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Ricciarelli, Matteo

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Investment Choice and Asset Allocation of Italian Households: the Discrete-Continuous Approach

Matteo Ricciarelli

Department of Economic and Institutions

University of Rome "Tor Vergata"

E-mail: m_ricciarelli@libero.it

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Abstract

Financial and monetary policies are considered to be effective depending on the reaction of financial markets which are increasingly populated by households. In this paper, from intertemporal settings, I derive a Financial Almost Ideal (FAI) Demand System and I estimate it by highlighting the determinants of both limited participation to financial markets and asset substitutability/complementarity in the allocating stage. Finally, the wealth elasticities provide some further insights on the low diffusion of the newer and more complex financial instruments across Italian households.

JEL Classification: G11; D91; C34

Keywords: Financial Almost Ideal Demand System; Household Participation; Portfolio Choice.

1 Introduction

Monetary and, in general, financial policies are thought to be effective depending on the reaction of investors who actually populate financial markets. In the last two decades, financial innovations, liberalizations of public companies and a broader financial information foster households entering financial markets, either directly or through intermediaries. Economists, practitioners and other researchers underpin the investigation of the investment choices on the well-known mean-variance approach due to Markowitz (1952) and on further generalizations due to Tobin (1958) and Sharpe (1964). Furthermore, Friedman (1956) argued that demand for money and, in general, for financial assets should obey to the axioms of consumer's choice. Recently, this framework has been considered as the basis for investigating the household allocating behaviour and, in particular, it represents the way to show how social and demographic variables heavily affect the demand for consumer goods (Bollino, Perali and Rossi, 2000). The fact that household behaviour may differ accordingly to some individual specific features is termed *heterogeneity* and is considered being the reason of mispredictions of portfolio theory applied to households. First, as summarized by Browning and Lusardi (1996), decisions concerning both the amount and the allocation of household savings can be driven by a huge set of motives; each of these motives can differently influence household allocating programs; second, households, usually examined such as homogeneous *black boxes*, present some heterogeneous features which interact with the motives leading savings behaviour and, in turn, complicate the analysis. Although the new generation of household portfolio models achieved more appealing results (see Guiso, Haliassos and Jappelli, 2001), *the gap between the theory and empirical result is still large* (McCarty, 2004) and, actually, several problems are still encountered in dealing with household portfolios. The modelling complexity is reflected in the fact that, even if they are intimately related, both theoretical and empirical works distinguish two aspects: household participation to financial markets, *i.e.* whether households have non-zero demand for certain assets and the allocating mechanism *i.e.* how households allocates their wealth to the subset of assets for which they present non-zero demand.

In this paper, I rest on the work by Perraudin and Sorensen (2000) and, given some properly specified preferences, I derive the asset demand embedded in an intertemporal set up. As previously outlined by Blundell, Browning and Meghir (1994), a static Almost Ideal (AI) demand system results from this framework and can be related to an intertemporal model under some assumptions on the stochastic process for the asset returns. Furthermore, since the parameters of the equations for the portfolio weights in Merton (1970) are functions of both asset features and investor preferences, the estimation of such a demand system is quite awkward and, hence, the Financial Almost Ideal (henceforth, FAI) demand system as derived in this paper may be thought as the empirical counterpart of the Consumption Capital Asset Pricing Model (henceforth, $CCAPM$) and is regarded as the continuous section of the model, whereas a multivariate sample-selection model is implemented to represent the discrete choice on whether households participate financial market or do not.

In this paper, I will progress as follows. In the first section, I will present both the stages of household portfolio formation in two subsection: in the former, a financial *Almost Ideal Demand System* is carried out, in the latter, this is associated with discrete choice model concerning household participation to different financial markets. In the second section, I will review the data sources. In the third section, I will deal with econometric methods which will be used for the estimation the model. In the fifth section, I will present estimating results. Finally, the sixth section concludes.

2 Setting up the household portfolio

Empirically household portfolios result from a decision process which is heavily influenced by several factors summarizing household heterogeneity. Furthermore, difficulties in defining several sources of heterogeneity determine the lack of theoretical benchmark as explanatory models for the household portfolio composition. It is realistic to distinguish household investment decision into two different stages: *i)* financial market participation, *i.e.* each household chooses whether she would enter certain financial markets that are suitable to pursue her own investment strategy, and *ii)* once a certain number of assets has been picked out, each household chooses the amount of wealth to be invested into the assets selected in step *i)*. Although these two stages are intimately related, many authors separately investigate household participation to certain forms of investments (Vissing-Jorgensen, 1999; Georgarakos, 2002) and the extent of asset holdings (Blake, 2003). In this section, I present an unified framework that allows for a joint investigation of both the aspects of household portfolio composition. For clarity reasons, I revert the exposition of the stages characterizing household investment decision.

2.1 The implicit demands for financial assets

In this subsection, I present the continuous part of the model, *i.e.* the part regarding the model for the extent of the holdings for each asset in the household portfolio. The material here collected massively refers to the classical demand theory whose adaptability to portfolio choice has been extensively stressed in the literature (among others, Epps, 1975; Sandmo, 1969; 1977). By generalizing the approach followed by Perraudin and Sorensen (2000), I carry out the Roy's equality from a model which is very similar to the Consumption Capital Asset Pricing Model (Merton, 1969). The method I present markedly differs from the one due to Samuelson (1969), who obtains a closed form for portfolio shares by imposing restrictions on the shape of utility function, the process of the labour income, the risk-free asset return and the infiniteness of the length of optimization horizon.

Assuming that generic household h is endowed with a continuous, twice differentiable and concave utility function, $u(c_{h,t})$, where $c_{h,t}$ represents the current consumption of non-durable goods, each household aims at maximizing her lifetime expected utility over a finite time horizon:

$$\max E_t \sum_{i=0}^{T-t} \frac{1}{(1+\beta)^i} u(c_{h,t+i}) \tag{1}$$

by choosing both the lifetime consumption plan $\{c_{h,t+i}\}_{i=0}^{T-t}$ and the fractions of wealth invested into the $N+1$ available assets $\left\{w_{h,t+i}^k\right\}_{i=0}^{T-t}$ for each $k = 0, ..., N$ [1].

The intertemporal maximization has to satisfy two constraints whose economic meaning is straightforward; the first describes the motion law for the household wealth

$$A_{h,t+i+1} = (A_{h,t+i} + y_{h,t+i} - c_{h,t+i}) \left[\sum_{k=0}^{N} \left(1 + r_{t+i+1}^k\right) w_{h,t}^k \right] \tag{2}$$

where $A_{h,t+i}$, $y_{h,t+i}$ and r_{t+i+1} denote, for generic household h, wealth, non-financial income and rate

[1] Several arguments may be called for justifying the presence of asset shares into utility function. Most of these argument refers to the so-called *motives approach* which regards financial assets as providers of transactional, precautionary or speculative services and, in turn, as yielding utility to their holders.

of return on the generic asset k, respectively. Both non-financial income and rates of return on each asset are assumed to be exogenous stochastic processes, with the exception of the process related to the non-risky asset, I say $k = 0$, which is not affected by uncertainty. Furthermore, I impose two technical conditions on household wealth: $A_t = \overline{A}$ with $\overline{A}$ given and $A_{T+1} \geqslant 0$[2]. The second constraint that households have to account for is given by:

$$\sum_{k=0}^{N} w_{h,t}^{k} = 1 \tag{3}$$

and represents the usual adding-up restriction on the portfolio shares.

In light of the technical conditions imposed over the household financial wealth, the value function for this problem takes on the following recursive shape:

$$V_t\left(A_t, \left\{\left(1+r_{t+1}^{k}\right)\right\}_{k=0}^{N}\right) = \max_{c_{h,t};\left\{w_{h,t}^{k}\right\}_{k=0}^{N}} u\left(c_{h,t}\right) + \frac{1}{1+\beta} E_t\left\{V_{t+1}\left(A_{h,t+1}\right)\right\} \tag{4}$$

By inserting 2 and 3 into the 4, I obtain the First Order Conditions:

$$\frac{\partial V_t\left(A_t, \left\{\left(1+r_{t+1}^{k}\right)\right\}_{k=0}^{N}\right)}{\partial c_{h,t}} = u'\left(c_{h,t}\right) - \frac{1}{1+\beta} E_t \left\{ \begin{array}{c} V'_{t+1}\left(A_{h,t+1}\right) \\ \left[\sum_{k=0}^{N}\left(1+r_{t+1}^{k}\right) w_{h,t}^{k}\right] \end{array} \right\} = 0 \tag{5}$$

$$\frac{\partial V_t\left(A_t, \left\{\left(1+r_{t+1}^{k}\right)\right\}_{k=0}^{N}\right)}{\partial w_{h,t}} = E_t\left\{V'_{t+1}\left(A_{h,t+1}\right)\left(r_{t+1}^{k} - r_{t+1}^{0}\right)\right\} = 0 \tag{6}$$

In order to obtain demands for risky assets which are implicit into this model, I compute the derivatives of the value function defined in 4 with respect to the state variables, i.e. household wealth $(A_{h,t})$ and compounded return $\left(1+r_{t+1}^{k}\right)$, and exploit the First Order Conditions 5 and 6. Hence, I get:

$$\frac{\partial V_t(A_{h,t}, \left\{\left(1+r_{t+1}^{k}\right)\right\}_{k=0}^{N})}{\partial A_{h,t}} = \frac{1+r_{t+1}^{0}}{1+\beta} E_t\left[V'_{t+1}\left(A_{h,t+1}\right)\right]$$

$$\begin{aligned} \frac{\partial V_t(A_{h,t}, \left\{\left(1+r_{t+1}^{k}\right)\right\}_{k=0}^{N})}{\partial\left(1+r_{t+1}^{k}\right)} &= \frac{1}{1+\beta} w_{h,t}^{k}\left(A_{h,t}+y_{h,t}-c_{h,t}\right) E_t\left[V'_{t+1}\left(A_{h,t+1}\right)\right] = \\ &= \frac{1}{1+\beta} A_{h,t}^{k} E_t\left[V'_{t+1}\left(A_{h,t+1}\right)\right] \quad for\ each\ k = 1, .., N \end{aligned}$$

[2] These technical requirements are necessary to ensure that the value function can be written with a recursive form.

$$\begin{aligned}
\frac{\partial V_t(A_{h,t}, \left\{ \left(1 + r_{t+1}^k\right) \right\}_{k=0}^N)}{\partial \left(1 + r_{t+1}^0\right)} &= \frac{1}{1+\beta} \left(1 - \sum_{k=1}^{N} w_{h,t}^k \right) \\
\left(A_{h,t} + y_{h,t} - c_{h,t}\right) E_t \left[V'_{t+1}\left(A_{h,t+1}\right)\right] &= \\
&= \frac{1}{1+\beta} A_{h,t}^0 E_t \left[V'_{t+1}\left(A_{h,t+1}\right)\right]
\end{aligned}$$

in which $A_{h,t}^k$ are the demand for the generic asset k. From the classical demand theory, a well-known result is that *marshallian demand* for a given commodity can be obtained from the Roy's equality whose analogous in the intertemporal framework is provided below:

$$\frac{\frac{\partial V_t(A_{h,t})}{\partial\left(1+r_{t+1}^k\right)}}{\frac{\partial V_t(A_{h,t})}{\partial A_{h,t}}} = \frac{A_{h,t}^k}{1 + r_{t+1}^0} \qquad for\ each\ k = 1, ..., N \tag{7}$$

$$\frac{\frac{\partial V_t(A_{h,t})}{\partial\left(1+r_{t+1}^0\right)}}{\frac{\partial V_t(A_{h,t})}{\partial A_{h,t}}} = \frac{A_{h,t}^0}{1 + r_{t+1}^0} \tag{8}$$

Once the form of the value function $V_t\left(A_{h,t}, \left\{ \left(1 + r_{t+1}^k\right) \right\}_{k=0}^N\right)$ has been specified, equations 7 and 8 are the means through which I can obtain implicit demand for all assets held by household h. As pointed out by Blundell, Browning and Meghir (1994), within-period allocation, such as the decision concerning wealth amounts to be invested in each available assets, is driven by period-specific utility function and is completely characterized by indirect utility function. Therefore, the intertemporal Value function can be written as below:

$$V_t(A_t, \left\{ \left(1 + r_{t+1}^k\right) \right\}_{k=0}^N) = \frac{1+\beta}{\beta} v(A_t, \left\{ \left(1 + r_{t+1}^k\right) \right\}_{k=0}^N) \tag{9}$$

where v represents the value function for standard within-period allocating program. Following Blundell (1988), I assume that within-period value function, v, belongs to the *PIGLOG* class and is given by:

$$v(A_t, \left\{ \left(1 + r_{t+1}^k\right) \right\}_{k=0}^N) = \frac{\ln A_t - \ln a(\left\{ \left(1 + r_{t+1}^k\right) \right\}_{k=0}^N)}{b(\left\{ \left(1 + r_{t+1}^k\right) \right\}_{k=0}^N)} \tag{10}$$

where, following Deaton and Muellbauer (1980) and recalling that $(1 + r_{t+1}^k)$, *i.e.* the expected compounded return of the asset k, can be also thought as expected asset price in analogy to commodity prices in the standard consumer theory[3], $a(\{(1+r^k_{t+1})\}^N_{k=0})$ and $b(\{(1+r^k_{t+1})\}^N_{k=0})$ are specified as follows:

$$\ln a(\{(1+r^k_{t+1})\}^N_{k=0}) = \alpha_0 + \sum_{k=0}^{N} \alpha_k \ln(1+r^k_{t+1}) + \frac{1}{2}\sum_{k=0}^{N}\sum_{j=0}^{N}\gamma_{kj}\ln(1+r^k_{t+1})\ln\left(1+r^j_{t+1}\right) \quad (11)$$

$$b(\{(1+r^k_{t+1})\}^N_{k=0}) = \sum_{k=0}^{N}\beta_k \ln(1+r^k_{t+1}) \quad (12)$$

Then, by inserting 10 into 9 and recalling 7-8, I carry out demand system expressed in terms of wealth shares invested in each financial asset. Given the functional form for the value function, I get the *Almost Ideal* (AI) Demand System whose generic share is given by:

$$w^k = \alpha_k + \sum_{j=0}^{N}\gamma_{kj}\ln\left(1+r^j_{t+1}\right) + \beta_k\left(\frac{A_t}{a(\{(1+r^k_{t+1})\}^N_{k=0})}\right) + \varepsilon^k_h \quad (13)$$

where $\varepsilon_{k,t}$ is an asset-specific error term summarizing measurement errors and unobservable variables affecting the amount invested in the *k-th* asset. It is worth noticing that each parameter of 13 is pre-multiplied by $(1+r^0_{t+1})$, *i.e.* the compounded return of risk-free asset. The specification resulting from equation 13 deserves some deepening comments. In particular, it looks like the one obtained by Merton (1973) with constant investment opportunity set and presumes that households undertake maximization plans "as if" they were facing with a static maximization problem. Technically, it is due to the two-state budgeting procedure on which the solution of the intertemporal problem has been underpinned and such a modeling choice may be consistent with some considerations on the nature of the distribution of the asset returns. If these are either completely random or time dependent in a non-stochastic fashion (*i.e.* they are perfectly predictable), the intertemporal separability of the individual preferences, namely the two-state budgeting, should be suitable to solve the intertemporal

[3]For instance, in Barr and Cuthberson (1991) and Dinenis and Scott (1993), the financial asset demand system is specified in terms of expected log-asset prices, *i.e.* $\ln R^k_{t+1} = \ln\left(\frac{1}{1+r^k_{t+1}}\right) = -\ln(1+r^k_{t+1})$. Hence, in a parameterization working with log-compounded returns, one may obtain economic interpretations in log-expected price terms by inverting the sign of the estimated coefficients.

allocation problem, otherwise equation 13 should include also the so-called *hedging demand* which is a mean to hedge against unfavourable shifts in the investment opportunity set. In this paper, under the efficient market hypothesis (Fama, 1970), prices, and in turn asset returns, are not predictable and the best forecasts one can do are based on the current realization of asset returns. This hypothesis theoretically ensures the suitability of equation 13 even for intertemporal settings.

In the econometric part of this work, equation 13 will be estimated for the N assets held in household portfolios. Indeed, one of the most common problem encountered in dealing with microeconomic surveys is the presence of zero-holdings and, as pointed out by Deaton and Irish, this represents an engaging challenge for classical demand theory. In order to account for zero-holding, I should adjust equation 13 on the basis of variables affecting participation to financial markets. In the next subsection, I will introduce participation model which will be integrated with the continuous part of the model in section four.

2.2 Modelling zero-holdings in household portfolios

Household limited participation to financial markets is a well-known research topic within the vast literature concerning household portfolio (Vissing-Jorgensen, 1999) and lies on the fact that *asset ownership is neither a permanent nor an exogenous state of affairs* (Attanasio, Banks and Tanner, 2002). Many attempts have been addressed to explain limited participation to financial markets which affects compositions of household portfolio across the more developed countries (see Guiso, Haliassos and Jappelli, 2002) and, although in the more recent years reforms of financial institutions, increased wealth and privatization of public companies favoured a widespread diffusion of several financial instruments, portfolios of broad groups of households are still characterized by zero-holdings. Several authors (among others Guiso and Jappelli, 2002) focus their attention on the determinants affecting the probability that households own financial assets. Many variables can be called for explaining the household participation to financial markets. Although the role played by participation and monitoring costs has been extensively stressed, recent empirical evidences pointed out that willingness to enter financial markets is positively related also to institutional factors such as investor's protection (Giannetti and Koskinen, 2004) and social interactions (Hong, Kubik and Stein, 2004).

In order to model the participation to financial markets, I introduce the multivariate sample selection model. In particular, participation equations are assumed to be *linear in the parameters* and are specified as follows:

$$P^k_{h,t} = \phi_h z_{h,t} + \eta_{h,t} \tag{14}$$

where $\phi_h, z_{h,t}$ and $\eta_{h,t}$ represent a vector of parameters, a conformable matrix containing household-specific variables and an error term, respectively. In this framework, $P^k_{h,t}$ may be regarded such as the desire of household h to invest into asset k and it is intended being a latent variable that affect whether share invested by household h into the generic asset k takes on positive values or it does not. In the section devoted to deal with econometric issues, I will show the way to associate multivariate participation system with demand system derived above.

To specify the choice model presented in equation 14, I refer to theoretical motives which lead household saving behaviour. Indeed, several reasons may be recalled to explain saving decisions (Browning and Lusardi, 1996) and these are mainly addressed to the investigation of the aggregate savings of households. However, most of the motives listed by Keynes (1936) may also govern allocating aspects of household saving decisions[4]. To further describe the variables included into $z_{h,t}$ I introduce a partition of such a matrix, *i.e.* $z_{h,t} = \left[z^1_{h,t}; z^2_{h,t}; z^3_{h,t}\right]$ where superscripts stem from a partition introduced for the sake of expository convenience.

In the first subset of variables $\left(z^1_{h,t}\right)$, I include those factors that can be related to life-cycle motive (Modigliani and Brumberg, 1954) and precautionary motive; in particular, measures of labour income jointly with some other proxies regarding the status of employment of household membership and the sector of activity are inserted to account for life-cycle effect, whereas the amount of wealth that each household believes to be necessary to save in order to face with adverse contingencies is a proxy for precautionary motive. The second $(z^2_{h,t})$ includes economic variables which do not enter equation 13, but effectively affect participation choice, e.g. demographic variables such as the number of children,

[4]Several examples may be provided to clarify this statement. For instance, the *bequest motive* can affect not only the saved amount, but also the composition of the household portfolio and the same can be claimed for the *precautionary* and *life-cycle motives*. However, the most striking example is clearly offered by the *improvement motive*: the gains from the invested wealth reflect the underlying portfolio allocation rather than the decisions on the amount to save.

the presence of retired individuals, the age of the household members, etc. All these household features are relevant in investment decision program of households. Indeed, Blundell, Browning and Meghir (1994) find out that demographics matter in either the intertemporal or the within-period allocation path, i.e. changes in demographic features affect both intertemporal pattern of household savings and intratemporal allocation of households. Finally, the third set $\left(z_{h,t}^{3}\right)$ includes variables which are directly or indirectly linked to the determination of fixed and monitoring costs. In particular, since monitoring costs appear to be related to subjective features rather than objectively identifiable factors, their quantification seems to require the inclusion of variables accounting for information disclosure and processing abilities. Indeed, given the asset typology, the former may be considered as constant across household, whereas the latter are much more related to household features and especially to variables concerning education of household membership.

3 Data

The data that I will use in this paper are provided by the Bank of Italy's Survey of Household Income and Wealth. Biannually the Bank of Italy collects information on demographics, income and both real and financial wealth of a large sample of households in order to monitor the status of income and wealth distribution in Italy. The most recent survey that I am going to use is carried out in 2002 and involves $8,011$ Italian households.

The Bank of Italy's Survey of Household Income and Wealth allows for an extremely detailed description of different forms of saving chosen by the households (page 112, Supplement to the Statistical Bulletin, no. 12, 2004). Specifically, several different financial products are grouped together into seven broad categories[5] according to a typological classification. In estimating equations (14) and (15), the sample that I will use covers $3,542$ households extracted from the Bank of Italy's Survey of Household Income and Wealth; this mismatch between the extent of the sample used in this paper and the original sample of the Bank of Italy's Survey is due to the fact that I take into account

[5]In particular, the household investment forms are articulated in: 1) Bank Deposits, Certificates of Deposits, Repos; 2) Post Office Deposits; 3) Italian Government Securities; 4) Bonds, Shares of Italian Mutual Funds; 5) Italian Shares; 6) Manged Savings; 7) Foreign Securities (issued by non-residents); and 8) Loans to Cooperatives.

some variables arising from the *first round*[6] and therefore I am enforced to filter all household affected by incomplete information out of sample. In dealing with household portfolios, a crucial issue is represented by aggregation criterion across different assets. In this paper, I adopt the following aggregating keys[7]: *a) bank and postal deposits*, including bank current account deposits, bank savings deposits and PO current account and deposit books; *b) Government securities and bonds*, including Italian Government securities (BOTs, CCTs, BTPs, CTZs and other) and Italian corporate bonds; *c) other assets*, including Italian shares, mutual fund shares, managed savings and foreign securities *i.e.* those issued by non-resident Governments, corporations et *al.*. The outlined re-classification avoids considering housing, and in general real estate investments, among different investment alternatives; even if, on one hand, the inclusion of real estate investment and in particular housing in household portfolios may be desirable to understand household choices concerning on the borrowing structure and short-run adjustments of financial assets due to the fact that housing represents an illiquid assets (among others, Pelizzon and Weber, 2003), on the other hand, the inclusion of housing among different investment alternative is foreshadowing for remarkable problems arising from the methodology adopted in quantifying the real estate values. In this paper, although home ownership is a widespread feature in the whole sample, I opt to model household portfolio as conditional to home ownership. The same modelling strategy is pursued with regard to other non-financial assets, such as human capital, which are modelled as portfolio share by some authors (Curcuru, Heaton, Lucas and Moore, 2004). Furthermore, the rationale of the proposed re-classification is thought as a distinction according to asset specific features, with proper attention to the nature of the cash flows arising from each asset: the first and second categories can roughly be considered as pure liquidity and fixed income assets, respectively, whereas, the third includes the variable income investment opportunities.

In order to estimate equation 13 that describes the allocating mechanism of households, a focal role is played by asset returns. The difficulty encountered in dealing with asset returns is twofold.

[6] The *first round* is a subsection of the survey that is exclusively addressed to note down peculiar aspects of households' economics and that involves only a random subsample of the households.

[7] The re-classification that I propose neglects the loans to cooperatives which represent an insufficiently widespread investment alternative and *other bank and postal products*, including certificates of deposits, repos and PO savings certificates which are held sporadically in the household portfolios.

First, according to what has been shown in the theoretical part of this paper, allocating mechanism should depend on expected returns. However, the extraction of expectations on asset returns from survey data is really an harsh task, since it entails to account for heterogeneity even in the expectation shaping mechanism. Second, apart from dividends and coupon payments, returns materialize only when asset will be liquidated, whereas for less complex assets, such as bank and postal deposits, returns are directly recorded in the Survey[8]. However, as the complexity of investment increases, measuring returns becomes an extremely akward task. For instance, Government securities and bonds generally have return that is made up of a stream of coupon payments and a price gain if households decide to sell the bonds before their maturity; in the same way, the return of other asset is provided by dividends and capital gain that is known only when the household liquidates her position. In the Bank of Italy's Survey of Household Income and Wealth, effective return is noted down for those assets which have been sold by the household during 2002 (see questions *C42*, *C43*, *C44*, *C45*), while for the assets currently held by the households, *i.e.* those which are held at the date of the interview, theoretical gains are reported[9]. By this way, following Pelizzon and Weber (2003), I assume that dividends and coupon payments earned by the households during 2002 are immediately reinvested[10] and, in turn, asset returns coincide with the capital gains, which are directly recorded by the Bank of Italy's Survey in the questions *C42-C48* (see the Supplements to the Statistical Bulletin, page 113). Moreover, since gains or losses reported by investors should accrue in different time horizons, they have to be standardized in order to allow cross comparisons. In the aforementioned questions, information allowing for retrieving investment durations is provided and this is used to compute annual return of both Government securities and bonds and other assets.

In the next section, after presenting econometric specification, I deal with econometric techniques

[8] In the Survey, the only rate earned on bank deposits is reported. This is assumed to be the rate of the aggregate bank and postal deposits.

[9] In particular, theoretical gain is defined as the gain obtained from selling the asset at the end of 2002 (see questions *C46*, *C47*, *C48*, *C49*).

[10] Even if such a way to quantify asset returns may penalize those assets which provide the investors with systematic stream of payments, it represents, however, an immediate measuring of financial gains/losses arising from the survey.

Alternative ways to avoid such assumption is to find out a reasonable relationship that can be used to charge the bulk of interests, coupons and dividends to the corresponding asset returns.

which will be employed to estimate equations 13 and 14.

4 Econometric Specifications and Estimating Procedure

In the recent years, following the developments of single equation models for censored dependent variable (Blaylock and Blisard, 1992), several authors (among others, Perali and Chavas, 2000; Yen, 2005) have attempted to carry out econometric estimators for censored demand systems. Indeed, these efforts are deeply motivated by either economic or econometric reasons. In the former sense, censored dependent variable, i.e. the zero-holding case, is the result of a choice that needs to be explained, whereas, in the latter, statistical methods, which avoid considering such a censoring, yield biased and inconsistent estimates. The most general way to estimate censored demand system is provided by multivariate sample selection model, MSSM, (Yen, 2005).

On the basis of equations 13 and 14, I assume that 6×1 vector of error terms $\zeta = [\varepsilon'_{4\times1}, \eta'_{4\times1}]$ has a multivariate normal distribution with zero mean and variance-covariance matrix given by:

$$\Sigma = E(\zeta_h, \zeta_l) = \begin{cases} \begin{bmatrix} \Sigma_{\varepsilon\varepsilon} & \Sigma_{\varepsilon\eta} \\ \Sigma_{\eta\varepsilon} & I_4 \end{bmatrix} & , \quad for\ h = l \\ 0 & , \quad otherwise \end{cases}$$

where $\Sigma_{\varepsilon\varepsilon}$ is an unrestricted positive-definite 3×3 matrix, I_4 is the 3×3 identity matrix, whereas $\Sigma_{\eta\varepsilon}$ is a 3×3 diagonal matrix whose generic element is ξ_i. Therefore, this variance-covariance structure entails that: *i)* correlation among allocated shares is allowed; *ii)* correlation is allowed between each participation decision and the corresponding allocation equation, whereas it is neglected between the participation equation of a certain asset, I say j, and the allocation equation for another asset, I say k and *iii)* orthogonality is assumed among the errors of the participation equations[11]. Certainly, one may argue that implication *iii)* may be too binding and that it could be circumvented by modelling participation system through the means of multinomial probit (MacFadden, 1984). Undoubtedly, multinomial probit can provide more general framework allowing for different correlation patterns, but, disregarding

[11] Dependence among partecipation decisions are neglected in the two-step estimator of Yen, Kan and Su (2002), where $\Sigma_{\eta\eta} = I_4$ entails that system of partecipation equations can be estimated by four different univariate probits.

the burden of both numerical integration and maximization algorithms which often lead to a collapse of the models, the effective benefits obtained from this modelling strategy are drastically constrained by the necessity of imposing some identification restrictions on variance-covariance matrix[12]. Hence, three arguments may be consistent with the variance-covariance structure that I have assumed above: *i)* the lack of theoretical rules and non-uniqueness of identifying restrictions reduce the problem to an arbitrary choice, *i.e.* to obtain different variance-covariance matrixes consistent with the estimates; *ii)* even if an appropriate set of identification restrictions has been found, it can land inappropriate curvature to the likelihood function and, in turn, prevent numerical maximization algorithms from successfully working; and, *iii)* in systems considering few alternatives (e.g. for $J = 2, 3, 4$), the maximum number of identified parameters equals about the number of the parameters which can be estimated from the variance-covariance matrix that I have assumed; moreover, most of the information of the off-diagonal covariance structure may be obtained from demand system [13]. Therefore, parameter estimates of participation equation is carried out from estimating equation-by-equation through a simple probit model.

Following Yen, Kan and Su (2002), by equation 13, I carry out the expected value for w^k conditioned on the fact that a positive observation occurs and then, after some manipulations, I can get the following equation:

$$w_h^k = \alpha_k + \sum_{j=1}^{3} \gamma_{jk} \ln\left(1 + r_{t+1}^j\right) + \beta_k \ln\left(\frac{A_h}{P_h^*}\right) + \xi_k \frac{f\left(\widehat{\phi_h^k} z_h\right)}{F\left(\widehat{\phi_h^k} z_h\right)} + \varepsilon_h^k \tag{15}$$

for each $k = 1, ..., 3$. It represents the *augmented system* (equation 15) which, following Deaton and Muellbauer (1980) and by making use of the analogous of the Stone index $\ln P^* = \sum_{k=1}^{N} w^k \ln\left(1 + r_t^k\right)$, can be estimated through *Seemingly Uncorrelated Regression* (*SUR*).

Social and demographic features potentially affecting the allocating stage of this model are included as *demand shifters:* hence, the intercepts of the allocating system are modelled in this fashion:

[12] For instance, in multinomial probit with J alternatives, the number of the parameters contained in the unrestricted variance-covariance matrix is given by: $\frac{J(J+1)}{2}$, while the maximum number of identified variance-covariance parameters is given by: $\frac{J(J-1)}{2} - 1$.

[13] For an exhaustive survey on this topic, see Bunch and Kitamura (1991).

$$\alpha_k = \delta_k + \lambda_k z_k$$

in which δ_k, λ_k and z_k are the true intercept of the model, a conformable vector of parameters to be estimated and a matrix of social and demographic features affecting the allocation, respectively. Since the presence of $\xi_{ii} \frac{f\left(\widehat{\phi_h^k} z_h\right)}{F\left(\widehat{\phi_h^k} z_h\right)}$ blights the possibility of imposing adding-up restrictions by estimating the demand system for *n-1* shares and, consequently, retrieving the *n-th*, I am enforced to estimate the demand system for all investment opportunities and to test:

$$Adding\ up: \sum_{k=1}^{3} \alpha_k = 1, \sum_{k=1}^{3} \gamma_{jk} = 0, \sum_{k=1}^{3} \beta_k = 0, \sum_{k=1}^{3} \xi_k = 0$$

$$Symmetry: \gamma_{jk} = \gamma_{kj}$$

In the estimates obtained by imposing these restrictions, homogeneity, *i.e.* $\sum_{j=1}^{3} \gamma_{jk} = 0$, is automatically imposed.

In the next section, I will show the econometric results which are obtained by putting into action the two-step estimator outlined in this section and I interpret economic implications.

5 The Econometric Results

In this section, I am going to present the results carried out from estimation of the model. The analysis will be framed into two parts: the first concerns brief comments on participation equations, while, the second is focused on demand system with special attention on the tests of demand theory and on the relationships among different assets.

The estimates of the participation system displayed in table 1 exhibit a deep coherence with the theoretical underlying relationships. Indeed, social, geographic and other economic variables approximating the household economic status matter in driving household participation to different financial markets. In particular, it is worth noticing that education degree (*schooling*), dwelling place (*dwelling macroarea*) and age are coherent with the descriptive analysis carried out in the third section. With the exception of bank and postal deposits which can be regarded as pure liquidity, the effect exerted by the education is increasing in the complexity of the assets themselves. Furthermore, dwelling place negatively affect the diffusion of assets and also this pattern is increasing in the asset complexity, while it is not statistically significant in the participation equation for bank and postal deposits. Finally, with regard to the age, the bell-shaped pattern is statistically testified and may be due to the combination of a wealth effect, *i.e.* the availability of increasing wealth to be invested, and the aversion to pursue risky investment strategies documented for the older individuals.

Turning the attention on allocating behaviour, the estimates of the demand system with adding-up and symmetry imposed are shown in table 2. The rejection of demand theory recorded in this paper falls in line with the conclusions of several papers (Barr and Cuthbertson, 1991; Blake, 2003) in which this setting is employed to investigate the short-run allocating behaviour. However, if I focus on those households holding complete portfolios, the restrictions of the demand theory are statistically non rejected[14]. Before reviewing the complementarity/substitutability among different assets, I test the separability between asset selection and allocating choice. The null-hypothesis that, in equation **??**, $\xi_k = 0$ for $k = 1, 2, 3$ is statistically rejected, $\chi^2(3) = 806.18$ ($p - value = 0.0000$), and it entails that participation and allocation stages cannot be separated from neither theoretical or empirical standpoints.

In order to assess the complementarity-substitutability among assets, I obtain the elasticities from the demand system estimates after imposing adding-up and symmetry. As displayed in table 3, the demands for bank and postal deposits and stocks and other assets are both elastic with respect to their own returns, whereas the fraction of wealth invested into Government securities and bonds is not significantly related to their own return, highlighting that reasons why investors hold this asset category lie on the certainty of embedded payoffs rather than on the yields they provide. This evidence may be hence summarized by the existence of a *convenience yield* which underlies the persistence of consistent amounts invested into these financial instruments, despite their returns have been substantially cut with the convergence toward the European Monetary Union.

With regard to the cross-return elasticities, I find that Government securities and bonds substitute bank and postal deposits, whereas I record a non-significant substitution pattern between stocks and

[14] Jointly testing the adding-up and symmetry yields: $\chi^2(9) = 6.68$ ($p - value : 0.67$).

other assets and bank and postal deposits. On the other hand, they complement Government securities and bonds, documenting that capital gains arising from one investment opportunity may positively affect the amount of wealth invested into the other financial instruments.

With regard to the wealth effects, all the three asset categories are termed as superior assets, since their demands increase as invested financial wealth grows up. However, if I refer to the services provided by different investment opportunities, I can parallel the notions of necessity and luxury goods in the consumer analysis by considering the wealth elasticities of each asset. To this end, in the bottom-right panel of table 3, I test the null-hypothesis of unitary wealth elasticities and I find out that both bank and postal deposits and Government securities and bonds are wealth-necessities, since they wealth elasticities are less than the unity, while the remaining asset category (*i.e.* stocks and other assets), exhibiting a wealth elasticity greater than one, can be regarded as a wealth-luxury. The explanatory power of these evidences is twofold: firstly, they testify that marked preferences for holding larger fraction of wealth invested into deposits and Government bonds are due to the services they provide, *i.e.* the transaction services embedded in the liquidity and the reserve of capital guaranteed by both the investment opportunities I am considering; secondly, the fact that stocks and, in general, the holdings of newer and more complex assets are thought as luxuries may account for the low diffusion of these financial instruments across the Italian households.

6 Concluding Comments

Traditional approach to portfolio theory is based on mean-variance criterion. Although it represented the bridge between portfolio choice and microeconomics, it often fails in accounting for low diversification and exogenous variables, such as age, wealth, education and dwelling place, which hardly affect household microeconomic behaviour. Limited applicability of such a theory to economic operators (households), who widely differ one from another, starkly undermines the possibility of evaluating effects of both financial and monetary policies which work conditionally on market agents' reactions. Neoclassical demand theory is commonly regarded as sound guideline for investigating individual allocating behaviour and providing insight on substitutability/complementarity among different assets and, due to the fact that, in general, most of microeconomic choices is taken conditionally on exogenous features, several authors delve into methodologies accounting for heterogeneity (among others, Bollino, Perali and Rossi, 2000). Moreover, the assessment that mispredictions of portfolio theory can be blamed to the fact that *these frameworks do model the decision to hold equities separately from the decisions about how many equities to hold* (McCarthy, 2004) parallels the Deaton and Irish (1984) claim concerning the relevance of zero-holding in demand theory and the attention recently focused on the determinants of the household participation to markets. All these motives, jointly with the original intuition of Friedman (1956), who, before the diffusion of demand systems, proposed to subject demand for financial assets to the axioms of consumer's choice, give a significant boost to develop portfolio models from neoclassical consumer theory (Barr and Cuthbertson, 1991; Blake, 2003).

This interest parallels the blooming literature on limited financial market participation (Vissing-Jorgensen, 1999) as candidate for explaining poorly-diversified portfolios. However, despite allocation and participation can be regarded such as two faces of the same coin, very few papers attempted to jointly model these two sides of microeconomic behaviour (Perraudin and Sorensen, 2000) and to test their linkage. In this paper, I present a unified framework that is used to jointly model financial market participation and allocation of Italian household wealth. In the first part, I clarify a notion that is implicit in Blundell, Browning and Meghir (1994): in an intertemporal setting, the optimal lifetime allocation is fully characterized by within-period indirect utility function under both perfectly predictable or totally unpredictable asset returns. Due to this claim, by assuming a *PIGLOG* indirect utility function and using the analogous of the Roy's identity, Financial Almost Ideal (*FAI*) demand system can be obtained (Blake, 2003) and may represent a well-behaved empirical counterpart of the financial demand system as originally derived by Merton (1970). In the second part, *FAI* demand system is plugged into multivariate sample-selection model (Yen, 2005). Specifically, I propose a two-step model which can provide estimates of both participation decisions and allocating mechanism accordingly to what shown by Yen, Kan and Su (2002).

From the estimates of three disjointed probit equations, I conclude that, as previously shown by descriptive statistics, age, education degree, dwelling place and total wealth play relevant roles in determining household participation to financial markets, even if their roles are different depending on the specific asset features. On the allocating side, the estimated demand system provides three evidences. Firstly, in the modelling strategy, the claim on the non-separability of the allocating stage from the participation is statistically supported. Secondly, the returns of both bank and postal deposits and stocks and other assets affect the corresponding portfolio weights, while the amounts invested into Government securities and bonds seem to be related to other economic issues such as the payoff certainty, rather than the asset return. Thirdly, the wealth effects can provide useful evidences which can account for the different diffusion of financial instruments within Italian household portfolios. Indeed, deposits and Government securities are perceived as necessities, due to the financial facilities they offer to the investors, whereas the bulk containing stocks and other newer and more complex investment opportunities can be termed as wealth-luxury and is, in turn, affordable only to the wealthiest investors who may fully exploit the financial benefits arising from these financial instruments.

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8 Appendix: Obtaining the Elasticities

Following Blake (2003), I carry out the uncompensated elasticities for the Financial Almost Ideal Demand System reported in equation (20). The uncompensated elasticities of demand for the *i-th* financial asset with respect to the invested wealth (E_{iA}) is:

$$E_{iA} = \frac{\beta_i}{w^i} + 1 \tag{A.1}$$

whereas, uncompensated return elasticities (E_{ii}) and uncompensated cross-return elasticities (E_{ij}) are given by:

$$E_{ij} = \frac{\gamma_{ij}}{w^i} + \delta_{ij} \tag{A.2}$$

where, δ_{ij} is the Kronecker delta which equals one for $i = j$ and zero otherwise. By paralleling the results obtained through the Slutzky equation, I get the compensated elasticities $\left(\overline{E}_{ij}\right)$:

$$\overline{E}_{ij} = E_{ij} + E_{iA} w^j \tag{A.3}$$

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Table 1 - Estimates of Participation System

	Bank & PO Deposits	*Gov. Sec.& Bonds*	*Stocks & Other Assets*
	ϕ^1	ϕ^2	ϕ^3
Constant	$-.6023084$ (.5114709)	-3.119793^* (.4652052)	-2.405478^* (.4397136)
Schooling	$.3641866^*$ (.0324767)	$.1660599^*$ (.0179612)	$.2555783^*$ (.0180858)
Age	$.0519657^*$ (.0154154)	$.0637791^*$ (.0156399)	$.0443534^*$ (.0151478)
Age^2	$-.0004251^*$ (.0001275)	$-.0004913^*$ (.0001336)	$-.0004258^*$ (.0001343)
Dwelling Macroarea	$.0083582$ (.1011184)	-0.23739^{**} (0.02264)	$-.2306564^*$ (.0711871)
Dwelling Town Dim.	$-.0551363^{***}$ (0342797)	$-.1765263$ (.0718056)	$-.1021202^*$ (.0290994)
Region	$-.071641^*$ (.023338)	$-.0144115$ (.0167846)	$-.0077256$ (.016669)
Employment Status	$-.1279007^{**}$ (.0600238)	$.0816708^{***}$ (.0469464)	$.1388259^*$ (.0459836)
Precautionary Savings	$1.92E-06^*$ ($6.93E-07$)	$1.70E-06^*$ ($2.91E-07$)	$1.81E-06^*$ ($2.96E-07$)
Sex	$-.0579702$ (.0717744)	$-.1750668^*$ (.0620205)	$-.2815744^*$ (.0624547)
Components	$-.1157175^*$ (.034133)	$-.0608213^{***}$ (.0318194)	$-.0570577^{***}$ (.0305616)
Income Receivers	$.4038899^*$ (.0587862)	$.1471477^*$ (.0432108)	$.1663745^*$ (.0421689)
Labour Income	$.0000144$ ($5.56E-06$)	$6.57E-06^*$ ($2.48E-06$)	$.0000119^*$ ($2.55E-06$)
Likelihood	-1005.389	-1238.007	-1351.548
Correct Predictions (%)	88.4	84.16	81.9

NOTES: * denotes 1% statistically significant coefficients;
** denotes 5% statistically significant coefficients;
*** denotes 10% statistically significant coefficients.
Standard errors in parentheses.

Table 2 - The Augmented Financial Almost Ideal Demand System

	Bank & PODeposits (i=1)	*Goverment Bonds* (i=2)	*Stocks & OtherAssets* (i=3)
α_i	$.939959^{*}$ (.087132)	$-.885569^{*}$ (.093563)	$.945609^{*}$ (.091277)
γ_{i1}	$.460680^{*}$ (.125498)	$-.102118$ (.105954)	$-.358561^{*}$ (.088024)
γ_{i2}	$-.102118$ (.105954)	$.034363$ (.100076)	$.067755^{***}$ (.035285)
γ_{i3}	$-.358561^{*}$ (.088024)	$.067755^{***}$ (.035285)	$.290806^{*}$ (.073030)
β_i	$-.804244E-02^{*}$ (.157147$E-$02)	$-.205446E-02^{**}$ (.104129$E-$02)	$.010097^{*}$ (.103879$E-$02)
ξ_i	$.260225^{*}$ (.023818)	$.260225^{*}$ (.023818)	$-.391648^{*}$ (.025642)
Precautionary	$-.335497E-06^{*}$ (.699908$E-$07)	$.522976E-06^{*}$ (.538697$E-$07)	$-.187478E-06^{*}$ (.729527$E-$07)
Components	$.157101E-02$ (.605737$E-$02)	$-.017709^{*}$ (.415274$E-$02)	$.016138^{*}$ (.418693$E-$02)
Sex	$.953060E-02$ (.012494)	$-.064308^{*}$ (.899334$E-$02)	$.054777^{*}$ (.010669)
Schooling	$.338549E-02$ (.421599$E-$02)	$.048342^{*}$ (.432857$E-$02)	$-.051728^{*}$ (.626546$E-$02)
Region	$-.555131E-02$ (.363765$E-$02)	$-.354617E-02$ (.241520$E-$02)	$.909748E-02^{*}$ (.271748$E-$02)
Age	$-.753989E-02^{*}$ (.283591$E-$02)	$.018182^{*}$ (.219669$E-$02)	$-.010642^{*}$ (.206298$E-$02)
Age^2	$.384119E-04$ (.242327$E-$04)	$-.143186E-03^{*}$ (.184958$E-$04)	$.104774E-03^{*}$ (.182859$E-$04)
Dwelling Macroarea	$.029562^{***}$ (.015659)	$-.053742^{*}$ (.010859)	$.024180^{***}$ (.012840)
Dwelling Town Dim.	$-.916466E-02$ (.598257$E-$02)	$-.933181E-02^{**}$ (.400907$E-$02)	$.018496^{*}$ (.479625$E-$02)
Employment Status	$-.020454^{**}$ (.950313$E-$02)	$.036345^{*}$ (.645137$E-$02)	$-.015891^{**}$ (.737139$E-$02)
Income Receivers	$.027811^{*}$ (.892864$E-$02)	$.031940^{*}$ (.658186$E-$02)	$-.059750^{*}$ (.768372$E-$02)
Labour Income	$-.126501E-05^{**}$ (.570158$E-$06)	$.219011E-05^{*}$ (.395192$E-$06)	$-.925101E-06^{***}$ (.552235$E-$06)
Obs.	3542	3542	3542
R^2	0.2847	0.1048	0.3002
Chi-test	1404.25 (0.000)	417.12 (0.000)	1501.67 (0.000)

NOTES: * denotes 1% statistically significant coefficients.
** denotes 5% statistically significant coefficients.
*** denotes 10% statistically significant coefficients.
Robust-White standard errors in parentheses.

Table 3 - The Elasticities

	Elasticities	
	Uncompensated	*Compensated*
Own Return		
E_{11}	1.73264* (.241608)	2.35339* (.241380)
E_{22}	1.41137 (1.21716)	1.49285 (1.21735)
E_{33}	3.39572* (.601638)	3.52721* (.601722)
Cross Elasticities		
E_{12}	−.162404* (.172484)	−.079939 (.172511)
E_{13}	−.570240 (.139989)	−.450407* (.140018)
E_{23}	.811106*** (.422406)	.929506** (.422469)
Wealth Elasticities		$H_0 : E_{iA} = 1, H_1 : E_{iA} \neq 1$
E_{1A}	.987210* (.216553E−02)	$t - stat$: 5.91 (0.000)
E_{2A}	.975406* (.011914)	$t - stat$: 2.07 (0.040)
E_{3A}	1.08318* (.855780E−02)	$t - stat$: 9.72 (0.000)

NOTES: * denotes 1% statistically significant coefficients.
** denotes 5% statistically significant coefficients.
*** denotes 10% statistically significant coefficients.
Standard errors, in parentheses, are carried out through the Delta method.