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Dimitris Christelis♥ and Dimitris Georgarakos♠

Abstract

We investigate US households' direct investment in stocks, bonds and liquid accounts and their foreign counterparts, in order to identify the different participation hurdles affecting asset investment domestically and overseas. To this end, we estimate a trivariate probit model with three further selection equations that allows correlations among unobservables of all possible asset choices. Our results point to the existence of a second hurdle that stock owners need to overcome in order to invest in foreign stocks. On the other hand, we find little evidence for additional pecuniary or informational costs associated with investment in foreign bonds and liquid accounts.

JEL Classification: I0, I1, I2.

Keywords: Multivariate probit, simulated maximum likelihood, selection, household finance, foreign assets, stockholding

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1. Introduction

The strong propensity of investors to concentrate their investments in domestic markets has been well documented (French and Poterba, 1991, Lewis, 1999)[1] and goes against the notion of diversification and the predictions of standard portfolio models like the International Capital Asset Pricing Model (Baele *et al*., 2007). In the case of stocks, the foregone benefits from international diversification can be substantial even after adjusting for exchange rate risk and border restrictions (Lewis, 1999).

Several explanations have been proposed for this phenomenon, including trading costs (Tesar and Werner, 1995, Amadi and Bergin, 2006), informational costs and asymmetries (Ahearne *et al.*, 2004, Choe *et al.,* 2005, Dvorak, 2005), poor investment protection and corporate governance (La Porta *et al.*, 1999, Dahlquist *et al.*, 2003, Leuz *et al.*, 2005, Stulz, 2005), transparency in international markets (Gelon and Wei, 2005), real exchange rate volatility (Fidora *et al*., 2007) and behavioral biases (Grinblatt and Keloharju, 2000, Strong and Xu, 2003). In addition, lack of international diversification has been recently linked to investors' poor understanding about financial information and opportunities available to them (Graham *et al.*, 2005).

When studying household foreign asset investment one needs to take into account that the decision to invest in an asset abroad is logically preceded by the decision to invest in the asset in any form (domestic or foreign) and that the vast majority of households do not hold any foreign asset. Thus, the issue of selectivity must be addressed, by first modeling the decision to invest in the asset in any form and, conditional on this first decision being affirmative, by then modeling the decision to invest in its foreign counterpart. Since the second choice is relevant only for the subset of the population that holds the asset in any

form, a two-stage specification accounts for the incidental truncation inherent to the household investment decision process. The economic rationale for disentangling the two decisions comes from the fact that choices at each step may be affected by different factors and be subject to different costs, pecuniary or informational, thus implying differing participation hurdles that one has to overcome before investing at each stage.

With respect to stocks, fixed entry costs have been proposed as a leading explanation of the limited stockmarket participation by households, despite the existence of a historical equity premium that in the US is of the order of 6 percentage points (Mankiw and Zeldes, 1991, Haliassos and Bertaut, 1995, Vissing-Jorgensen, 2003). Apart from explicit brokerage and monetary fees such costs also include non-tangible costs perceived by investors, costs of time, costs of processing information as well as costs of picking and monitoring advisors and keeping up with market developments. It is likely however that some of the candidates in explaining non-participation in the stock market do not automatically extend to non-participation in foreign stock markets, for a number of reasons: i) ignorance about the existence of stocks can be quite common in the general population (see Guiso and Jappelli, 2005, for the case of Italy), while we would expect that stockowners are normally aware of the existence of foreign stocks; ii) directly held stocks, represent a risky, information intensive, and demanding with respect to its management investment option that is undertaken by a select group of households. These households are very different in terms of resources, investment experience, education, and risk aversion from the rest of the population (Guiso *et al.*, 2002), and thus it is possible that they make their investment choices differently compared to the rest of the population; iii) foreign stocks can be affected by additional costs related to the monitoring of foreign companies,

trading costs (Amadi and Bergin, 2006) as well as the lack of information regarding foreign policies, institutions and accounting practices (Ammer *et al*., 2006, Covrig *et al.*, 2007, Dvorak, 2005); iv) having social interactions has been found to positively affect stock market participation (Hong *et al.*, 2004), possibly because word of mouth information lowers informational costs. The same argument should imply a reverse effect for investments in foreign equity markets, given that only few households hold foreign stocks.

The home bias is not limited to stocks but extends to the case of bonds as well. Burger and Warnock (2006) document that US investors have very limited participation in foreign bond markets (especially those in emerging countries), while Fidora *et al*. (2007) extend this finding to several other industrialized economies, typically concluding that the bond home bias is even more pronounced than that for equities.

In this paper, using data from the US Survey of Consumer Finances (SCF), we investigate US households' decision to invest in three domestic assets, namely stocks held directly, bonds, and accounts, and their foreign counterparts. We model the foreign investment decision by using a multivariate probit specification with triple selection that is estimated under simulated maximum likelihood. The model allows for differential effects of regressors as well as for cross correlations of the unobservables across all investment alternatives[2], while taking into account the fact that investment in a foreign asset is an option only after one decides to invest in the asset irrespective of its provenance. Despite the model's complexity, we can still use coefficient estimates to derive economically meaningful magnitudes, namely probabilities of several asset choices of interest and their associated marginal effects.

While there have been numerous studies that use macro-level data (e.g. Burger and Warnock, 2006, Fidora *et al.*, 2007) or data about institutional investors (e.g. Dahlquist *et al.*, 2003, Strong and Xu, 2003, Ahearne *et al.*, 2004, Leuz *et al.*, 2005, Ammer *et al.*, 2006), there have been only few that use household-level data to examine investments in foreign assets. Bailey *et al.*, (2007), using administrative data from a brokerage firm find that investing experience, higher wealth, and some behavioral biases can lead to international diversification in investors' portfolios. For the purposes of studying discrete asset choices however, their sample is not representative of the US population since at least 70% of investors therein hold domestic stocks directly and at least 26% hold foreign stocks directly (as opposed to roughly 19% for any direct stockholding and 2% for direct foreign stockholding in the US population according to the SCF). Thus it is probable that choosing to open a brokerage account is correlated with the decision to own directly foreign and domestic stocks, resulting into endogenous stratification. In addition, the authors do not account for the two-stage decision process involved in foreign asset investment. Kyrychenko and Shum (2006) use the SCF to look at determinants of households' decision to invest in foreign stocks and bonds. To this end they model investments in foreign assets as a one step process, by means of standard probit and tobit models and find that financial sophistication and pessimistic expectations about the domestic economy induce ownership of foreign stocks and bonds (they don't consider liquid accounts). However, they do not take into account either the problems created by selectivity in the estimation of foreign asset investment equations (they estimate their equations for owning foreign stocks and bonds on the same sample) or the interrelationships among the different asset choices. The objective of our paper is clearly different since we focus on disentangling the different

participation hurdles that affect foreign investment in various assets while taking into account the correlations of their unobservables.

Our results point to the existence of a second hurdle that stock owners have to overcome in order to invest in foreign stocks. Within the select group of investors that hold stocks directly, it is the very wealthy, those willing to assume extra risks, those who use the internet to obtain financial information and those who spend significant time and effort to shop around for the best investment opportunities that choose to invest in foreign stocks. Interestingly, we find that households who seek financial advice from relatives, friends and work contacts are significantly less likely to invest in foreign stocks, implying that the limited popularity of foreign assets tends to magnify any objective costs related to investing in equity markets abroad. By contrast, most of the factors we control for do not appear important in explaining investments in foreign bonds and currency that are not subject to the stock market uncertainty. This may suggest that any other costs and risks they entail do not represent a key discouragement factor for investing abroad. We also find that, in the case of investment in foreign stocks, probabilities and marginal effects can change dramatically if one fails to take into account the possible inter-relations of the unobservables affecting stocks with those affecting other assets. Finally, we show that foreign asset owners are split mostly in two distinct groups, one owning only foreign stocks and the other foreign accounts, with the former being considerably more affluent, educated and financially sophisticated than the latter.

The rest of the paper is organized as follows. Section 2 provides information on the data. Section 3 discusses the empirical model setup and the estimation procedure. The

empirical results and comparisons of the multivariate probit model with selection against simpler models are presented Section 4. Section 5 concludes.

2. Data

In our analysis we use data from 1995, 1998, 2001, and 2004 cross sections of the SCF[3], which is generally considered to be the best source of disaggregated information on US households' financial, real assets, and liabilities. A key feature of the SCF is that it is not subject to top coding of wealthy households and that the rich who own the largest share of wealth and are difficult to interview (and thus underrepresented in most surveys) are oversampled. As a result the SCF becomes more representative of the US population (for more details on the SCF see Kennickell, 2000). Households are first asked in considerable detail whether they own any stocks, bonds and liquid accounts at all, and if they respond affirmatively they are then asked whether (part of) these investments are foreign.

The question on foreign stocks, refers to "stocks in a company headquartered outside the US" which includes stocks that are cross-listed in US stock exchanges. Companies issuing such stocks must adhere to the same financial disclosure rules as domestic companies. Hence, the informational requirements of investing in stocks of cross listed companies should not be very different from those of domestic companies. Indeed Ammer *et al.* (2006) and Ahearne *et al.* (2004) find that cross-listing makes foreign firms considerably more attractive to domestic investors. Moreover, Errunza *et al*. (1999) show that domestically traded stocks of companies headquartered abroad represent a natural diversification option for spreading international risk. In our context cross-listing implies that estimates of the influence that various factors have on households' tendency to invest

in foreign stock markets are likely to represent lower bounds on the effects that would have been found if the data had allowed us to focus only on foreign companies that are not cross-listed in the US.

Unfortunately, the SCF does not provide any information on whether households invest in foreign assets through their mutual funds or retirement accounts. However, as Kyrychenko and Shum (2006) point out, aggregate statistics suggest that the foreign content in these saving vehicles is quite small and unlikely to account for the bias against holding foreign assets. In addition, many households who have mutual funds or retirement accounts leave the investment decision making to the professionals who manage them. From that perspective, the study of investment choices that require active involvement is more informative about households' attitudes towards foreign assets.[4]

Table I reports ownership rates of the three asset categories and their foreign counterparts. A non trivial fraction of households (roughly 10%) does not own any liquid accounts. Directly held stocks have become quite more popular since mid 1990s, while the intervening downswing seems to have slow down rather than completely reverse this trend. Bonds display a different pattern and seem to become less favorable over the years. A similar fraction of households, which varies from 1.2 to 3.1 percent, depending on the year, owns foreign stocks and foreign accounts. However, ownership of foreign stocks represents an investment option that is preferred by a non trivial number of stockholders (almost 10 percent). On the other hand, only a tiny fraction of households reports ownership of foreign bonds.

A household can invest in foreign assets in a number of different ways. In Table II, we list all the possible combinations of direct foreign asset investment and their observed

proportions among foreign asset holders in the data. We observe that the vast majority of foreign asset holders either invest only in foreign stocks (42.8%) or only in foreign accounts (51%), and thus very few hold more than one kind of foreign asset. In Table III, we compare the economic and demographic characteristics of the two groups of foreign investors with those of the whole sample. It is clear that those who invest only in foreign stocks have much higher economic resources, higher education, higher propensity to assume financial risks and higher financial sophistication (as implied by a longer investment horizon, a more extensive use of the internet to obtain financial information, and a higher propensity to shop around for financial advice) relative to those of investors in only foreign accounts and to those of the whole population. Investors that own only foreign stocks are also older, healthier, more optimistic about the prospects of the US economy, more likely to be white, single males, self-employed, to work currently or in the past in the financial sector. We also note that investors only in foreign accounts are also wealthier, healthier, more educated, more risk loving and more financially sophisticated than the average investor.

The striking dichotomy in foreign asset ownership and the substantial differences in the characteristics of the two principal groups of foreign investors suggest that there are distinct purposes behind investment in foreign stocks and in foreign accounts, possibly mainly speculative for the former while mostly transactions-related for the latter.

3. The Model

3.1 Description

The diversified pattern of foreign asset ownership shown in Section 2 suggests that there could be different participation thresholds associated with each type of foreign asset, and thus a disaggregated model is needed to study the foreign investment choices of US households. We construct such a model, and its underlying economic decision process is shown in Fig. 1. First, households decide whether to hold any stocks, bonds or accounts, and any combination of these choices is possible. If the household decides to invest in a given saving vehicle, then it has to take a second decision on whether to invest in its foreign counterpart (again, any combination of foreign asset holdings is possible). On the other hand, if the household decides not to invest in one of the three vehicles, then it is naturally not faced with the second-stage decision of foreign investment.

In the specification for each of the choices pictured in Fig. 1 we control for a rich array of household demographic and economic characteristics and we examine their differential influence on investing in the same asset domestically and abroad, as well as across a range of asset types with varying level of risk. More specifically, we control for age, marital status, having children, health status, and race of the household head. Households with self reported health problems are discouraged from investing in stocks according to Rosen and Wu (2004), and this effect is not driven by some other factor which influences both health status and portfolio choices. Previous studies report strong race effects on the probability of owning risky financial assets in the US (see for instance, Bertaut and Starr-McCluer, 2002) and this may be mainly attributed to the less aggressive targeting of minorities by the financial sector. Significant race effects have been also

identified to influence the probability of a household to own a bank account (see Rhine *et al.*, 2006, who also examine alternative ways to carry out basic financial transactions).

We also control for the educational attainment of the household head. Household portfolio studies from various countries have documented a net positive contribution of education in investing in information intensive financial assets, like stocks (see for instance the empirical contributions in Guiso *et al*., 2002). Education can affect portfolio choice mainly through three channels. First, less educated households are typically less aware of the properties of stocks, which tends to amplify any pecuniary costs associated with stock market participation. Second, education makes it easier to obtain and efficiently process information. Third, higher educated households typically face steeper future income profiles and this is likely to influence their asset choices. In addition, there is empirical evidence that education can be important for owning a bank account (Caskey and Peterson, 1997). The effect may relate to the minimum financial knowledge that is required in picking and managing an account or it may reflect some broader effects like trust in the banking system.

The survey also provides detailed information on households' financial attitudes and practices. Financial attitudes and practices can play an important role on investment decisions that goes well beyond the effect of life cycle fundamentals (see for instance the discussion in Bilias *et al*., 2006). To that effect, we use doing a great deal of shopping for the best terms when making major saving, investment and borrowing decisions as a control. In addition, we distinguish households who work/ed in the financial industry sector, since they might be familiar with financial products due to their work environment (Kyrychenko and Shum, 2006).[5] Further, we examine the role of financial information collected through

friends, relatives and work contacts as well as internet use (Bogan, forthcoming). As a measure of risk aversion, we use households' willingness to take more than average financial risks. We also control for having a long investment horizon, namely in excess of ten years.

To account for household economic resources, we use non investment income as well as net real and net financial wealth (thus allowing for distinct effects of accumulated assets that differ in terms of liquidity). The latter covariate enters in each equation after deducting the amount of the asset in question in order to avoid endogeneity problems. It is quite important to control for resources since standard theoretical models imply a key role of 'cash on hand' in determining portfolio choices. Furthermore, in the empirical specification we need to avoid confounding the role of other determinants with that of wealth, when the latter is not adequately accounted for.[6]

We include a dummy for having received an inheritance, since this can represent the existence of resources that were made available early in life. In addition, we examine how the intention to leave a bequest can affect investment choices that imply higher risks but have also a greater potential for households to achieve a target wealth level that will be bequeathed to their descendants. We also take into consideration several household expectations about the future state of the US economy, the domestic interest rates, and their future real income in order to see their influence on the asset allocation decisions in general and on the decision to move funds into foreign assets in particular.[7]

3.2 Specification

We empirically implement the three-way foreign investment decision problem, shown in Fig. 1, by using a trivariate probit model with three additional selection equations. Van de Ven and Van Praag (1981) were the first to estimate a probit model adjusted for selectivity. More recently, Jenkins *et al.* (2006) have used a bivariate probit model with two selection equations to study consent to give information during a survey interview.

The structure of our model is shown in Table IV. Using the notation of Jenkins *et al*. (2006) the three first stage equations (shown as equations (1), (3), and (5) in Table IV) model respectively the decisions to hold stocks directly, to hold bonds directly, and to have a liquid (checking or savings) account. The three second-stage probit equations model the decision to hold foreign stocks given that one directly owns any stocks (equation (2) in Table IV), the decision to hold foreign bonds given that one directly owns any bonds (equation (4)), and finally the decision to have liquid accounts in foreign currency given that one has any liquid account (equation (6)). Thus there are six probit equations in total, and we allow for unrestricted correlations between all six error terms of the underlying latent indices.

Parameter identification is obtained through the non-linearity of the probit functional forms, the fact that the three second-stage equations are not estimated on the whole sample, and with the use as an exclusion restriction from the three second-stage equations of the variable denoting saving for precautionary reasons. This saving motive could potentially affect investment in stocks, bonds and liquid accounts, but it's unlikely that it would affect the foreign investment content in those saving vehicles. As a robustness check, we also estimated the model without this exclusion restriction and the results were

unchanged. In addition, we experimented with many different initial conditions, especially with respect to the estimation of the correlations of errors across equations. In all cases these checks resulted in substantially the same or worse log-likelihood values than the one for the model currently presented.

The likelihood function distinguishes between eight different cases, which correspond to the eight possible outcomes of the three first-stage equations that denote holdings of any stocks, bonds, and liquid accounts. As in Jenkins *et al*. (2006) we use the indices $k_T=2T-1$ for $T \in \{S, FS, B, FB, A, FA\}$, and represent the *q*-variate normal distribution by $N_q(.)$. As an example, if the household holds directly any stocks then $k_S=1$, while if the household has (not) any foreign stocks $k_{FS}=1$ (-1). On the other hand, if the household does not own any stocks directly then $k_S=-1$ and the equation for foreign stocks (equation (2)) does not appear in the likelihood term of that particular household. The equations for bonds and liquid accounts and their foreign counterparts appear in the likelihood in an analogous fashion. Thus, the likelihood terms corresponding to the eight possible cases of first-stage asset holdings can be written as follows (dropping for simplicity the subscript i denoting households):

1) The household holds directly neither stocks, nor bonds nor liquid accounts:

$$L_1 = N_3(k_S C'\alpha, k_B G'\gamma, k_A X'\zeta; k_S k_B \rho_{\upsilon\nu}, k_S k_A \rho_{\upsilon\varepsilon}, k_B k_A \rho_{\nu\varepsilon}) \tag{8}$$

with $k_S = k_B = k_A = -1$

2) The household invests directly in stocks but does not hold directly any bonds and does not have liquid accounts:

$$L_2 = N_4(k_S C'\alpha, k_{FS} D'\beta, k_B G'\gamma, k_A X'\zeta; k_S k_B \rho_{\upsilon\nu}, k_S k_A \rho_{\upsilon\varepsilon}, k_B k_A \rho_{\nu\varepsilon}, k_S k_{FS} \rho_{\upsilon u}, k_{FS} k_B \rho_{u\nu}, k_{FS} k_A \rho_{u\varepsilon}) \tag{9}$$

with $k_S = 1, k_B = k_A = -1, k_{FS} = \pm 1$

3) The household invests directly in bonds but does not hold directly any stocks and does not have liquid accounts:

$$L_3 = N_4(k_S C'\alpha, k_B G'\gamma, k_{FB} H'\delta, k_A X'\zeta; k_S k_B \rho_{\upsilon\nu}, k_S k_A \rho_{\upsilon\varepsilon}, k_B k_A \rho_{\nu\varepsilon}, k_S k_{FB} \rho_{\upsilon n}, k_B k_{FB} \rho_{\nu n}, k_{FB} k_A \rho_{n\varepsilon}) \quad (10)$$

with $k_B = 1, k_S = k_A = -1, k_{FB} = \pm 1$

4) The household has liquid accounts but holds directly neither stocks nor bonds:

$$L_4 = \Phi_4(k_S C'\alpha, k_B G'\gamma, k_A X'\zeta, k_{FA} Y'\theta; k_S k_B \rho_{\upsilon\nu}, k_S k_A \rho_{\upsilon\varepsilon}, k_B k_A \rho_{\nu\varepsilon}, k_S k_{FA} \rho_{\upsilon e}, k_B k_{FA} \rho_{\nu e}, k_A k_{FA} \rho_{\varepsilon e}) \quad (11)$$

with $k_A = 1, k_S = k_B = -1, k_{FA} = \pm 1$

5) The household holds directly both stocks and bonds but has no liquid accounts:

$$L_5 = N_5(k_S C'\alpha, k_{FS} D'\beta, k_B G'\gamma, k_{FB} H'\delta, k_A X'\zeta; k_S k_B \rho_{\upsilon\nu}, k_S k_A \rho_{\upsilon\varepsilon}, k_B k_A \rho_{\nu\varepsilon}, k_S k_{FS} \rho_{\upsilon u}, k_{FS} k_B \rho_{u\nu}, k_{FS} k_A \rho_{u\varepsilon}, k_S k_{FB} \rho_{\upsilon n}, k_B k_{FB} \rho_{\nu n}, k_{FB} k_A \rho_{n\varepsilon}, k_{FS} k_{FB} \rho_{un}) \quad (12)$$

with $k_S = k_B = 1, k_A = -1, k_{FS} = \pm 1, k_{FB} = \pm 1$

6) The household holds directly bonds, has liquid accounts but has no direct stock holdings:

$$L_6 = N_5(k_S C'\alpha, k_B G'\gamma, k_{FB} H'\delta, k_A X'\zeta, k_{FA} Y'\theta; k_S k_B \rho_{\upsilon\nu}, k_S k_A \rho_{\upsilon\varepsilon}, k_B k_A \rho_{\nu\varepsilon}, k_S k_{FB} \rho_{\upsilon n}, k_B k_{FB} \rho_{\nu n}, k_{FB} k_A \rho_{n\varepsilon}, k_S k_{FA} \rho_{\upsilon e}, k_B k_{FA} \rho_{\nu e}, k_A k_{FA} \rho_{\varepsilon e}, k_{FB} k_{FA} \rho_{ne}) \quad (13)$$

with $k_B = k_A = 1, k_S = -1, k_{FB} = \pm 1, k_{FA} = \pm 1$

7) The household holds directly stocks and has liquid accounts but has no direct bond holdings:

$$L_7 = N_5(k_S C'\alpha, k_{FS} D'\beta, k_B G'\gamma, k_A X'\zeta, k_{FA} Y'\theta; k_S k_B \rho_{\upsilon\nu}, k_S k_A \rho_{\upsilon\varepsilon}, k_B k_A \rho_{\nu\varepsilon}, k_S k_{FS} \rho_{\upsilon u}, k_{FS} k_B \rho_{u\nu}, k_{FS} k_A \rho_{u\varepsilon}, k_S k_{FA} \rho_{\upsilon e}, k_B k_{FA} \rho_{\nu e}, k_A k_{FA} \rho_{\varepsilon e}, k_{FS} k_{FA} \rho_{ue}) \quad (14)$$

with $k_S = k_A = 1, k_B = -1, k_{FS} = \pm 1, k_{FA} = \pm 1$

8) The household holds directly stocks and bonds and has liquid accounts:

$$L_8 = N_6(k_S C'\alpha, k_{FS} D'\beta, k_B G'\gamma, k_{FB} H'\delta, k_A X'\zeta, k_{FA} Y'\theta; k_S k_B \rho_{vv}, k_S k_A \rho_{v\varepsilon}, k_B k_A \rho_{v\varepsilon}, k_S k_{FS} \rho_{vu}, k_{FS} k_B \rho_{uv}, k_{FS} k_A \rho_{u\varepsilon}, k_S k_{FB} \rho_{vn}, k_B k_{FB} \rho_{vn}, k_{FB} k_A \rho_{n\varepsilon}, k_S k_{FA} \rho_{v\varepsilon}, k_B k_{FA} \rho_{v\varepsilon}, k_A k_{FA} \rho_{\varepsilon\varepsilon}, k_{FS} k_{FB} \rho_{un}, k_{FB} k_{FA} \rho_{ne}, k_{FS} k_{FA} \rho_{u\varepsilon}) \quad (15)$$

with $k_S = k_A = k_B = 1, k_{FS} = \pm 1, k_{FB} = \pm 1, k_{FA} = \pm 1$

Thus the overall contribution to the log likelihood by a given household is equal to

$$\log L = (1-S)(1-B)(1-A)\log L_1 + S(1-B)(1-A)\log L_2 + (1-S)B(1-A)\log L_3 + (1-S)(1-B)A\log L_4 + SB(1-A)\log L_5 + (1-S)BA\log L_6 + S(1-B)A\log L_7 + SBA\log L_8 \quad (16)$$

Estimation is performed using maximum likelihood estimation by pooling the 1995, 1998, 2001 and 2004 SCF waves, which contain 17,565 households in total. Since the SCF uses multiple imputation methods to impute missing values (see e.g. Kennickell, 2000), there are five different implicate datasets for each wave. We thus use multiple imputation estimation methods to take into account the additional uncertainty induced by the imputation, that is we first perform the estimation and compute robust standard errors within each implicate, and then combine the estimates and standard errors across implicates using the rules described in Rubin (1987). Since multiple integrals appear in the aforementioned likelihood terms L_1 - L_8, we evaluate them by simulated maximum likelihood using the GHK simulator (Geweke, 1999, Keane, 1994). We use 150 Halton draws and the Stata function mvnp to implement the GHK simulator, as described in Cappellari and Jenkins (2006).

The results of the estimation are presented in Table V. As is well known however, regression coefficients in discrete choice models are very difficult to interpret economically since they show the effect of a given regressor on a latent index which has limited

economic significance. Making sense of these coefficients becomes even more difficult in the context of a multi-equation discrete choice model with correlated disturbances. This is so because a coefficient in a given equation does not reflect the influence that its associated regressor can have through its presence in the equations for the other choices. This influence could be transmitted to the equation of interest through the cross-correlated equation disturbances.[8] Hence, we will concentrate our discussion of the estimation results on the following economically meaningful magnitudes, derived out of the full multi-equation model: i) the probabilities of different asset choices of interest generated by the model; ii) the marginal effects of the regressors on the probabilities of those asset choices. Throughout our discussion we will be comparing the aforementioned magnitudes as derived from the multivariate probit with selectivity with those derived from estimating three separate probit models with selectivity for stocks (equations (1) and (2) in Table IV), bonds (equations (3) and (4)), and liquid accounts (equations (5) and (6)).[9]

It is also important to examine the estimated correlations of the disturbances across equations (shown at the bottom of Table V), since they could substantially affect probabilities of asset choices. We observe that the selectivity term for stocks, ρ_{vu}, is equal to 0.73 and strongly significant, while the corresponding one for bonds, ρ_{vn}, is equal to 0.17 and also very significant. On the other hand, there is no evidence of selectivity for liquid accounts.[10] These results suggest that stock and bond owners form a selected sample and thus estimating probits of foreign stock (bond) ownership among stockholders (bondholders) without accounting for selectivity leads to inconsistent estimates. As for the correlations across the three saving vehicles (stocks, bonds, accounts) we find that the unobservables in the equation for any stockholding are correlated with the unobservables in

the equations for bonds, foreign bonds, liquid accounts, and foreign liquid accounts, possibly because of some common investment characteristics and preferences like interest in foreign investment, common monitoring costs and appreciation of the benefits of diversification (Alessie *et al.*, 2004). On the other hand, unobservables in the foreign accounts equations are not correlated with those in the foreign bonds and foreign accounts equations, which is consistent with the sharp dichotomy in foreign asset holdings observed in Table II. Finally, unobservables in the foreign bonds equation are correlated with those in the foreign liquid accounts equation, potentially because both decisions involve less risk than that for foreign stocks.

We then proceed to check the joint statistical significance of the correlation coefficients. Since our estimation procedure takes into account multiple imputation, we use the F-test suggested by Li *et al*. (1991) to account for the additional uncertainty induced by multiple imputation. We first perform the test by including all correlation coefficients except three, namely the correlations $\rho_{\upsilon u}$, $\rho_{\upsilon n}$ and $\rho_{\varepsilon e}$ of the errors that respectively correspond to the first and second stage equations for stocks, bonds and liquid accounts and their foreign counterparts and represent selectivity within each of those three saving vehicles. Hence, if the null hypothesis were not rejected, then one could model foreign asset investment in each of the three saving vehicles independently of what happens with the other two by performing the aforementioned simpler alternative estimation of three separate two-stage probits with selection. However, the value of the F-statistic is equal to 30.83 (p-value: 0), and thus the null hypothesis is strongly rejected. When we add the aforementioned three selectivity terms to the joint test of correlations, the F-statistic is equal to 34.22 (p-value: 0), again strongly rejecting the null. Thus, in our context and in

contrast to what happens in Jenkins *et al*. (2006), we conclude that one cannot ignore the correlations of the unobserved factors across equations when computing the probabilities of asset choices of interest.

The multivariate nature of the model permits the computation of a wide range of asset choice probabilities as follows: any asset combination is reflected by a particular 6-tuple of values (s, fs, b, fb, a, fa) of the six-element vector (S, FS, B, FB, A, FA) and has a probability given by

$$P(s, fs, b, fb, a, fa) = N_p(k_S C\hat{\alpha}, m_{FS} D\hat{\beta}, k_B G\hat{\gamma}, m_{FB} H\hat{\delta}, k_A X\hat{\zeta}, m_{FA} Y\hat{\theta}, \bar{\rho}) \qquad (17)$$

$$\text{with } s \geq fs, b \geq fb, a \geq fa, k_S = 2 \cdot s - 1, k_{FS} = 2 \cdot fs - 1, k_B = 2 \cdot b - 1,$$
$$k_{FB} = 2 \cdot fb - 1, k_A = 2 \cdot a - 1, k_{FA} = 2 \cdot fa - 1, m_{FS} = k_{FS} \cdot I(s = 1),$$
$$m_{FB} = k_{FB} \cdot I(b = 1), m_{FA} = k_{FA} \cdot I(a = 1), p = |k_S| + |m_{FS}| + |k_B| + |m_{FB}| + |k_A| + |m_{FA}|,$$
$$\bar{\rho} = (k_S k_B \hat{\rho}_{\nu\nu}, k_S k_A \hat{\rho}_{\nu\varepsilon}, k_B k_A \hat{\rho}_{\nu\varepsilon}, k_S m_{FS} \hat{\rho}_{\nu u}, m_{FS} k_B \hat{\rho}_{u\nu}, m_{FS} k_A \hat{\rho}_{u\varepsilon}, k_S m_{FB} \hat{\rho}_{\nu n}, k_B m_{FB} \hat{\rho}_{\nu n},$$
$$m_{FB} k_A \hat{\rho}_{n\varepsilon}, k_S m_{FA} \hat{\rho}_{\nu e}, k_B m_{FA} \hat{\rho}_{\nu e}, k_A m_{FA} \hat{\rho}_{\varepsilon e}, m_{FS} m_{FB} \hat{\rho}_{un}, m_{FB} m_{FA} \hat{\rho}_{ne}, m_{FS} m_{FA} \hat{\rho}_{ue})$$

Since each asset combination is unique, a set of asset combinations has a probability equal to the sum of the probabilities of the individual combinations. Thus, one can express the probability of any asset choice as the sum of the probabilities of all asset combinations in which this choice is observed. As an example, the conditional probability of holding foreign stocks given ownership of stocks in any form can be expressed as the sum of the probabilities of all asset combinations that include investment in foreign stocks, divided by the corresponding sum for investment in any stocks, that is

$$P^C(FS=1/S=1)=\frac{P(S=1,FS=1)}{P\ (S)}=\frac{\sum_{B=0}^{1}\sum_{\substack{FB=0\\B\geq FB}}^{1}\sum_{A=0}^{1}\sum_{\substack{FA=0\\A\geq FA}}^{1}P(1,1,B,FB,A,FA)}{\sum_{FS=0}^{1}\sum_{B=0}^{1}\sum_{\substack{FB=0\\B\geq FB}}^{1}\sum_{A=0}^{1}\sum_{\substack{FA=0\\A\geq FA}}^{1}P(1,FS,B,FB,A,FA)}= \quad (18)$$

$$\frac{N_2(C'\hat{\alpha},D'\hat{\beta},\rho_{vu})}{N(C'\hat{\alpha})}$$

The reduction in the dimensionality of the normal integrals implied by the last equality in (18) does not generally extend to more complicated choices of interest, e.g. to the probability of owning foreign stocks conditional on owning any foreign asset, which is equal to

$$P^C(FS=1/AFI=1)=\frac{P(FS=1,AFI=1)}{P\ (AFI=1)}=\frac{P\ (FS=1)}{P(AFI=1)}=$$

$$\frac{\sum_{B=0}^{1}\sum_{\substack{FB=0\\B\geq FB}}^{1}\sum_{A=0}^{1}\sum_{\substack{FA=0\\A\geq FA}}^{1}P(1,1,B,FB,A,FA)}{\sum_{S=0}^{1}\sum_{\substack{FS=0\\S\geq FS}}^{1}\sum_{B=0}^{1}\sum_{\substack{FB=0\\B\geq FB\\FS+FB+\\FA>0}}^{1}\sum_{A=0}^{1}\sum_{\substack{FA=0\\A\geq FA}}^{1}P(S,FS,B,FB,A,FA)}=$$

$$\frac{N_2(C'\hat{\alpha},D'\hat{\beta},\rho_{vu})}{\sum_{S=0}^{1}\sum_{\substack{FS=0\\S\geq FS}}^{1}\sum_{B=0}^{1}\sum_{\substack{FB=0\\B\geq FB\\FS+FB+\\FA>0}}^{1}\sum_{A=0}^{1}\sum_{\substack{FA=0\\A\geq FA}}^{1}P(S,FS,B,FB,A,FA)} \quad (19)$$

where AFI denotes investment in any foreign asset, and the summation in the denominator is over all asset combinations in which at least one foreign asset is held.[11]

We evaluate all probabilities of interest for each household in the sample using the GHK simulator and the same Halton draws that were used in the estimation.

The marginal effects of the regressors on the probabilities of interest are computed as the change in the probabilities when there is a change in the value of the regressor. For 0-1 dummy variables the marginal effect is defined as the weighted mean difference across households in the predicted probability when the regressor is equal to one and when the

regressor is equal to zero. For income- and wealth-related continuous variables we compute the median semi-elasticities of the probabilities, which are equal to the marginal effect multiplied by the regressor.[12] Since these probabilities, marginal effects and semi-elasticities are nonlinear functions $g(\hat{\psi})$ of the estimated parameters $\hat{\psi} = (\hat{\alpha}, \hat{\beta}, \hat{\gamma}, \hat{\delta}, \hat{\zeta}, \hat{\theta}, \overline{\rho})$, we compute their point estimates (expected values) and standard errors using Monte Carlo simulation (Train, 2003), that is

$$E(g(\psi)) = \int g(\psi) f(\psi) d\psi \qquad (20)$$

where $f(\psi)$ denotes the joint distribution of all the elements in ψ. We implement this simulation estimator by drawing from the distribution of the parameters $\hat{\psi}$ under the assumption that they are distributed asymptotically normally with means and variance-covariance matrix equal to the maximum likelihood estimates.[13] At each parameter draw we generate for every household probabilities and marginal effects and then calculate $g(\hat{\psi})$ as their weighted average (median) across households.[14] We then estimate $E(g(\psi))$ as the average of $g(\hat{\psi})$ across draws, and the standard error of $g(\psi)$ as the standard deviation of the distribution of $g(\hat{\psi})$ across draws.[15]

4. Empirical Results

In this section we present predictions of various asset choices of interest, and marginal effects (or semi-elasticities) for each of the three assets and their foreign counterparts. In particular, Table VI compares actual and predicted population proportions of households who make various asset choices, while Table VII presents marginal effects

on the probability of owning stocks and conditional marginal effects on the probability of owning foreign stocks, conditional on owning any stocks, from both the two stage probit with selection (columns 1-4) and the multivariate probit with selection (columns 5-8). Similar results for bonds and accounts are summarized by Tables VIII and IX, respectively. By focusing on conditional probabilities of second-stage foreign asset choices we can disentangle the effects of household characteristics on these choices while controlling for their corresponding effects on first-stage decisions. Therefore, we can investigate whether there exist additional participation thresholds faced by prospective investors in foreign assets in a given saving vehicle, after they have overcome any informational or pecuniary obstacles of investing in the vehicle in the first place.

4.1 Prediction of Asset Ownership

A useful check of the fit of our model would be to compare its predictions with the outcomes observed in the data. To this effect, in column 1 of Table VI we report the observed population proportions of households making various asset choices and we compare them with the predictions from the simple two-stage probits with selection (column 2) and with those from the multivariate probit with selection (column 4). The predicted population proportions are obtained as follows:

i) Using the Monte Carlo draws of the estimated coefficients, discussed in Section 3.2 above, we compute the probability of a given asset choice for every household at each draw.

ii) For each household, we randomly draw a number from a (0,1) uniform distribution and if it is smaller than the predicted probability we predict that

the household makes the asset choice, while if the random number is greater we predict that it does not. Repeating this procedure for all households allows us to compute the predicted proportion of households that make the asset choice.

iii) We repeat i) and ii) for every coefficient draw and obtain point estimates and standard errors of predicted proportions by simulation as described in Section 3.2.

We observe that the multivariate model with selection does in general a good job in predicting sample proportions, even for asset choices with small actual prevalence.[16] In addition, it gives significantly better predictions than the simple independent two-stage probits for the probabilities of holding foreign stocks conditional on holding any stock, and the corresponding conditional probability for bonds. The superiority in the predictions of the multivariate probit model is even more apparent for probabilities involving choices across the three different saving vehicles (e.g. the probabilities of holding any stocks conditional on owning any bonds, of owning foreign stocks given ownership of foreign accounts, of owning any foreign asset etc.). The reason for the generally very poor predictive performance of the independent two-stage probits in those cases (with the exception of the probability of holding foreign bonds conditional on holding foreign stocks and the probability of having liquid accounts conditional on having any foreign asset, for which the two models give similar predictions) is precisely the failure to take into account the correlations in the unobservables across the different saving vehicles.[17]

4.2 Stocks and Foreign Stocks

Marginal effects from the first stage regression of the multivariate probit specification on stock ownership are shown in Table VII, column 5. Our results are in line with existing findings in the empirical household portfolio literature for the US (e.g. Bertaut and Starr-McLuer, 2001). Specific household characteristics like larger resources, higher education attainment, willingness to assume additional risks, and being white, strongly increase the probability of owning stocks. For instance, having a college degree increases by 18 percentage points the probability of owning stocks directly after controlling for resources and several indicators of financial attitudes and practices. Expectations about increases in future real income have a positive effect on direct stock holding which is consistent with the predictions of intertemporal household portfolio models with background income risk and borrowing constraints (Cocco *et al.* 2005, Haliassos and Michaelides, 2003). More specifically, these models predict a positive investment in the risky asset for households that anticipate steeper future income profiles.[18] The existing empirical literature (see for example the contributions in Guiso *et al. 2002)* has attributed part of the estimated influence of education to this effect, since the more educated face upward income profiles; nevertheless our results suggest that income and education have separate and significant effects. It is also worth mentioning that households that have members working in the financial sector now or in the past are also more likely to invest in stocks. This is consistent with the view that directly held stocks represent a saving vehicle which is favored by investors familiar with the properties and the management of sophisticated and information intensive investments. Using the internet to collect financial information, is also positively

associated with investment in stocks, possibly because of the informational advantages and the lower monitoring costs that internet use can bring about. All in all, results in the first stage indicate that directly held stocks are owned by a select group of investors characterized by large economic resources, low risk aversion and financial attitudes and practices that favor information intensive investments.

Moving to the results from the second stage (Table VII, column 7) we find that among this select group of stockowners those with higher financial and real wealth, and a sizeable inheritance received are significantly more likely to invest in foreign stocks. Furthermore, households willing to undertake more than average risks, have a 4% higher probability of holding foreign stocks compared to their more risk-averse counterparts. More likely to own foreign stocks are also stockowners who extensively shop around for the very best terms before investing, who have a long investment horizon, and who are sophisticated enough to use internet to get financial information. Having a college degree also tends to make foreign stockholding more likely (the effect is 4.7 percentage points and significant at 10%). On the other hand, dummies controlling for various expectations were not found significant. While race effects were positive and significant in the first stage, they are no longer significant and have the opposite sign in the second, in which suggests that, ceteris paribus, foreign stocks are equally popular among non-white stock owners.[19]

The negative effect of asking people for financial information, and the fact that this factor does not matter for the first-stage decision are quite interesting, since they *prima facie* contradict the findings of Hong *et al.* (2004), who document a positive association between social interactions and stockholding (direct and through mutual funds). However, as they also point out this effect could work either way, that is if the asset is widely held

then a prospective investor is likely to find in her social circle people who hold it and can provide information about it (thus making it more likely to invest in it), while the opposite should happen with assets that are only owned by few (like directly held stocks and especially foreign stocks). Hence, the conjecture by Hong *et al*. (2004) is indeed corroborated by our results.

Our results imply that some of the factors that could help households to clear the unobserved threshold of participation in the stock market and that appear significant in the first stage, also have an economically significant role in the decision to invest in foreign stocks. Since these factors do not exhaust their influence in the first stage, they point to the existence of an additional (unobserved) threshold that stockholders have to overcome in order to invest in foreign stocks. This may well relate to information requirements about foreign accounting and tax practices, corporate relationships, rate of return calculations, and the legal system as well as monetary costs of participation in such markets. In addition, there are non-tangible costs in terms of time required to process information and trade assets in foreign markets, which are likely to be higher than those of domestic investments. Thus it appears that households who directly own stocks do not face investments in foreign stocks as a simple investment option which can increase their portfolio diversification and provide hedging against domestic market uncertainty. Rather, households perceive foreign stocks as a specialized investment, which involves higher risks (both market and exchange rate related) and requires additional resources, good knowledge of foreign financial markets, and well-informed investment decision making. These requirements may be even stronger than what our estimates imply, given that we have to include in our investigation

foreign stocks that are cross-listed in US stock exchanges, and thus should exhibit lower information and pecuniary costs than stocks that are not cross-listed.

Marginal effects from the simple two-stage probit model for stocks are shown in columns 1-4 of Table VII. While the first stage effects differ very little from those of the multivariate model, those in the second stage, referring to the conditional probability of owning foreign stocks given ownership of any stocks, are very different. No variable exhibits any statistically significant effect in the simpler model, leading to a very misleading picture of the determinants of foreign stockholding and implying that there are no additional obstacles for investors to overcome when considering this choice.[20]

4.3 Bonds and Foreign Bonds

Table VIII summarizes the results for bonds. There are no notable differences in the results from the multivariate and the two-stage probit, with the only exception being the time dummies and the dummy for self-employed in the second stage which turn to be significant under the multivariate model.

First stage results on bond ownership from the multivariate model (column 5) suggest that they are more likely to be held by the wealthier, the better educated, the whites, the married and those with long investment horizon. In contrast to stocks, indicators of financial attitudes and practices (extensively shop around for the best investment options and willingness to assume high risks) do not matter. Willingness to undertake risk is not significant either, which is expected given that bonds are generally considered safer than stocks. However, bond ownership is encouraged by social interactions. An expected

decrease in real income augments the probability to own bonds, possibly because they reduce overall portfolio risk in unfavourable circumstances.

On the other hand, the effects on the conditional probability of foreign bond ownership are small and insignificant (except for time effects), suggesting that once the threshold of any bond ownership is overcome, there are small or no additional costs of investment in foreign bonds.[21]

4.4 Liquid Accounts and Accounts in Foreign Currency

Turning to the liquid accounts (Table IX) we observe that the multivariate probit and the simpler two-stage probit produce similar results not only for the first stage, but also for the second one. Results from the first stage suggest that households with low resources, as well as those with non white, low educated, retired and unemployed heads are less likely to own a liquid account. This is also the case for single males, those in poor health as well as households with problems in obtaining credit. These findings are consistent with existing empirical research that investigates the characteristics of households who do not have an account (see for instance Rhine *et al*., 2001). Some of the reasons that have been put forward to account for lack of bank accounts include households' lack of resources, inability to manage an account, preference not to deal with banks and maintain privacy in financial matters, poor credit histories as well as the existence of monetary costs and fees, mainly minimum balance requirements and service charges (see Aizcorbe *et al*., 2003, and Hogarth *et al*., 2004).

We also find that investors who save for precautionary reasons are more likely to hold a liquid account. The same holds for those who use internet in obtaining financial

information, possibly because this way they can monitor and manage their savings more easily. Those who expect the US economy to do worse are less likely to have a bank account (possibly because they fear the repercussions of a downturn on the financial system), while those who expect a lower real income in the future are more likely to have a bank account, probably as part of a defensive investment strategy. On the other hand, financial practices, like systematic shopping for the best investment options and long investment horizon, are small in magnitude or insignificant.

Marginal effects on the probability of owning accounts in foreign currency conditional on ownership of any liquid account are summarized in column 7 of Table IX. We notice that, and in contrast to the case of foreign stocks, almost none of the factors that might help overcome informational or pecuniary costs (education, length of investment horizon, using the internet, shopping around for the best terms before investing, discussing financial choices with others, non-investment income, financial and real wealth) matter for holding a foreign account, the only exception being working now or in the past in the financial sector. In addition, the effect of the willingness to assume higher risk is significant in the second stage, possibly reflecting the exchange rate risk that account holders need to assume in order to invest in foreign currency. However, this effect is quantitatively much smaller than the corresponding one derived for foreign stocks, which involve additional uncertainties related to the performance of the stock market. Finally, those who expect an increase in domestic interest rates are less likely to invest money into foreign accounts, which makes economic sense since higher domestic interest rates make liquid accounts in the US relatively more attractive.

4.5 Foreign Asset Location among Owners of Foreign Assets

One of the advantages of the multivariate probit estimation is that it allows the calculation of probabilities of composite events, in contrast to simpler models like the two-stage probits. As has already been discussed, households who own foreign assets are essentially split between those who own only foreign stocks and those who have only foreign accounts, while only very few make a foreign investment in more than one saving vehicle (see Table II). In addition, regression analysis suggests that different covariates play different roles in households' propensity to invest in each of the three foreign assets we consider. Thus, it would be interesting to examine the factors that influence households' decision to choose each of the three foreign assets *conditional* on any foreign asset ownership. In other words, we ask how do households who invest abroad in any form, locate their money across the three investment alternatives that have different market risk but potentially the same exchange rate risk? This exercise allows us to examine from a different angle participation thresholds in the three foreign assets.

Conditional marginal effects for each of the three assets are displayed in Table X.[22] As expected, given the dichotomy in the asset location choices among foreign asset owners, there are opposite effects of many covariates on the conditional probabilities of investing in foreign stocks and foreign accounts. Higher education, higher economic resources, willingness to take high financial risks, shopping around before investing, and a longer investment horizon, all contribute to clearing the participation threshold related to the ownership of foreign stocks. On the other hand, all these factors make households less likely to invest in foreign liquid accounts, given that they own any foreign asset. In addition, the role of expectations about domestic interest rates appears consistent with

economic theory: an expected increase in the US interest rates encourages investments in foreign stocks, while it discourages investments in foreign accounts. As for foreign bonds, the only factors that matter are willingness to assume financial risk (negatively) and time dummies (positively).

All in all, results from this section suggest that among foreign asset holders, the wealthier and more financially sophisticated choose primarily to invest in stocks, while the less affluent and less educated tend to prefer foreign accounts. To the extent that the immigrant population is overrepresented in the latter group, their preference for liquid accounts could be explained by their need to transfer money back to their home countries.

5. Conclusions

The limited investment in foreign assets by US households is notable because it can imply large foregone gains from international diversification. This phenomenon has not been studied up to now in all its possible manifestations in different saving vehicles. Our contribution consists of the construction of a flexible model of the determinants of foreign investment not only in stocks, but also in bonds and liquid accounts and its estimation using micro data from the SCF. In addition, we parameterize the multivariate probit with selection so that there is interdependence of all decisions through the correlations of their unobservables. We also show how one can use the coefficient estimates to calculate economically meaningful magnitudes (probabilities and marginal effects) out of this multi-equation discrete choice model while taking into account the full spectrum of the aforementioned correlations.

We find that households face obstacles in investing in foreign stocks that are separate from those affecting investment in domestic stocks and require economic resources and financial sophistication to be overcome. We find no such evidence for foreign bonds while for liquid accounts there is some evidence for the presence of participation thresholds, which seem however much weaker than those for foreign stocks. Furthermore, our results suggest that households who seek financial advice from relatives, friends and work contacts are significantly less likely to invest in foreign stocks. This result corroborates the conjecture by Hong *et al.* (2004) that social interactions should discourage investment in foreign stocks, given their limited popularity. In addition, conditional on owning any foreign asset, we find that economic resources and characteristics that suggest financial sophistication are positively associated with ownership of foreign stocks and negatively so with ownership of foreign accounts. This finding is mainly due to the fact that foreign investment is undertaken primarily by two population groups: the first one is wealthier, more educated and better informed about financial issues and invests only in foreign stocks while the second one has opposite characteristics and invests only in foreign liquid accounts.

We also find that accounting for interrelationships among different foreign investment decisions through a multivariate probit model with selection is important because: i) both foreign stock owners and bond owners are selected samples and thus not representative of the general population; ii) ignoring correlations of unobservables across the three saving vehicles is strongly rejected statistically and leads to very misleading results about the effects of characteristics on foreign stock ownership and in many cases to inferior predictions of population asset choices.

Finally, our results point to the importance of household financial literacy (Lusardi and Mitchell, 2007, Alessie *et al.*, 2007). They imply that there is room for promoting financial literacy even among households who have already invested directly in stocks, which are typically wealthier, better educated, and more financially sophisticated than average. Awareness of the benefits from international diversification can increase the returns from stocks for households who already participate in the stock market and can make stockholding more appealing for prospective investors.

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Table I. Prevalence of Asset Ownership

Year	Directly held stocks	Foreign stocks (*among stock owners*)	Directly held bonds	Foreign bonds (*among bond owners*)	Liquid accounts	Foreign liquid accounts (*among liquid account owners*)
1995	15.3	1.2 *(8.0)*	24.7	0.2 *(0.8)*	87.4	1.5 *(1.7)*
1998	19.2	2.1 *(10.9)*	21.5	0.1 *(0.4)*	90.6	1.8 *(2.0)*
2001	21.3	2.1 *(9.7)*	18.8	0.2 *(0.9)*	91.4	3.1 *(3.4)*
2004	20.7	2.4 *(11.5)*	18.8	0.1 *(0.4)*	91.3	2.7 *(2.9)*

Notes: SCF 1995, 1998, 2001, 2004, weighted data. The reported statistics are corrected for multiple imputation. Liquid Accounts include all types of transaction accounts (checking, savings, money market and call) comprising even the few of those with zero reported balances. Stocks refer to directly held stocks which are publicly traded. Bonds include US government savings bonds and other types of bonds (tax-exempt, mortgage-backed, US government/agency and other).

Table II. Combinations of Foreign Asset Investment among Foreign Asset Owners

Foreign stocks	Foreign bonds	Foreign liquid accounts	Percentage owning the combination
Yes	No	No	42.8
No	Yes	No	2.3
No	No	Yes	51.0
Yes	Yes	No	0.5
No	Yes	Yes	0.4
Yes	No	Yes	2.9
Yes	Yes	Yes	0.0

Notes: See Table I.

Table III. Distribution of Household Characteristics

Variable	Whole sample	Owns only foreign stocks	Has only foreign liquid accounts
Age (mean)	48.9	53.6	48.9
High school graduate	0.509	0.297	0.481
College degree or more	0.337	0.683	0.430
Married	0.588	0.676	0.629
Single male	0.140	0.176	0.148
Has children	0.435	0.378	0.394
White	0.762	0.898	0.795
Poor health	0.061	0.019	0.033
Uses Internet to obtain financial information	0.111	0.260	0.147
Asks Friends/Relatives/Work contacts for financial information	0.360	0.331	0.358
Extensively "shops around"	0.157	0.239	0.156
Expects US economy to do better	0.312	0.335	0.339
Expects US economy to do worse	0.251	0.224	0.229
Expects US interest rates to go higher	0.683	0.680	0.614
Expects US interest rates to go lower	0.063	0.064	0.079
Expects future income to rise faster than prices	0.220	0.277	0.237
Expects future income to rise lower than prices	0.305	0.280	0.299
Investment horizon > 10 yrs	0.143	0.236	0.125
Willingness to take above average financial risk	0.205	0.447	0.298
Intention to leave a bequest	0.293	0.542	0.301
Has received inheritance	0.199	0.459	0.196
Credit constrained	0.224	0.076	0.189
Last year's income unexpectedly low	0.171	0.162	0.156
Works/ed in the Financial Sector	0.204	0.259	0.253
Saves for "rainy days"	0.300	0.297	0.324
Self-employed	0.113	0.209	0.138
Retired	0.240	0.233	0.213
Unemployed/Inactive	0.051	0.025	0.047
Non-investment income (median)	37,788	69,076	44,153
Net real wealth (median)	57,968	219,359	68,783
Net financial wealth (median)	9,943	384,092	27,920

Notes: SCF 1995, 1998, 2001, 2004, weighted data. The reported statistics are corrected for multiple imputation. Numbers denote prevalence, except for age (mean), non-investment income, net real wealth, net financial wealth (medians in 2004 prices).

Table IV. Model Specification

Eqn.	Outcome	Latent propensities	Observed binary outcomes
For each respondent i = 1, …, N:			
1)	Owns any Stocks	$S_i^* = C_i'\alpha + \upsilon_i$	$S_i = I(S_i^* > 0)$
2)	Owns Foreign Stocks	$FS_i^* = D_i'\beta + u_i$	$FS_i = I(FS_i^* > 0)$ if $S_i = 1$, else unobserved
3)	Owns any Bonds	$B_i^* = G_i'\gamma + \nu_i$	$B_i = I(B_i^* > 0)$
4)	Owns Foreign Bonds	$FB_i^* = H_i'\delta + n_i$	$FB_i = I(FB_i^* > 0)$ if $B_i = 1$, else unobserved
5)	Has any Liquid Accounts	$A_i^* = X_i'\zeta + \varepsilon_i$	$A_i = I(A_i^* > 0)$
6)	Has Foreign Liquid Accounts	$FA_i^* = Y_i'\theta + e_i$	$FA_i = I(FA_i^* > 0)$ if $A_i = 1$, else unobserved
7)	Error terms $(\upsilon_i, u_i, \nu_i, n_i, \varepsilon_i, e_i) \sim N_6(0, \Omega)$, where Ω is a symmetric matrix with typical element $\rho_{ij} = \rho_{ji}$ for $i, j \in \{\upsilon, u, \nu, n, \varepsilon, e\}$ and $j \neq i$, and $\rho_{jj} = 1$, for all ρ, and N_6 denotes a 6-variate normal distribution. The errors in each equation are assumed to be orthogonal to the predictors		

Notes: $I(.)$ is the indicator function equal to one if its argument is true, and zero if false.

Table V. Multivariate Probit with Selection: Regression Estimates

Variables	(1)	(2)		(3)	(4)		(5)	(6)		(7)	(8)		(9)	(10)		(11)	(12)	
	Owns directly any stocks			Owns directly foreign stocks			Owns directly any bonds			Owns directly foreign bonds			Has any liquid accounts			Has foreign liquid accounts		
	Coeff.	Std. Error		Coeff.	Std. Error		Coeff.	Std. Error		Coeff.	Std. Error		Coeff.	Std. Error		Coeff.	Std. Error	
Age	0.178	0.505		0.012	0.899		-1.867	0.457	***	-2.042	2.161		-0.146	0.661		-0.803	0.739	
Age squared	0.353	0.461		0.540	0.787		1.990	0.425	***	2.836	1.750		1.467	0.685	**	0.924	0.690	
High school graduate	0.448	0.057	***	0.384	0.155	**	0.427	0.049	***	0.030	0.282		0.590	0.045	***	-0.007	0.087	
College degree or more	0.837	0.057	***	0.607	0.168	***	0.612	0.051	***	0.549	0.278	**	1.230	0.072	***	0.079	0.098	
Married	0.219	0.037	***	0.031	0.074		0.254	0.034	***	0.086	0.166		0.029	0.047		-0.029	0.057	
Single male	0.131	0.047	***	0.151	0.087	*	0.049	0.045		0.081	0.213		-0.203	0.057	***	0.042	0.070	
Has children	-0.062	0.027	**	-0.023	0.044		0.361	0.026	***	0.152	0.104		-0.081	0.042	*	-0.052	0.045	
White	0.314	0.038	***	0.069	0.081		0.439	0.036	***	0.162	0.187		0.458	0.040	***	-0.056	0.059	
Self-employed	0.006	0.032		0.069	0.048		-0.159	0.029	***	0.008	0.101		-0.021	0.065		-0.026	0.050	
Retired	0.123	0.043	***	0.016	0.068		-0.025	0.041		-0.144	0.135		-0.233	0.069	***	-0.130	0.073	*
Unemployed/Inactive	0.139	0.073	*	0.118	0.134		-0.045	0.067		-0.070	0.382		-0.192	0.069	***	0.051	0.112	
Poor health	-0.217	0.077	***	-0.150	0.152		-0.187	0.068	***	-..-	-..-		-0.198	0.070	***	-0.066	0.116	
Uses Internet to obtain financial information	0.291	0.036	***	0.222	0.055	***	0.110	0.035	***	0.236	0.118	**	0.367	0.089	***	-0.015	0.059	
Asks Friends/Relatives/Work contacts for financial information	0.006	0.026		-0.117	0.046	**	0.061	0.024	**	-0.104	0.096		0.024	0.039		0.011	0.043	
Extensively "shops around"	0.018	0.031		0.111	0.047	**	0.009	0.029		-0.019	0.097		-0.024	0.052		-0.027	0.051	
Expects US economy to do better	-0.008	0.028		0.019	0.046		-0.021	0.026		0.130	0.095		-0.009	0.045		0.011	0.045	
Expects US economy to do worse	0.042	0.029		0.081	0.049		-0.001	0.029		0.064	0.106		-0.182	0.046	***	0.029	0.049	
Expects US interest rates to go higher	0.010	0.028		0.000	0.044		0.007	0.026		-0.087	0.089		-0.065	0.045		-0.102	0.043	**
Expects US interest rates to go lower	-0.013	0.055		0.091	0.090		0.049	0.052		-0.114	0.172		-0.097	0.084		0.042	0.079	
Expects future income to rise faster than prices	0.080	0.029	***	0.070	0.046		-0.018	0.028		0.014	0.092		0.013	0.047		0.063	0.047	
Expects future income to rise lower than prices	0.025	0.029		0.035	0.052		0.049	0.027	*	-0.027	0.098		0.117	0.045	***	0.003	0.048	
Investment horizon > 10 yrs	0.110	0.029	***	0.141	0.042	***	0.115	0.028	***	0.092	0.085		0.117	0.065	*	-0.028	0.049	
Willingness to take above average financial risk	0.358	0.027	***	0.326	0.041	***	0.001	0.026		-0.075	0.083		0.151	0.054	***	0.078	0.046	*
Non-investment income	0.026	0.006	***	0.001	0.007		0.010	0.005	**	-0.019	0.012		0.061	0.007	***	-0.004	0.009	
Net real wealth	0.089	0.008	***	0.084	0.010	***	0.041	0.005	***	0.056	0.032	*	0.074	0.004	***	0.012	0.009	
Net financial wealth	0.027	0.002	***	0.027	0.005	***	0.023	0.002	***	0.075	0.050		0.009	0.002	***	0.003	0.003	
Intention to leave a bequest	0.285	0.026	***	0.272	0.045	***	0.194	0.025	***	0.251	0.117	**	0.183	0.046	***	-0.025	0.043	
Has received inheritance	0.188	0.026	***	0.201	0.039	***	0.109	0.026	***	-0.090	0.088		0.172	0.063	***	0.019	0.045	
Credit constrained	-0.020	0.039		-0.150	0.086	*	-0.084	0.035	**	-0.092	0.223		-0.126	0.041	***	-0.025	0.060	
Last year's income unexpectedly low	-0.054	0.035		0.072	0.059		-0.089	0.033	***	0.135	0.125		-0.153	0.044	***	0.029	0.054	
Works/ed in the Financial Sector	0.177	0.027	***	0.069	0.042	*	0.038	0.025		0.057	0.079		0.129	0.054	**	0.070	0.043	
Year 1998	0.066	0.034	**	-0.012	0.055		-0.149	0.031	***	-0.278	0.106	***	0.197	0.050	***	0.016	0.058	
Year 2001	0.051	0.034		-0.055	0.056		-0.315	0.032	***	-0.337	0.121	***	0.212	0.053	***	0.196	0.056	***
Year 2004	-0.005	0.035		-0.063	0.059		-0.286	0.033	***	-0.411	0.122	***	0.128	0.052	**	0.151	0.058	***
Saves for "rainy days"	-0.038	0.025		-..-	-..-		-0.018	0.024		-..-	-..-		0.199	0.043	***	-..-	-..-	
Constant	-3.825	0.155	***	-4.242	0.420	***	-2.176	0.134	***	-4.351	0.742	***	-1.201	0.174	***	-1.770	0.341	***

Table V. Multivariate Probit with Selection: Regression Estimates (continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Owns directly any stocks		Owns directly foreign stocks		Owns directly any bonds		Owns directly foreign bonds		Has any liquid accounts		Has foreign liquid accounts	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
Correlation terms												
ρ with Direclty Held Stocks			0.734	0.231 ***	0.232	0.015 ***	0.279	0.044 ***	0.266	0.051 ***	0.212	0.038 ***
ρ with Directly Held Foreign Stocks					0.195	0.076 ***	-0.105	0.067	0.286	0.072 ***	-0.038	0.038
ρ with Directly Held Bonds							0.167	0.029 ***	0.180	0.066 ***	0.178	0.049 ***
ρ with Directly Held Foreign Bonds									0.544	0.188 ***	0.179	0.069 ***
ρ with Liquid Accounts											0.069	0.186
Log likelihood	-24,362.99											
Number of observations	17,565											

Notes: Coefficients estimates and standard errors account for multiple imputation in the SCF, using the results in Rubin (1987). ***,**,* denote significance at 1%,5% and 10% respectively.

Table VI. Observed and Predicted Population Proportions of Asset Owners

Choices	(1)	(2)	(3)		(4)	(5)	
	Data	Independent two-stage probits with selection			Multivariate probit with selection		
		Estimate	Std. Error		Estimate	Std. Error	
Directly owns any stocks, unconditional	0.192	0.214	0.004	***	0.213	0.005	***
Directly owns any bonds, unconditional	0.209	0.214	0.004	***	0.214	0.005	***
Has any liquid accounts, unconditional	0.903	0.903	0.003	***	0.904	0.003	***
Directly owns foreign stocks | directly owns any stocks	0.102	0.078	0.057	*	0.118	0.010	***
Directly owns foreign bonds | directly owns any bonds	0.007	0.088	0.181		0.011	0.004	***
Has foreign liquid accounts | has any liquid accounts	0.025	0.026	0.003	***	0.026	0.003	***
Directly owns any stocks | directly owns any bonds	0.359	0.214	0.004	***	0.402	0.012	***
Directly owns any bonds | directly owns any stocks	0.391	0.214	0.004	***	0.408	0.012	***
Directly owns foreign stocks | has foreign liquid accounts	0.055	0.017	0.012	*	0.064	0.020	***
Directly owns foreign bonds | directly owns foreign stocks	0.011	0.019	0.039		0.023	0.009	***
Has foreign liquid accounts | directly owns foreign stocks	0.064	0.024	0.003	***	0.067	0.020	***
Owns any foreign asset	0.042	0.057	0.040	*	0.048	0.004	***
Directly owns foreign stocks | owns any foreign asset	0.463	0.275	0.207	*	0.491	0.031	***
Directly owns foreign bonds | owns any foreign asset	0.032	0.195	0.211		0.045	0.012	***
Has foreign liquid accounts | owns any foreign asset	0.544	0.555	0.226	***	0.507	0.029	***

Notes: Estimates and standard errors account for multiple imputation in the SCF, using the results in Rubin (1987). ***, **, * denote significance at 1%, 5% and 10% respectively. P-values are derived from one-sided tests of significance.

Table VII. Average Marginal Effects – Stocks

Variables	(1)	(2)		(3)	(4)	(5)	(6)		(7)	(8)	
	Two-stage probit with selection					Multivariate probit with selection					
	Owns directly any stocks			Owns directly foreign stocks (conditional on directly owning any stocks)		Owns directly any stocks			Owns directly foreign stocks (conditional on directly owning any stocks)		
	Marg. Eff.	Std. Error		Marg. Eff.	Std. Error	Marg. Eff.	Std. Error		Marg. Eff.	Std. Error	
Age	0.001	0.000	***	0.001	0.001	0.001	0.000	***	0.001	0.000	**
High school graduate	0.080	0.009	***	0.019	0.026	0.082	0.009	***	0.033	0.027	
College degree or more	0.176	0.010	***	0.029	0.029	0.179	0.011	***	0.047	0.026	*
Married	0.048	0.008	***	-0.010	0.016	0.048	0.009	***	-0.014	0.015	
Single male	0.031	0.011	***	0.016	0.018	0.028	0.011	***	0.021	0.021	
Has children	-0.013	0.006	**	0.000	0.008	-0.014	0.006	**	0.000	0.009	
White	0.065	0.007	***	-0.011	0.019	0.067	0.007	***	-0.016	0.018	
Self-employed	0.001	0.006		0.009	0.011	0.001	0.007		0.000	0.003	
Retired	0.029	0.010	***	-0.006	0.013	0.027	0.011	***	-0.009	0.004	**
Unemployed/Inactive	0.033	0.018	*	0.008	0.025	0.031	0.017	*	-0.010	0.006	*
Poor health	-0.044	0.015	***	-0.006	0.028	-0.046	0.018	***	-0.014	0.027	
Uses Internet to obtain financial information	0.068	0.009	***	0.018	0.013	0.070	0.009	***	0.026	0.011	**
Asks Friends/Relatives/Work contacts for financial information	0.001	0.006		-0.016	0.014	0.002	0.006		-0.026	0.009	***
Extensively "shops around"	0.004	0.007		0.016	0.014	0.004	0.007		0.025	0.012	**
Expects US economy to do better	-0.002	0.006		0.003	0.008	-0.002	0.006		0.004	0.010	
Expects US economy to do worse	0.010	0.007		0.011	0.011	0.010	0.007		0.014	0.012	
Expects US interest rates to go higher	0.002	0.007		-0.001	0.008	0.002	0.006		-0.001	0.009	
Expects US interest rates to go lower	-0.005	0.012		0.014	0.019	-0.004	0.013		0.025	0.022	
Expects future income to rise faster than prices	0.019	0.007	***	0.007	0.009	0.018	0.007	***	0.008	0.009	
Expects future income to rise lower than prices	0.007	0.006		0.004	0.010	0.005	0.006		0.006	0.011	
Investment horizon > 10 yrs	0.024	0.007	***	0.015	0.012	0.025	0.008	***	0.021	0.009	**
Willingness to take above average financial risk	0.086	0.007	***	0.028	0.018	0.087	0.007	***	0.043	0.008	***
Non-investment income	0.006	0.001	***	-0.001	0.001	0.006	0.001	***	-0.002	0.001	
Net real wealth	0.022	0.001	***	0.006	0.005	0.022	0.002	***	0.010	0.002	***
Net financial wealth	0.006	0.000	***	0.002	0.002	0.006	0.000	***	0.003	0.001	***
Intention to leave a bequest	0.065	0.006	***	0.024	0.017	0.066	0.007	***	0.035	0.010	***
Has received inheritance	0.043	0.007	***	0.020	0.015	0.044	0.006	***	0.029	0.009	***
Credit constrained	-0.004	0.008		-0.019	0.019	-0.005	0.009		-0.027	0.016	*
Last year's income unexpectedly low	-0.012	0.008		0.015	0.017	-0.011	0.007		0.022	0.014	
Works/ed in the Financial Sector	0.041	0.007	***	0.001	0.008	0.042	0.007	***	0.000	0.009	
Year 1998	0.015	0.008	*	-0.006	0.011	0.015	0.008	*	-0.009	0.012	
Year 2001	0.012	0.008		-0.012	0.013	0.011	0.008		-0.016	0.012	
Year 2004	-0.001	0.008		-0.009	0.013	-0.001	0.008		-0.013	0.013	
Saves for "rainy days"	-0.009	0.006		-..-	-..-	-0.009	0.006		-..-	-..-	

Notes: Median semi-elasticities are shown for net investment income, and net financial and net real wealth, average marginal effects for the remaining covariates. Estimates and standard errors account for multiple imputation in the SCF, using the results in Rubin (1987). ***,**,* denote significance at 1%,5% and 10% respectively.

Table VIII. Average Marginal Effects – Bonds

Variables	(1)	(2)		(3)	(4)	(5)	(6)		(7)	(8)	
	Two-stage probit with selection					Multivariate probit with selection					
	Owns directly any bonds			Owns directly foreign bonds (conditional on directly owning any bonds)		Owns directly any bonds			Owns directly foreign bonds (conditional on directly owning any bonds)		
	Marg. Eff.	Std. Error		Marg. Eff.	Std. Error	Marg. Eff.	Std. Error		Marg. Eff.	Std. Error	
Age	0.000	0.000		0.001	0.002	0.000	0.000		0.000	0.000	
High school graduate	0.090	0.009	***	-0.021	0.060	0.090	0.009	***	-0.003	0.007	
College degree or more	0.138	0.010	***	-0.008	0.061	0.141	0.010	***	0.008	0.008	
Married	0.063	0.009	***	-0.013	0.030	0.063	0.008	***	0.000	0.005	
Single male	0.014	0.012		0.003	0.029	0.011	0.010		0.002	0.007	
Has children	0.093	0.007	***	-0.010	0.030	0.093	0.007	***	0.001	0.003	
White	0.100	0.007	***	-0.018	0.043	0.102	0.007	***	-0.001	0.006	
Self-employed	-0.039	0.007	***	0.010	0.023	-0.039	0.008	***	0.001	0.001	**
Retired	-0.007	0.010		-0.004	0.022	-0.006	0.010		0.000	0.000	
Unemployed/Inactive	-0.010	0.016		0.008	0.056	-0.012	0.016		0.000	0.001	
Poor health	-0.047	0.016	***	-..-	-..-	-0.045	0.015	***	-..-	-..-	
Uses Internet to obtain financial information	0.026	0.010	***	0.006	0.023	0.029	0.010	***	0.007	0.005	
Asks Friends/Relatives/Work contacts for financial information	0.015	0.006	**	-0.008	0.014	0.015	0.006	**	-0.003	0.003	
Extensively "shops around"	0.002	0.007		-0.001	0.016	0.003	0.007		0.000	0.003	
Expects US economy to do better	-0.006	0.007		0.007	0.014	-0.005	0.007		0.004	0.003	
Expects US economy to do worse	0.001	0.007		0.003	0.015	0.000	0.007		0.002	0.003	
Expects US interest rates to go higher	0.002	0.006		-0.004	0.014	0.002	0.007		-0.003	0.003	
Expects US interest rates to go lower	0.012	0.014		-0.007	0.029	0.012	0.013		-0.003	0.004	
Expects future income to rise faster than prices	-0.004	0.007		0.002	0.015	-0.004	0.007		0.001	0.003	
Expects future income to rise lower than prices	0.013	0.007	*	-0.004	0.016	0.013	0.007	*	-0.001	0.003	
Investment horizon > 10 yrs	0.028	0.008	***	-0.001	0.015	0.030	0.008	***	0.002	0.002	
Willingness to take above average financial risk	-0.001	0.007		-0.002	0.012	0.000	0.006		-0.002	0.002	
Non-investment income	0.003	0.001	*	-0.001	0.002	0.003	0.001	**	0.000	0.000	
Net real wealth	0.011	0.001	***	0.000	0.005	0.011	0.001	***	0.001	0.001	
Net financial wealth	0.006	0.000	***	0.000	0.007	0.006	0.000	***	0.001	0.001	
Intention to leave a bequest	0.049	0.006	***	0.001	0.022	0.051	0.007	***	0.005	0.003	
Has received inheritance	0.028	0.007	***	-0.007	0.015	0.028	0.007	***	-0.003	0.002	
Credit constrained	-0.020	0.008	**	-0.001	0.031	-0.020	0.009	**	-0.001	0.006	
Last year's income unexpectedly low	-0.022	0.008	***	0.011	0.019	-0.022	0.008	***	0.005	0.004	
Works/ed in the Financial Sector	0.008	0.007		0.001	0.012	0.009	0.007		0.001	0.002	
Year 1998	-0.040	0.008	***	-0.008	0.023	-0.040	0.008	***	-0.008	0.004	**
Year 2001	-0.082	0.009	***	0.000	0.034	-0.080	0.008	***	-0.008	0.004	*
Year 2004	-0.075	0.009	***	-0.005	0.032	-0.074	0.008	***	-0.009	0.004	**
Saves for "rainy days"	-0.004	0.005		-..-	-..-	-0.005	0.006		-..-	-..-	

Notes: Median semi-elasticities are shown for net investment income, and net financial and net real wealth, average marginal effects for the remaining covariates. Estimates and standard errors account for multiple imputation in the SCF, using the results in Rubin (1987). ***,**,* denote significance at 1%,5% and 10% respectively.

Table IX. Average Marginal Effects – Liquid Accounts

Variables	(1)	(2)		(3)	(4)		(5)	(6)		(7)	(8)	
	Two-stage probit with selection						Multivariate probit with selection					
	Has any liquid accounts			Has foreign liquid accounts (conditional on having any liquid accounts)			Has any liquid accounts			Has foreign liquid accounts (conditional on having any liquid accounts)		
	Marg. Eff.	Std. Error		Marg. Eff.	Std. Error		Marg. Eff.	Std. Error		Marg. Eff.	Std. Error	
Age	0.001	0.000	***	0.000	0.000		0.001	0.000	***	0.000	0.000	
High school graduate	0.094	0.009	***	0.002	0.005		0.093	0.008	***	0.000	0.005	
College degree or more	0.149	0.009	***	0.008	0.006		0.146	0.009	***	0.007	0.005	
Married	0.004	0.005		-0.002	0.004		0.003	0.005		-0.001	0.004	
Single male	-0.026	0.008	***	0.003	0.005		-0.025	0.008	***	0.003	0.005	
Has children	-0.010	0.005	**	-0.003	0.003		-0.009	0.005	**	-0.003	0.003	
White	0.059	0.006	***	-0.002	0.004		0.058	0.006	***	-0.003	0.004	
Self-employed	-0.002	0.007		-0.002	0.003		-0.002	0.007		0.000	0.000	
Retired	-0.029	0.009	***	-0.007	0.004	*	-0.028	0.008	***	0.000	0.000	
Unemployed/Inactive	-0.023	0.009	***	0.001	0.008		-0.023	0.009	**	0.000	0.000	
Poor health	-0.024	0.009	***	-0.004	0.007		-0.024	0.010	**	-0.004	0.007	
Uses Internet to obtain financial information	0.038	0.007	***	0.000	0.004		0.036	0.008	***	0.000	0.004	
Asks Friends/Relatives/Work contacts for financial information	0.003	0.004		0.001	0.003		0.003	0.004		0.001	0.003	
Extensively "shops around"	-0.003	0.006		-0.001	0.003		-0.003	0.006		-0.002	0.003	
Expects US economy to do better	0.000	0.005		0.001	0.003		-0.001	0.005		0.001	0.003	
Expects US economy to do worse	-0.023	0.005	***	0.002	0.003		-0.022	0.005	***	0.002	0.003	
Expects US interest rates to go higher	-0.007	0.005		-0.007	0.003	**	-0.007	0.005		-0.006	0.003	**
Expects US interest rates to go lower	-0.012	0.009		0.003	0.007		-0.011	0.010		0.004	0.006	
Expects future income to rise faster than prices	0.001	0.006		0.005	0.003		0.001	0.006		0.004	0.003	
Expects future income to rise lower than prices	0.012	0.005	**	0.001	0.003		0.013	0.005	***	0.000	0.003	
Investment horizon > 10 yrs	0.012	0.007		-0.001	0.003		0.012	0.007	*	-0.001	0.003	
Willingness to take above average financial risk	0.017	0.006	***	0.006	0.003	**	0.016	0.006	***	0.006	0.003	**
Non-investment income	0.004	0.000	***	0.000	0.000		0.004	0.000	***	0.000	0.001	
Net real wealth	0.004	0.000	***	0.001	0.000	**	0.005	0.000	***	0.001	0.000	*
Net financial wealth	0.000	0.000	***	0.000	0.000		0.000	0.000	***	0.000	0.000	
Intention to leave a bequest	0.020	0.005	***	-0.001	0.003		0.020	0.005	***	-0.001	0.003	
Has received inheritance	0.019	0.006	***	0.002	0.003		0.019	0.007	***	0.002	0.003	
Credit constrained	-0.014	0.005	***	-0.002	0.004		-0.015	0.005	***	-0.002	0.004	
Last year's income unexpectedly low	-0.018	0.006	***	0.002	0.004		-0.019	0.006	***	0.002	0.004	
Works/ed in the Financial Sector	0.015	0.006	***	0.005	0.003	*	0.014	0.006	**	0.005	0.003	*
Year 1998	0.023	0.006	***	0.001	0.003		0.023	0.006	***	0.001	0.003	
Year 2001	0.024	0.006	***	0.013	0.004	***	0.025	0.006	***	0.012	0.004	***
Year 2004	0.015	0.006	***	0.010	0.004	***	0.015	0.006	**	0.009	0.004	**
Saves for "rainy days"	0.023	0.004	***	-..-	-..-		0.022	0.004	***	-..-	-..-	

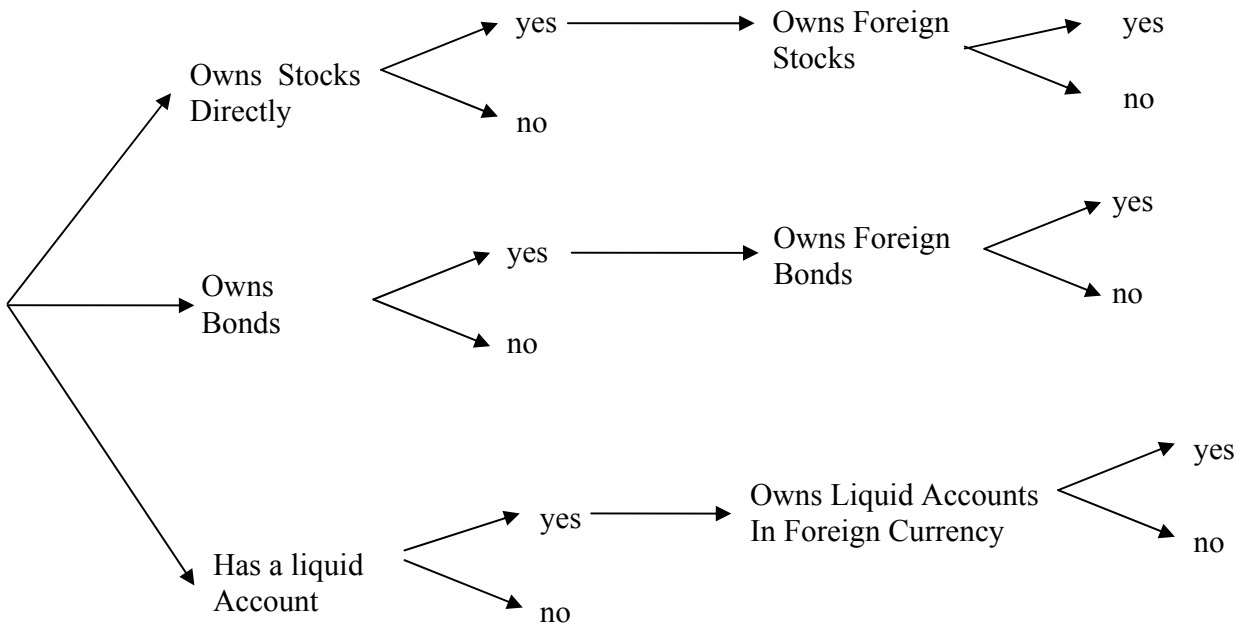
Notes: Median semi-elasticities are shown for net investment income, and net financial and net real wealth, average marginal effects for the remaining covariates. Estimates and standard errors account for multiple imputation in the SCF, using the results in Rubin (1987). ***,**,* denote significance at 1%,5% and 10% respectively.

Table X. Average Marginal Effects conditional on any Foreign Asset Ownership

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Holds directly foreign stocks conditional on holding any foreign asset		Holds directly foreign bonds conditional on holding any foreign asset		Has foreign liquid accounts conditional on holding any foreign asset	
	Marg. Eff.	Std. Error	Marg. Eff.	Std. Error	Marg. Eff.	Std. Error
Age	0.001	0.001	0.001	0.001	-0.001	0.001
High school graduate	0.168	0.073 **	-0.010	0.025	-0.148	0.064 **
College degree or more	0.203	0.072 ***	0.027	0.028	-0.202	0.066 ***
Married	0.021	0.037	0.009	0.016	-0.027	0.037
Single male	0.042	0.044	0.002	0.020	-0.037	0.045
Has children	-0.002	0.028	0.024	0.013 *	-0.020	0.026
White	0.045	0.039	0.014	0.017	-0.054	0.035
Self-employed	0.002	0.002	-0.002	0.001	-0.001	
Retired	0.006	0.007	0.000	0.001	-0.004	
Unemployed/Inactive	0.005	0.008	-0.001	0.001	-0.004	
Poor health	-0.043	0.080	-..-	-..-	0.027	0.070
Uses Internet to obtain financial information	0.089	0.031 ***	0.017	0.016	-0.095	0.033 ***
Asks Friends/Relatives/Work contacts for financial information	-0.051	0.028 *	-0.005	0.011	0.053	0.026 *
Extensively "shops around"	0.061	0.028 **	-0.005	0.010	-0.055	0.028 *
Expects US economy to do better	-0.005	0.029	0.012	0.012	-0.003	0.027
Expects US economy to do worse	0.019	0.030	0.003	0.012	-0.017	0.028
Expects US interest rates to go higher	0.046	0.023 *	-0.006	0.009	-0.045	0.025 *
Expects US interest rates to go lower	0.023	0.046	-0.014	0.015	-0.008	0.046
Expects future income to rise faster than prices	0.002	0.026	-0.004	0.010	0.006	0.027
Expects future income to rise lower than prices	0.015	0.029	-0.005	0.011	-0.010	0.028
Investment horizon > 10 yrs	0.064	0.026 **	0.006	0.010	-0.066	0.028 **
Willingness to take above average financial risk	0.114	0.026 ***	-0.025	0.009 ***	-0.080	0.023 ***
Non-investment income	0.003	0.005	-0.001	0.001	-0.002	0.004
Net real wealth	0.031	0.007 ***	0.001	0.002	-0.029	0.006 ***
Net financial wealth	0.006	0.003 **	0.004	0.003	-0.009	0.002 ***
Intention to leave a bequest	0.115	0.025 ***	0.016	0.013	-0.120	0.027 ***
Has received inheritance	0.080	0.025 ***	-0.018	0.008 **	-0.059	0.026 **
Credit constrained	-0.048	0.048	0.002	0.026	0.041	0.040
Last year's income unexpectedly low	0.014	0.031	0.011	0.015	-0.020	0.029
Works/ed in the Financial Sector	0.001	0.023	0.000	0.009	0.005	0.024
Year 1998	0.010	0.030	-0.044	0.016 ***	0.026	0.034
Year 2001	-0.077	0.031 **	-0.056	0.018 ***	0.129	0.033 ***
Year 2004	-0.060	0.034 *	-0.058	0.018 ***	0.112	0.036 ***

Notes: Median semi-elasticities are shown for net investment income, and net financial and net real wealth, average marginal effects for the remaining covariates. Estimates and standard errors account for multiple imputation in the SCF, using the results in Rubin (1987). ***,**,* denote significance at 1%,5% and 10% respectively.

Figure 1. Graphical Representation of the Model



Endnotes

[1] Baele *et al.*, 2007, while noting that the extent of the home bias has been decreasing due to globalization and regional integration, still find a large home bias in several countries.

[2] Most of the empirical literature on household portfolios is based on univariate models for a given asset without taking into account possible spillover effects to the other assets. Perraudin and Sorensen (2000) who simultaneously model demands for money accounts, stocks and bonds and Alessie *et al*. (2004) who simultaneously study stocks and mutual funds represent two notable exemptions.

[3] Questions on foreign asset investments are asked for the first time in 1992, but information on some of the covariates we use in our estimation is only available since 1995.

[4] Ameriks and Zeldes (2004) document widespread inactivity of households as regards changes to the share of stocks in either their retirement accumulation or in their flow contributions in retirement accounts over a ten-year period. On the other hand, Barber and Odean (2000) report that households who directly own stocks through a brokerage account tend to engage in excessive stock trading.

[5] None of the cross correlations among the dummies of being a college graduate, doing a great deal of shopping around, and working in the financial industry exceed .09 in the data, which implies that each of these three factors can play a quite distinct role as factors that influence investment choices.

[6] We control for income, net real and net financial wealth, which all have skewed distributions, by using the inverse hyperbolic sine transformation: $\log(x+(x^2+1)^{1/2})$, which allows for non linear effects and is defined for zero and negative values.

[7] French and Poterba (1991), Bohn and Tesar (1996), and Kilka and Weber (2000) argue that expectations about high returns in a particular market make investors to increase the share of their portfolios invested in stocks from that market.

[8] The discrepancy between coefficients and marginal affects can also occur in other multi-equation discrete choice models in which choices are inter-related (e.g. in multinomial logit/probit).

[9] Coefficient estimates from the three two-stage probit models are available upon request.

[10] In the simpler alternative estimation of three two-stage probits only the selection term in stocks is significant, and is even stronger than in the multivariate model (equal to 0.97).

[11] Replacing this summation with the sum of the three unconditional probabilities of owning foreign stocks, foreign bonds and foreign accounts would involve double counting of several asset combinations. In our calculations we always use the sum of probabilities of the relevant asset combinations in order to calculate probabilities of asset choices.

[12] We vary continuous variables by 1 in order to compute the associated marginal effects and calculate median semi-elasticities instead of average ones because computation of semi-elasticities requires multiplication of the marginal effect with the level of the financial variables that have very skewed distributions.

[13] Since this process is a simulation within the simulation of the multiple integrals (using the GHK simulator), a modest number of draws should probably suffice for obtaining reliable estimates (Train, 2003).

[14] We avoid evaluating probabilities or marginal effects at sample means/medians since this can lead to severely distorted results (see for instance Train, 2003, pp. 33-34).

[15] Alternatively one could calculate the standard error by bootstrap, but this requires estimating the model numerous times, which is impractical because estimation is quite time consuming, and furthermore has to be performed separately for each of the five implicate datasets.

[16] The good predictive performance of the multivariate probit is all the more notable given that maximization of its likelihood function does not lead to any automatic equality of actual proportions with average predicted probabilities, as is the case with a simple probit.

[17] In order to compute probabilities of choices spanning two or more of the three saving vehicles that are generated by the three independent two-stage probits, we do as follows: i) any probability of a choice in a given saving vehicle conditional on a choice in another is computed as equal to the unconditional (marginal) probability; ii) any joint probability of choices across different asset vehicles is computed as the product of the respective marginal probabilities.

[18] In those models, higher future income, although uncertain, implies a minimum guaranteed value of income at each future period that can serve as a surrogate riskless asset that is discounted by households, encouraging investment in stocks today.

[19] The SCF does not provide information on immigrant status, but to the extent that the immigrants are overrepresented in the group of non-whites it may be the case that they opt for investments in foreign stocks that relate to their country of origin, given the lower information costs that this option would involve. However, more information on immigrant status is needed to investigate this conjecture.

[20] Marginal effects are insignificant despite the fact that some regression coefficients of the second stage in the two-stage probit are significant. This divergence between coefficients and marginal effects is an illustration of the complications affecting probability calculations in nonlinear models with highly correlated disturbances (the correlation coefficient is equal to 0.97 and very significant). Marginal effects involve a change in a regressor that modifies the range of values of the disturbances in both stages for which any stockholding and foreign stockholding are undertaken. Since we are interested in the conditional probability of owning foreign stocks, the change in the range of the second stage error conditional on the change in the range of the first stage one is relatively small. This is so because: i) the support of the joint distribution of the two errors is very close to a straight line due to their very high correlation; ii) the conditional probability of owning foreign stocks is typically small and thus a change in a regressor affects it only modestly. Thus, the change in the probability of the conditional choice in the second stage ends up being small and statistically insignificant.

[21] We can not estimate the effect of bad health on foreign bonds, since bad health perfectly predicts lack of ownership.

[22] The conditional probability of owning foreign stocks conditional on owning any foreign asset is given in equation (19) above and the corresponding probabilities for foreign bonds and foreign accounts are computed in an analogous way.