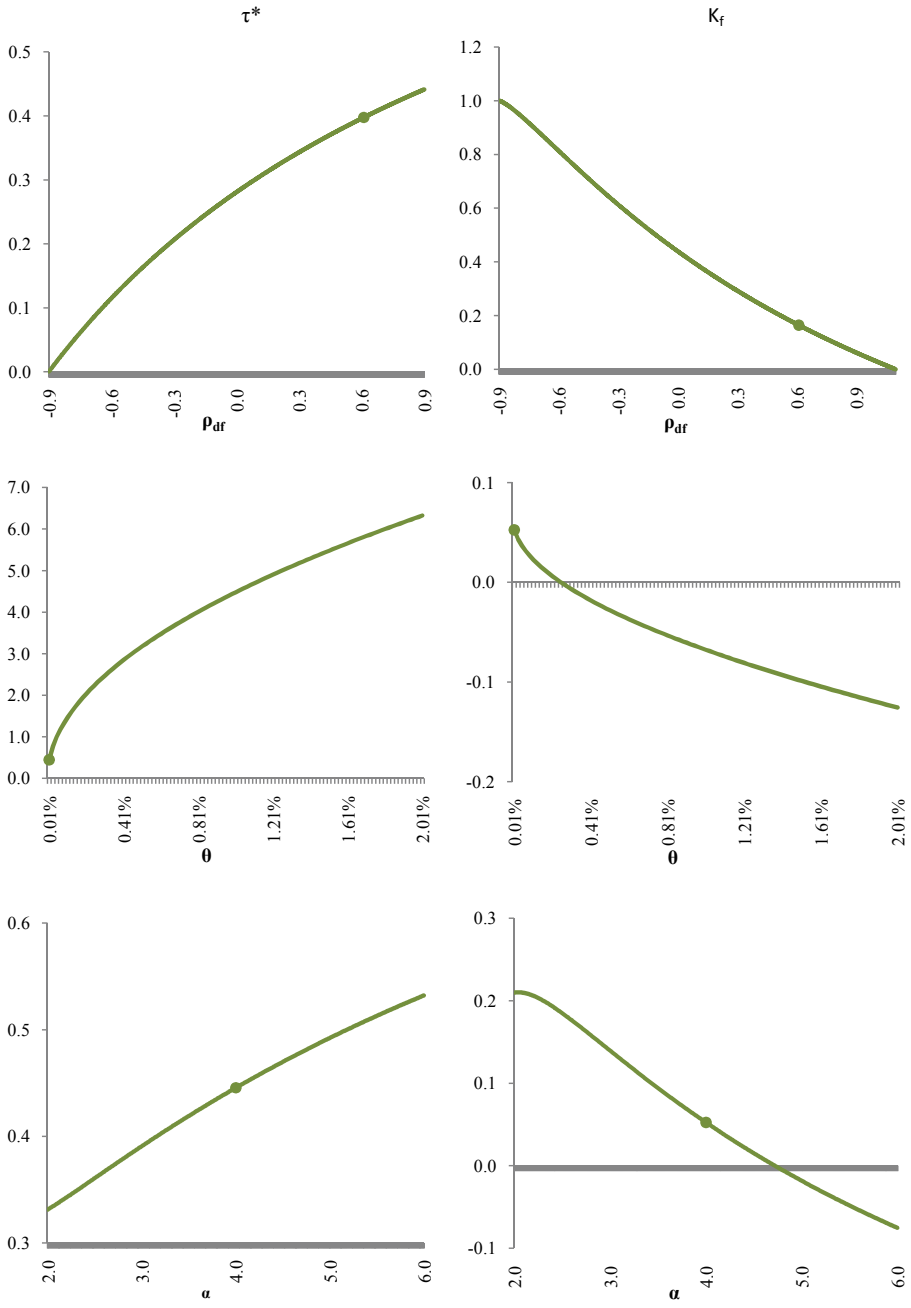

Figure 4: Optimal inattention and minimum entry cost - Assuming equal returns and volatility

held of assets. The larger the risk aversion, the smaller is the share of the portfolio held in stocks (both foreign and domestic), and hence, agents update their information set less frequently.[53] Finally, if risk aversion is set at 5 instead of 4, the minimum entry cost ranges on the negative side, indicating that it is not profitable to invest in foreign stocks.

6 Conclusion

This paper contributes to the household finance participation puzzle literature by focusing on international holdings of stocks. Participation in foreign stock markets is very limited and the recent literature points to the role of information in determining investments in foreign assets. While the international finance literature has focused on the share of foreign assets held on financial portfolios, this paper studies the decision to invest in foreign stocks, that is, the participation decision.

Using the Survey of Consumer Finances, I show that holders of foreign stocks are substantially wealthier, more educated, with a different age profile, and more sophisticated in their sources of information than domestic-only stock holders. These empirical results point toward the importance of information in determining agents' entry in foreign stock markets. To account for the two main features of the data – low participation in foreign stock markets and higher attentiveness – the paper considers a model where information is costly and investors decide whether to enter the domestic and foreign stock markets. In the model, to update their information set investors pay a fixed cost out of their portfolio value. In addition, to account for the costs of acquiring information, a version of the model also features an entry cost to be paid in the first period by agents who invest in the stock market. The model predicts agents optimally choosing to update their portfolio only infrequently, at equally spaced points in time. More importantly, agents that invest in foreign stocks update their information set more frequently. After calibrating the model to match returns and volatility for the U.S. economy and different foreign stock investments, the model predicts that, once agents already invest in domestic stock markets, the minimum cost that would drive investors out of foreign stock markets can be fairly small (depending on the model calibration), justifying the lack of participation in foreign markets. Both empirical and theoretical results point to the importance of information in determining agents' entry in foreign stock markets.

The empirical evidence highlights the characteristics of holders of stocks, in particular foreign stocks. While the equity holdings literature documents that equity holdings are increasing in wealth, increasing in education, and hump-shaped in age, the empirical results of this paper show that participation in *foreign* stock markets is increasing in wealth, increasing in education, *non* hump-shaped in age, decreasing but less sensitive to risk aversion, and increasing and more sensitive to information acquisition.

Among the caveats, I must emphasize that estimation results provide inference on the correlation between different variables and the entry decision, but they do not imply causation. It is possible that more access to information drives households to enter the foreign stock market, or equally possible that agents with a diversified portfolio search more for information. The propensity score matching results, however, seem to point toward the first case. In addition, the data for this paper only includes households

[53] Notice that varying risk aversion also affects K_d, but the effects are smaller than on K_f. K_d ranges from 0.91 to 0.72 when I vary α from 2 to 6.

who hold stocks directly, and since the data show agents starting their stock investments through investment funds, it is more likely that holders of foreign stocks in this sample are already wealthy, supporting the case for an effect of information on foreign holdings and not the opposite. Nevertheless, given my results pointing toward the importance of information, further analyzing causality effects seems worth pursuing. A more complete and disaggregated description of household assets, particularly of indirect holdings, could provide the tools for such analysis.

The calibrated model indicates the size of the entry cost needed to preclude agents from foreign stock investments, and shows that the model-implied gains from diversification are highly dependent on the calibration of main parameters. This paper relies on an entry cost to account for the low participation in foreign stock markets. Other possible venues taken by the literature include the assumption of borrowing constraints, transaction costs (as in Vissing-Jorgensen 2003), and background risks, in addition to variations in participation costs and risk aversion levels.[54] The results of Section 5.7 show that, indeed, a combination of higher updating costs, risk aversion, and uncertainty about asset returns can bring down the minimum cost needed to drive agents out of the foreign stocks markets. The model also sets aside exchange rate risks by assuming agents can invest in foreign stocks that are traded in U.S. markets. Introducing currency variation risk could bring the minimum entry cost even lower.

Finally, the model does not address life-cycle behavior such as the effects of age, education, wage income, and background risks. The empirical evidence in the household finance literature shows that such variables are important in determining equity holdings.[55] Hence, the model can be interpreted as an analysis of inattention and entry costs when holding constant demographic characteristics, along the same line as the regression presented in Section 4.2. Extending the model to test for such facts appears to be a challenging and interesting path to pursue in order to contribute to the understanding of participation in international stock markets.

[54] Heaton and Lucas (2000*a*, 2000*b*) address background risk and its effects on portfolios.

[55] Bertaut and Starr-McCluer (2002) give empirical evidence about the effects of those variables.

References

[1] Abel, Andrew B., Janice C. Eberly, and Stavros Panageas (2007), "Optimal Inattention to the Stock Market," *American Economic Review* 97(2): 244–249.

[2] Alvarez, Fernando, Luigi Guiso, and Francesco Lippi (2010), "Durable consumption and asset management with transactions and information costs," Economics Working Papers, ECO2010/04, European University Institute.

[3] Ameriks, John, and Stephen P. Zeldes (2004), "How do household portfolio shares vary with age?," working paper, Columbia University.

[4] Antoniewicz, R. (1996), "A comparison of the Household Sector from the Flow of Funds Accounts and the Survey of Consumer Finances," Federeal Reserve Board Discussion Paper 96-26. Washington, D.C.: Federal Reserve Board.

[5] Attanasio, Orazio P., and Annette Vissing-Jorgensen (2003), "Stock Market Participation, Intertemporal Substitution and Risk Aversion," *American Economic Review*, *Papers and Proceedings*, 93(2): 383-391.

[6] Baumol, William J. (1952), "The Transaction Demand for Cash: An inventory-theoretic approach," *Quarterly Journal of Economics* 66(4): 545-556.

[7] Baxter, Marianne and Urban J. Jermann (1997), "The International Diversification Puzzle Is Worse Than You Think," *American Economic Review* 87(1): 170-80.

[8] Bertaut, Carol C., and Martha Starr-McCluer (2002), "Household portfolios in the United States," in Luigi Guiso, Michael Haliassos, and Tullio Jappelli, eds.: *Household Portfolios* (MIT Press,Cambridge, MA).

[9] 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.

[10] Campbell, John (2006), "Household Finance," *The Journal of Finance* 61(4): 1553-1604.

[11] Chetty, Raj, and Adam Szeidl (2010), "The effects of Housing on Portfolio Choice," NBER working paper 15998, available at http://www.nber.org/papers/w15998.

[12] Christelis, Dimitris, and Dimitris Georgarakos (2009), "Investing at Home and Abroad: Different Costs, Different People?", Center for Financial Studies, Working Paper 2009/28.

[13] Curcuru, Stephanie, John Heaton, Deborah Lucas, and Damien Moore (2009), "Heterogeneity and portfolio choice: Theory and evidence," in Yacine Ait-Sahalia and Lars P. Hansen, eds.: *Handbook of Financial Econometrics* (Elsevier Science, Amsterdam).

[14] Duffie, Darrell, and Tong-sheng Sun. (1990), "Transactions Costs and Portfolio Choice in a Discrete-Continuous-Time Setting,." *Journal of Economic Dynamics and Control* 14(1): 35–51.

[15] Gabaix, Xavier and D. Laibson (2002), "The 6D Bias and the Equity-Premium Puzzle," in Ben S. Bernanke and Kenneth Rogoff eds., *NBER Macroeconomics Annual* 16: 257-312.

[16] Guiso, Luigi, Michael Haliassos and Tullio Jappelli, eds.: 2002, *Household Portfolios* (MIT Press, Cambridge, MA).

[17] Guiso, Luigi, and Tullio Jappelli (2005), "Awareness and stock market participation," *Review of Finance* 9: 537-567.

[18] Heaton, John, and Deborah Lucas (2000*a*), "Portfolio choice and asset prices: The importance of entrepreneurial risk," *Journal of Finance* 55(3): 1163–1198.

[19] Heaton, John, and Deborah Lucas (2000*b*), "Portfolio Choice in the Presence of Background Risk," *Economic Journal, Royal Economic Society*, 110(460): 1–26.

[20] Heckman, James (1979), "Sample Selection Bias as a Specification Error," *Econometrica* 47: 153-161.

[21] Huang, Lixin, and Hong Liu (2007), "Rational Inattention and Portfolio Selection.", *The Journal of Finance* 62(4): 1999-2040.

[22] Investment Company Institute (2009*a*), "2009 Investment Company Fact Book - A Review of Trends and Activity in the Investment Company Industry," Washington, D. C.: Investment Company Institute, available at: http://www.ici.org/pdf/2009_factbook.pdf

[23] Investment Company Institute (2009*b*), "Ownership of Mutual Funds, Shareholder Sentiment, and Use of the Internet, 2009," Washington, D. C.: Investment Company Institute, available at: http://www.ici.org/pdf/fm-v18n7.pdf.

[24] Investment Company Institute and the Securities Industry Association (2005),"Equity ownership in America," Washington, D. C.: Investment Company Institute, available at: http://www.ici.org/pdf/rpt_05_equity_owners.pdf.

[25] Investment Company Institute and the Securities Industry Association (2008),"Equity and bond ownership in America," Washington, D. C.: Investment Company Institute, available at: http://www.ici.org/pdf/rpt_08_equity_owners.pdf.

[26] 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.

[27] Kennickell, Arthur B. (1998), "Multiple imputation in the Survey of Consumer Finances," Working paper, Federal Reserve Board, available at: http://www.federalreserve.gov/pubs/oss/oss2/method.html.

[28] Lewis, Karen K. (1999), "Trying to Explain Home Bias in Equities and Consumption," *Journal of Economic Literature* 37(2): 571-608.

[29] Mankiw, Gregory, and Stephen P. Zeldes (1991), "The consumption of stockholders and nonstockholders," Journal of Financial Economics, 29(1): 97–112.

[30] Mehra, Rajnish, and Edward C. Prescott (1985), "The Equity Premium: A Puzzle," Journal of Monetary Economics 15 (2): 145–161.

[31] Merton, Robert C. (1969), "Lifetime Portfolio Selection under Uncertainty: The Continuous-Time Case," *The Review of Economics and Statistics* 51(3): 247-257.

[32] Merton, Robert C. (1971), "Optimum consumption and portfolio rules in a continuous-time model," *Journal of Economic Theory* 3: 373-413.

[33] Merton, Robert C. (1973), "An intertemporal capital asset pricing model," *Econometrica* 41: 867–887.

[34] Miller, Merton and D. Orr (1966), "A Model of the Demand for Money by Firms", *Quarterly Journal of Economics* 80(3): 413-442.

[35] Mondria, J. and T. Wu (2010), "The Puzzling Evolution of the Home Bias, Information Processing and Financial Openness," Journal of Economic Dynamics & Control 34: 875-896.

[36] Rossi, Alberto G. (2010), "Towards a Theoretical Explanation of Time-Varying Trading,", mimeo.

[37] Samuelson, Paul A. (1969), "Lifetime Portfolio Selection by Dynamic Stochastic Programming," *Review of Economics and Statistics* 51(3): 239–46.

[38] Tobin, James (1958), "Estimation of Relationships for Limited Dependent Variables," *Econometrica* 26: 24-36.

[39] Veldkamp, Laura and Stijn Van Nieuwerburgh (2010), "Information Acquisition and Under-Diversification, with Information Acquisition and Under-Diversification," *Review of Economic Studies*, forthcoming.

[40] Vissing-Jorgensen, Annette (2003), "Perspectives on behavioral finance: Does "irrationality" disappear with wealth? Evidence from expectations and actions," in Mark Gertler and Kenneth Rogoff, eds.: *NBER Macroeconomics Annual* (MIT Press, Cambridge, MA).