**Università degli Studi di Modena e Reggio Emilia**
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# Materiali di discussione

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# The Introduction of a Private Wealth Module in CAPP_DYN: an Overview

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# The Introduction of a Private Wealth Module in CAPP_DYN: an Overview

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***Abstract***

We describe and discuss the integration in the dynamic micro simulation model CAPP_DYN of a new module in which household's savings and asset allocation are modelled. In particular, our efforts are addressed at accounting for some possible behavioural change in household savings within a framework which remains mainly probabilistic. To this end, our strategy has been that of adopting the traditional stochastic micro simulation approach for assets allocation, while approximating a structural framework for estimating consumption/saving behaviour. Our framework has been inspired from a basic version of the life cycle hypothesis as formulated in Ando and Nicoletti Altimari (2004). In fact, we emphasize the role of life cycle economic resources in households consumption decisions, yet we further modify their empirical model in order to account for internal habit formation and subjective expectations on pension outcomes in the econometric stage. Moreover, among the several probabilistic processes we introduce in the simulation program and present in this paper, we conceive the modelling of intergenerational transfers of private wealth as an original contribution to the existing micro simulation literature.

JEL Classification: D31, D12, D91, C23, H55, J11

Keywords: Microsimulation, Household consumption, income and wealth distribution, intergenerational transfers, social security.

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## *1. Introduction*

In micro simulation literature a limited number of models are provided with a module aimed at analyzing and projecting the evolution of private wealth along time[5]. Indeed, introducing a wealth module in a dynamic micro simulation model implies undoubtedly advantages, yet it entails some significant drawbacks. On the one hand, in fact, the modelling of wealth permits researchers to draw a more complete picture of disposable income dynamics (i.e. labour plus capital income components) and of households' well-being distribution, allowing also to analyze the future redistributive effects of reforms which are going to affect - as expected in Italy – both public and private pension pillars. On the other hand, however, it increases significantly the complexity of the model, explicitly arising the debated question of the choice between a mechanical and a behavioural approach.

The traditional one, called also 'probabilistic', assumes relations estimated (through reduced forms) on data to be structurally stable over a period of about 50 years. To our knowledge, existing models – especially population based - including a wealth module have mainly relied on an arithmetical-probabilistic approach, providing a deterministic representation of household decisions such as transmission, accumulation and decumulation of financial and real wealth, though enriched with several stochastic processes in order to account for heterogeneity and uncertainty in the dynamic simulation of all variables. In particular, some processes are modeled by means of reduced forms estimated on information from panel data surveys[6] - or administrative panel datasets matched with surveys[7] - sufficiently long to estimate steady relations for the accumulation and spend-down of the main private assets, with no explicit modeling of household consumption decisions[8] and mainly focusing on first round budgetary and distributional effects of possible policy change.

Differently, the 'structural dynamic' approach models economic variables as a solution of a utility maximization problem subject to constraints given by the institutional framework or policy, trying to represent second round (behavioural) effects, which could either strengthen or offset the first order impact of reforms depending on the nature of responses. In this second scheme, a value function characterised by uncertainty in one or more arguments is maximized, and the solution is derived by *backward recursion* under dynamic programming. Therefore, the researcher attempts to estimate the "deep" underlying preferences, which are assumed to be stable in the long run. However, in large-scale dynamic cross-sectional models the structural part (when does exist) does not involve all the simulated processes but, usually, integrates as an input, with many other probabilistic processes (see, for instance, Harris, Sabelhaus and Sevilla-Sanz, 2005).

[5] PENSIM2 in Great Britain, MINT3 in the United States or SESIM III in Sweden are some of the most relevant examples.
[6] FRS and BHPS for Pensim2, PSID and SIPP for MINT3.
[7] LINDA, the main source for SESIM, is an administrative dataset starting from 1960 which covers about 3.5% of Swedish population.
[8] Models based on surveys (PENSIM, MINT) estimate the unconditional probability for a household to hold a certain asset – and then the amount – at an age preceding retirement. Then they simulate the asset yearly evolution until household extinction .
In SESIM, wealth is represented by means of a *two part* model as well; however, accumulation dynamics is simulated also at younger ages. A special effort in SESIM has been addressed in modeling a specific dynamics for private pension wealth (pension funds), starting from a reconstruction of accumulated tax-deferred pension savings.

The reasons for this are manifold. First, dynamic micro simulation models do not explicitly allow for the supply side of the economy and therefore, at least so far, have not been tools for general equilibrium analyses (about linking CGE and Microsimulation models, see Peichl 2008). Second, a practical limitation with this approach is that the estimation of an entirely structural modelling of the processes usually involved in a dynamic population MSMs would imply an excessively heavy computational burden at the state of the computer technology.

Nevertheless, the introduction of some form of behavioral function is extremely important in models aimed at analyzing long run effects of radical reforms in the social protection system as long as these are expected to affect saving and labour supply decisions.

The present work aims at developing and integrating the dynamic micro simulation model CAPP_DYN[9] with a new module in which household's savings and asset allocation are modelled. In particular, our efforts are addressed at accounting for some possible behavioural change in household savings within a framework which remains mainly probabilistic. To this end, our strategy has been that of adopting the traditional stochastic micro simulation approach for assets allocation (investments decisions), while approximating a structural framework for estimating consumption/saving behaviour.

On the one hand in fact, consistently with the nature of CAPP_DYN, the wealth accumulation and spend down module allows the representation of several processes characterized by a high degree of institutional details by means of a large set of empirical '*ad hoc*' solutions. On the other hand, since saving behaviour can be strongly affected by radical reforms, as the ones adopted in Italy, the traditional probabilistic approach based on reduced-form estimations on current data would fail in representing long run relations, especially when reforms have not been fully phased-in yet, due to a long transitional phase. In such cases, in order to account for the change in expectations and to give a proper account of household saving/consumption decision, the empirical model needs to be "clasped" to a theoretical framework.

Our framework has been inspired from a basic version of the life cycle hypothesis as formulated in Ando and Nicoletti Altimari (2004) (AN henceforth) as most of their assumptions made in order to obtain a computable algebraic expression for the household consumption rule as well as several of their enlightening 'heuristic' solutions appeared reasonably compatible with the nature of our model. However, while AN aimed at carrying out a forecast for the evolution of aggregated saving, we are mainly interested in a long-run distributional analysis of income, consumption and wealth, especially in the individual's retirement period.

In order to better represent behaviours and catch heterogeneity in a micro framework, we also allow for *internal habit formation*, as this hypothesis results particularly helpful in reconciling the life-cycle theory with most of the empirical evidence on household inter-temporal decisions (See, among others, Meghir and Weber, 1996; Seckin, 2000; Angelini, 2009). This approach assumes individuals/households derive utility not only from current consumption but also from the comparison with a reference level of it, which, in a simplified version, is represented by previous period (lagged) consumption. As a result, this setting has the important implication that

[9] For a description of the pre-existing structure of CAPP_DYN, see Mazzaferro and Morciano (2009).

agents attempt to smooth both level and variation in consumption. Therefore, as in the original AN microsimulation analysis, we emphasize the role of life cycle economic resources in households consumption/saving decision, yet we further modify their empirical model in order to account for habit persistence and subjective expectations on pension outcomes in the econometric stage; in addition, we allow for liquidity constraints on consumption expenditure in the simulation program.

In the next section we briefly outline the stylized functioning of the Wealth Module, by illustrating the sequencing of the main tasks i.e. transferring, investing, and allocating wealth among main assets. Then, in section 3, we describe the theoretical background for modelling the behaviour of households in distributing resources for consumption over the life cycle. In order to achieve this aim, we focus on the estimation of household lifetime human resources - and their specific components (section 3.1) - a key variable employed for the estimation of the consumption rule explained in section 4. In section 5 we discuss the empirical strategy for modelling intergenerational transfers and their mechanics in the simulation program. Data issues and other empirical details, as well as the some insights on income netting algorithms preceding the module itself, are provided in the Appendices.

## *2. The Wealth module sequence*

The Wealth Module of CAPP_DYN starts the simulation from the panel dataset provided by the pre-existing blocks of the model, where demographic events, labour incomes and a full range of social security benefits are simulated for the period 2008-2050[10]. Consistently with the previous part of the model, the base year population is represented by the 2002 wave of the Bank of Italy's Survey of Households Income and Wealth (SHIW). As the SHIW suffers of an heavy financial assets under-estimation due to under-reporting, we employ the adjusted wealth data from D'Aurizio et al. (2006) on the same source[11].

The sequence of processes for the mechanisms of formation, transmission and accumulation/spend down of household wealth are synthetically reported in figure 1.

The module adopts the traditional recursive logics of dynamics MSMs , included CAPP_DYN, – i.e. it estimates all the variables in year (t) and uses them to determine the transition probabilities in year (t+1). In addition, some of the simulated processes have a dynamic specification themselves and have been estimated on

[10] The main implication is that feedbacks from wealth to demographic and occupational decision are not allowed for. In a further development of the research the Wealth Module will be sequentially integrated with the other pre-existing modules.
[11] See Appendix A for details on SHIW and adjustment of financial wealth.

the panel component of SHIW using the lagged dependent[12] among the covariates. The decisional unit for the wealth processes is the household[13].

In short, the module begins by modeling the intergenerational transmission of wealth, which includes *inter vivos* and *mortis causa* transfers. Following, the model updates each wealth component as a *random walk*, with its specific asset returns. Concerning financial wealth, before determining the current value, we preliminarily estimate the propensity and (if positive) the share of financial resources allocated in risky assets, using a selection model à la Heckman (results provided in the appendix B).

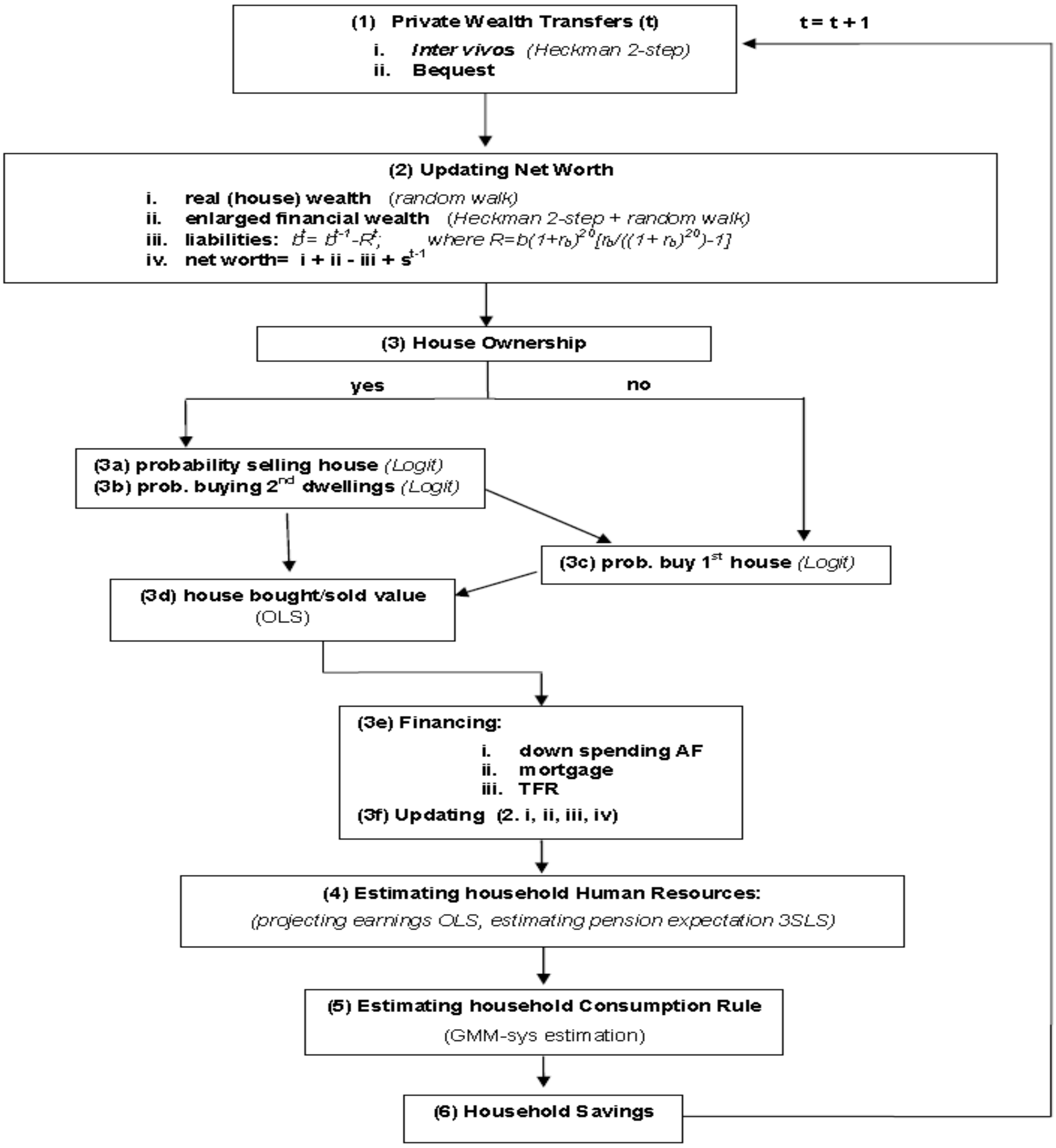
Next the module runs the investment part which is leaded by the house equity decisions (buying, selling and amount): these processes are carried out by means of a traditional *two part model*, combining discrete choice models (logit, plus Monte Carlo techniques in simulation) for the probability of being a seller or a buyer, and OLS models for the determination of the amount of the house bought. Every time a household is selected for a transition in the housing market, debt (i.e. stock of capital borrowed) and the new mortgage instalment (if any) are re-computed.

In case of a purchase decision, the model distinguishes among three modalities of financing the assets which will be described in details later in the section. The final steps of the loop determines yearly household consumption expenditure, provided the computation of the Human Lifetime Resources, and ultimately performs the last recursive process, i.e. the determination of yearly household savings. In figure 1 we show the structure of the Wealth Module and the sequence of its main tasks.

[12] CAPP_DYN is a discrete-time annual model, while our main estimation dataset (the *Bank of Italy Survey of Household Income and Wealth*) has a biannual frequency. This fact causes an underestimation of persistence in the simulated dynamic models. We are aware of this problem, nevertheless, at the state of the art, a annual panel data source with the information we need is not available for Italy and we believe the advantages of fitting, on the whole, a better model (especially for the consumption rule) overtake the drawback of an underestimated persistence.

[13] Consistently with the demographic hypotheses which ground CAPP_DYN we use a definition of household which excludes non-nuclear, composite structure families.

***Figure 1: a stylized scheme of formation and transmission of wealth in the Wealth Module***




For simulation purposes, we adopt a re-coding of SHIW wealth variables in two macro-aggregates: (a) house equity (real wealth) (b) an enlarged financial wealth component, which includes all financial assets plus tangible goods other than real estate (which will be assimilated to non-risky assets). Net worth is obtained by subtracting financial debt (if any) from total gross wealth.

As mentioned above, the first simulated events are the intergenerational transfers of wealth between parents and children outside the family of origin. The inter-vivos transfers have been modeled by means of a probabilistic approach based on a Heckman two steps procedure in order to account for the selection bias, while bequests have a mechanical connotation. It is worth noticing that, due to insufficient information on financial transfers in the SHIW for our purposes, a different micro data source specifically focused on this issue has been employed: the *Survey of Health, Ageing and Retirement in Europe* (SHARE). Details on the econometrics and the functioning of such a crucial sub-module are discussed in section 5.

Once transfers have fully accomplished[14], every household (included the new born ones), have an initial wealth stock.[15] Next, an updating of wealth stock is operated by assigning a specific return on each assets in order to determine current wealth value. Returns are derived from an i.i.d draw from a specific normal (or Pearson) distribution with mean, variance (and kurtosis) derived from available time series for Italy (see footnotes 13, 14, 15 and 18)[16]. This step introduces the individual portfolio risk in private accumulation process. The current house equity value of household *h*, ($AH^t$) is obtained by multiplying the lagged value of real wealth by (1 plus) the rate of return on real assets $r_h^t$ (random walk) [17]. Concerning financial wealth, in order to account for differential returns on the share of risky ($\varphi^t$ )[18] and non-risky[19] assets, we preliminarily estimate financial wealth allocation between these two components with a dynamic model[20] accounting for persistence in risk attitude[21] and for the role of other observables (see appendix B). Since (in the baseline) we assume the non risky share of financial accrues a null real return, the weighted rate of return on overall enlarged financial assets amounts to $\varphi^t r_f^t$, where the latter rate is a specific return on financial risky assets obtained as an i.i.d draw from a asset-return-specific distribution[22]. The updated value for the enlarged financial aggregate for the household ($AF^t$) is then determined as the lagged financial wealth multiplied by (1 plus) the weighted returns and then increased by the previous period savings ($S^{t-1}$). The outstanding debt is, in first stance, obtained by subtracting the capital component of mortgage instalment paid in the previous period ($R^t_{cap}$) from its lagged value ($B^{t-1}$). Here we adopt the convention that all households repay the mortgage in 20 years[23] (i.e. roughly the average mortgage duration in Italy, according to Rossi, 2008); thus, capital mortgage instalment $R^t_{cap}$ amounts to 1/20 of borrowed capital stock ($B^t$), while total installment (including interest) is computed as $R^t_{tot} = B^t(1+r_m)^{20}\left[r_m/((1+r_m)^{20}-1)\right]$, where $r_m$ is assumed to be normally distributed with mean equal to 3% and standard deviation amounting to 0.5% (in the baseline). For this formula to be true, we assume the borrowing

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[14] See section 5 for a thorough description of the private transferring processes

[15] This stock, in the first year of simulation, is drawn from the base year population dataset (SHIW 2002) and it is stochastically processed by the transfer sub-module.

[16] We consider different hypotheses on the returns of the various assets in order to carry out sensitivity analyses, obtaining a benchmark, a low and a high accumulation scenarios.

[17] In the benchmark scenario we have adjusted the average return over the 1970-2007 period from Muzzicato et al. (2002) amounting to about 2.5% by imputing a lower (very long run) rate (2%). At the same time we impute a moderate 8% standard deviation, close to that estimated by Cannari et al. (2008) for houses prices in Italy.

[18] This aggregate is composed of stocks, mutual funds, private bonds, foreign government bonds, shares of limited liability companies.

[19] Non-risky assets include bank and postal deposits CDs, PCTs, BFPs and government securities. We also added real (tangible) goods other than real estate.

[20] Such allocation is estimated through a Heckman two steps model.

[21] A static model determines initial conditions for new households.

[22] In the benchmark simulation we assume a 3% real returns with a standard deviation equal to 18% and an excess of kurtosis of 2.4 for risky assets. These values amount to a weighted average among short, medium and very long run returns for Italy computed by Dimson et al. (2006). Figures for a wide set of countries are available in the DMS Global Returns database.

[23] If a household extinguishes before the debt has been repaid, it simply transmits its overall net worth to its heirs according to the rule defined in section 5.

rate – $r_m$ – to be fixed over time once the mortgage has been subscribed and the mortgage repayment to be constant. The net wealth is then given by the sum of real and financial wealth minus the outstanding debt (i.e. mortgage being the only form of borrowing we allow in the model).

In the following step the model simulates choices affecting the stock of real estate and the number of dwellings owned by the family. The decisions of purchasing or selling a house work on a set of discrete choice model (logit, estimated on the pooling of 1989-2006 waves of SHIW-HA, see Appendix C) combined, in simulation, with Monte Carlo techniques and then the totals are calibrated to match an external source (ISTAT, 2005)[24]. First, the model distinguishes between households already owning at least a house, which are allowed to sell a property, and households not owning any house equity, which are not allowed to sell. Once the family is selected for the "sale" event, the value of house equity sold $AH_s^t$ is "heuristically" assumed to be the current value of real wealth divided by the number of houses owned. The new value of household real wealth is the difference between the current real wealth and the value of the sold house.

The financial wealth is assumed to increase by the value of equity in case exceeding the existing debt, while the latter (if exists) falls by the price of equity sold up to its outstanding value; finally, the new mortgage (total and capital) instalment is computed on the new debt (if any).

When a household is selected – through an analogous procedure (logit) – for buying, the value of the purchased dwelling is estimated by means of an OLS on a pooling of SHIW cross sections (1989-2006) using the ratio of house value to household net wealth as dependent variable. In case a household is selected for buying, the model distinguishes among three cases:

i) purchase with down-spending up to 90%[25] of the enlarged financial wealth; in this case financial wealth decumulates by the price of the house bought, real wealth increase by the same amount and the eventual debt does not vary;

ii) if the price of the house exceeds the 90% threshold, the financial advance can be complemented with creation of new debt for the difference between the value of the house and the 90% of financial wealth; real and financial wealth are updated accordingly;

iii) if at least one of the two spouses has an accrued end-of-service allowance[26] and the purchase concerns the first house, a 70% redemption of it is allowed as a set-off of debt contracted in ii), possible difference exceeding the debt re-integrating the financial wealth (decumulated by 90%).

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[24] Since SHIW data seems to severely under-report the official trade flows in the housing market for the household sector, we fit the econometric models in order to model systematic differences in house equity decisions according to some observable characteristics then we align the totals to match external aggregate data. According to ISTAT among 2002 and 2008 in Italy around 1 million of real estate buying and selling per year have been recorded. This level corresponds to about a 4.5 percent households per year involved in house equity purchasing/building. We assume this frequency to be stable all over the simulation.

[25] This is an assumption aimed at avoiding households to completely run out of their overall resources.

[26] In Italy, private sector employees benefit of an additional relevant resource at retirement which is called TFR (end-of-service allowance). In practice, TFR is a deferred share of wage, which can also be partially redeemed in some special cases, and in particular for the purchase of the 1st house or can be completely or partially devolved to complementary pension funds.

Finally, since the issued debt may be excessively high due to low financial assets relative to the price of the house, we operate a control on the sustainability of mortgage by imposing a ceiling to the (total) instalment, as the 40% of the current household net labour and pension income[27]. In case the instalment exceeds the threshold, we force the instalment to the ceiling and re-compute the maximum sustainable debt given current resources.

Subtracting the pre-existing debt from this amount, one gets the maximum amount which can be loaned in the current period for the purchase of the house. Finally, the maximum value of house bought consistent with the new stock of debt is re-computed by summing the 90% financial resources and the maximum amount which can be loaned for the current period, plus the 70% of TFR for households which are constrained despite its redemption.

In the last steps of the loop the model predicts household human lifetime resources, which are the present discounted value of labour incomes stream up to retirement plus the pension income flows up to household extinction (see section 3.1 for details). Such aggregate is crucial for determining household consumption expenditure[28] and finally yearly household savings are obtained as the difference between disposable labour and pension incomes (net of mortgage instalment) and consumption. In the following sections we try to focus, one by one, on the main aspects we briefly mentioned in this section.

## *3. The households saving/consumption behaviour*

In this section we illustrate the theoretical background modelling behaviour of households in allocating resources for consumption among different periods of their life. Our main task is to fit our data as better as possible while, at the same time, representing household consumption behaviour through a quite general expression for the consumption rule. This latter, once estimated, is implemented in the simulation program and aims at catching some possible behavioural reactions related to gradual changes in pension outcome expectations as a consequence of a radical social security reform which is characterized by a long transitional phase.

Assuming a homothetic - non-separable over time - utility function[29], a closed-form life-cycle consumption function from the optimization problem as elaborated in Modigliani and Brumberg (1954 and 1979) can be derived. Hence, our general formulation - in order to get an approximate optimizing model - is given by:

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It is computed as 6.91% of the yearly gross wage and can be reasonably approximated with one gross monthly wage. It accrues at an yearly rate equal to 1.5% plus 75% the inflation. The introduction of TFR in the model serves to a twofold purpose:

1) allows for financing house purchase, making liquidity constraint less bounding
2) modelling the financing of complementary pension funds.

At the moment we have attempted to model the first issue, although, the inclusion of TFR in the model paves the way for future developments of the second point whenever data availability will allow to model such an aspect.

[27] The average incidence of mortgage repayment on household income is around 30% in Italy (Rossi, 2008)

[28] Actual consumption cannot exceed the sum of all disposable households income and the "liquid" financial wealth [(1-$\varphi$)AF] net of any mortgage installment. Of course for some household this constraint is bounding and they are not allowed to consume their "desired" amount of resources.

[29] Nagatani (1972), Hayashi (1982) and Zeldes (1989) argue a sensible way to account for income uncertainty, without implying certainty equivalent from a quadratic function, is to discount future income stream adding a risk premium term.

$$\underset{C^{t+i}}{Max}\ \ \mathrm{E}_t \sum_{i=0}^{\infty} \phi^i \left[ \mathrm{U}_a^{t+i}(C_a^{t+i}, C_a^{t+i-1};\ H^t) \right]$$

s.t.

$$A_a^t = (1 + r_a^t)[\frac{A_{a-1}^{t-1}}{1-\pi} + y_a^t - C_a^t]$$

Where:

$a$ = age of household head

$C_a^t$ = current consumption

$C_a^{t-1}$ = last period consumption for the same household (internal habit)

$A_a^t$ = non-human household wealth in year $t$ when the age of household head is $a$

$y_a^t$ = current household disposable income (earnings and pensions) in year $t$ when the age of household head is $a$

$\pi$ = period constant probability of household extinction[30]

$H$ = household characteristics and type

$r$ = real interest rate

Following Willman (2003) we can derive an algebraic expression for current consumption which in its implicit form is given by:

$$C_a^t(H) = f\left(C_a^{t-1}; a, \pi, H; \mathrm{A}_{a-1}^{t-1}, \mathrm{y}_a^t, HR^t(\mathrm{r}, H, a)\right) \qquad (1)$$

Where, in particular, $HR$ represents the (expected) life-time human resources (or human wealth) given by the discounted future labour and pension incomes stream. As we are going to explain in the next sub-sections the "structural" element of the equation resides in the introduction of expectations about future income stream, through the role of human resources, as a determinant of household consumption. This approach requires in turn HR to be re-programmed every period. $C_a^{t-1}$ represent the role of habit in consumption.

For the estimation we chose an empirical specification which nicely describes the consumption/saving behavior of Italian household in our sample, summarized by the following formula:

$$\frac{C^t}{HR^{t+1}} = \rho \frac{C^{t-1}}{HR^t} + f(a) + \beta_1 A^t + \beta_2 y^t + \sum_k \beta_k D_k^t(H) \qquad (2)$$ [31]

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For our practical purposes we neglect uncertainty in the future income stream. Moreover, we assume the discount factor to be equal to the exogenous growth rate in productivity (wage growth) in every period.

[30] Following Blanchard (1985) agents face each period a constant probability of death (π) - instead of being infinitely lived - implying uncertain lifetime. For practical needs of our dynamic micro simulation framework we neglect such a source of uncertainty in the estimation and in the simulation of the consumption rule, by assuming households take as reference for household life time planning the expected age of death of surviving spouse ($T^t$) as in Ando and Nicoletti Altimari (2004).

We will discuss the implications of such an empirical specification and the econometric estimation in section 4.

In the dynamic simulation program this equation provides us with a predicted value for the current level of consumption $\hat{C}^t$. In order to account for the role of liquidity constraints, which should not be neglected in a distributional analysis, we compute current simulated consumption as:

$$C^t = \min\left\{\hat{C}^t,\ y^t + (1-\varphi^t)AF^t - R_{tot}{}^t\right\} \qquad (3)$$

i.e. current household consumption can never exceed the sum of current disposable income plus the liquid share of enlarged financial wealth (non risky assets), net of the mortgage instalment (if any).

### *3.1 Household lifetime human resources (HR)*

Before turning to the proper empirical specification of the household consumption rule, we focus on the definition of total household expected Human Wealth, whose estimation is propedeutic to the estimation of the consumption rule. The expected value of Human Wealth (or human resources) is empirically obtained by aggregating spouses' individual projected (after tax) incomes (earnings and pensions), plus the stream of adult children's expected labour incomes up to the age of 30, plus one year of earnings contribution of active children over 30. That is the assumptions are under 30 active children will leave the family of origin at 30, while over 30 active children are going to exit in one year. We know these are arbitrary hypotheses that leave room for refinements on the base of an in-depth study of the evolution of individuals demographic behaviour. However, at the state of the art they represent sensible, though simplifying, hypotheses that, as we will show in section 4, provide a good fit of our data in the analysis of household consumption behaviour.

In algebraic terms:

$$HR^t(i,H,a) = \left( \underbrace{\sum_{k=1}^{2}\left\{ \underbrace{\sum_{i=1}^{p_k-a_k} E_i \frac{\left[w^t_{k,a_k+i}\right]}{(1+r)^i}}_{=0 \text{ if } p_k \le a_k} + \sum_{i=1}^{T_k-a_k-p_k} E_t \frac{\left[P^t_{k,a+i}\right]}{(1+r)^i} I_k \right\}}_{\text{Spouses' human resources}} + \underbrace{\sum_{j=1}^{J}\left\{ \sum_{i=1}^{30-a_j} E_i \frac{\left[w^t_{j,a_j+i}\right]}{(1+r)^i} \right\}}_{\text{active children's projected resources up to 30}} \right) \qquad (4)$$

where:

$k$ = 1,2 adult members

$j$ = active children up to 30 living in the household

$w^t_{k,a_k+i}$ = net labour income of household member $k$ (or $j$) expected in year $t$ when he/she will be aged $a+i$

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[31] As we discussed above our reference propensity to consume out of human resources is the two year lag value of the dependent variable (i.e. t-2). For new born households the initial condition is estimated by means of a static FE model.

$P^{t}_{k,a+i}$ = net old age pension benefit of household member k expected in year t when he/she will be aged a+i, or, if already retired, projection of current old age (or survivor) pension benefit in year t when he/she will be aged a+i

$p_k$ = expected retirement age for spouse k

$a_k$ = age of spouse k

$T_k$ = expected death age for spouse k (ISTAT projections)

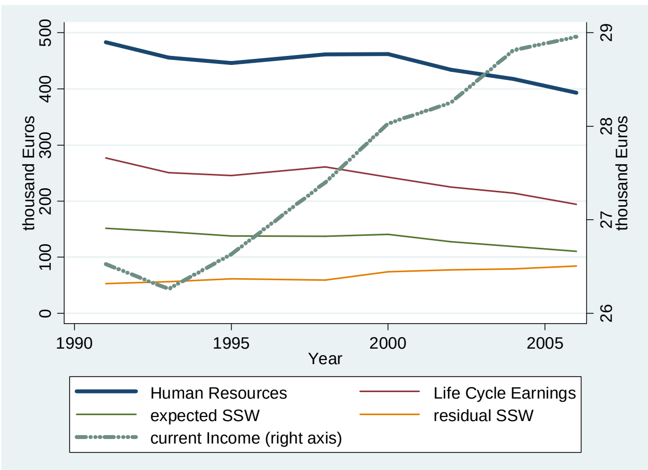
Therefore, in order to evaluate this (stock) variable we need to evaluate its three main components, that is the household life time labour income, the expected social security wealth for active individuals and the current (residual) social security wealth for the individuals who are already retired. It is worth noting that in the simulation program the predicted values of estimated equations used to build HR are re-computed – using the current simulated values of explanatory variables - every year in order to obtain the current value of HR which, in turn, is a determinant of the yearly simulated consumption.

These topics will be the subject of the next two sections.

To conclude this sub-section we show the evolution of the variable HR and its components all over the estimation period and across the households population in SHIW data (figure 2).

From 1991 to 2006 the average value of the household human resources decreases from 482 to 393 thousand Euros while the average current household income (excluded capital incomes) increases from 26.5 to 28.9 thousand Euros (all values are in real terms, price 2002). This decreasing trend of HR is explained by the downward trend of the expected household life cycle earnings (from 277 to 194 thousand Euros) and the expected social security wealth (from 151 to 110) components and is partially offset by the increasing trend of the residual social security wealth component (from 52 to 84, representing the pension wealth of those individuals who are already receiving an old age or a survivor pension benefit).

***Figure 2: Average evolution of HR and its component vs current income (1989-2006)***

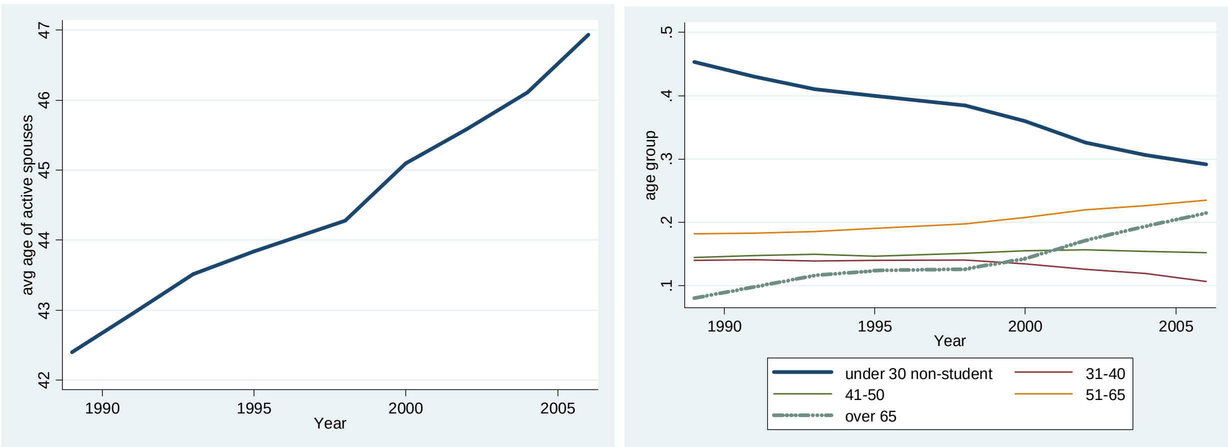



Source: Author's computations on SHIW 1989-2006, Euros 2002

Demography plays a crucial role in the relative weight of each HR component. In figure 3 (left panel) we show the mean age of the active spouses (i.e. those who contribute the most to the life cycle earnings component of the family) which increases from 42.4 in 1989 to almost 47 in 2006. This fact implies, on average, a shorter residual active life also with respect to the planned age of retirement which, from 1993 to 2006 increases, on average, 2.1 years only, passing from 60.1 to 62.4 (figure 4, left panel). At the same time the average number of earners in the family (figure 4, right) just slightly increases, passing from 1.63 in 1991 to 1.65 in 2006 with its peak in 1995 (1.68 earners per household). With regard to the weight of different age group in the society, we can notice a steady downward trend of non-student under 30 (from 45% to 29%) mirrored by an as much steady upward trend in the weight of over 65 individuals (from 8% to 21.4%). This evidence explains the increase in the residual social security wealth component of HR.

Finally, with regard to the decreasing trend in the expected social security wealth component of HR, a non-negligible role is attributable to the significant fall in the average expected replacement rate[32] which, especially after 1998 decreases ten percentage points, from about .76 to about .66 (figure 4, left panel).

***Figure 3.: Average evolution of active spouses age (left panel) and the weight of different age groups(right panel) (1989-2006)***




Source: Author's computations on SHIW 1989-2006, Euros 2002

In order to demonstrate how demography matters in determining the average evolution of the household human resources, in figure 5 we show the average pattern of the individual expected life cycle earnings component by age classes (left panel) and the evolution of the relative composition of such age classes themselves (right panel). From this analysis we exclude all of the individuals who do not contribute to this component of HR (i.e. students, house wives, pensioners, well off people voluntarily out of the labour market) or contribute with a minor weight (i.e. active children under 30), therefore we restrict the analysis to the household head and his/her spouse (if any).

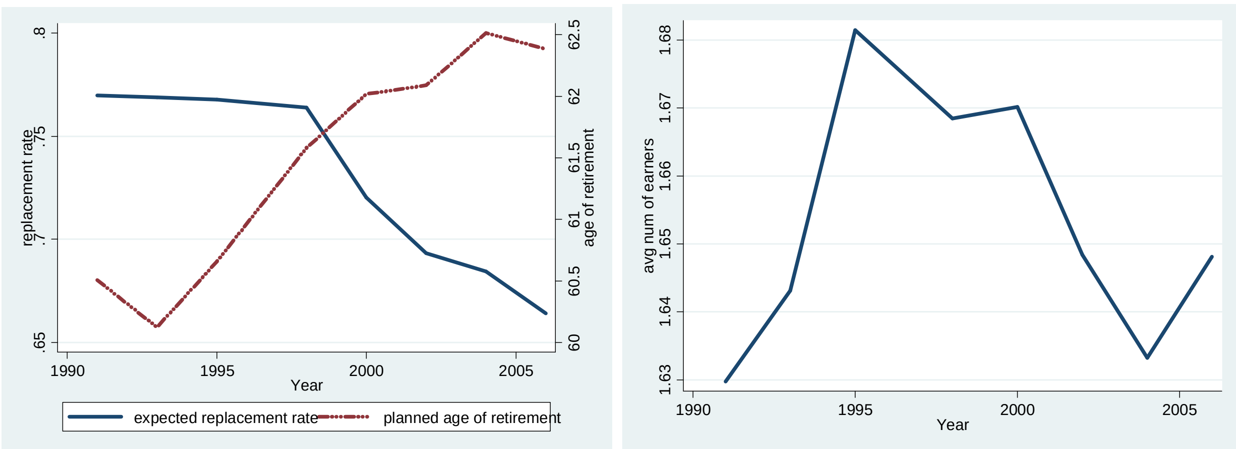
[32] Expected replacement rate is the expected value of the ratio between last earnings before retirement and the first old age pension benefit, declared by adult individual in SHIW. This variable, as we will see in section 3.1.2, is crucial in determining the value of the expected social security wealth component of HR and, therefore, of HR itself.

In general, the average expectation about future earnings for each age class moderately increases according to the moderate growth recorded in the period 1991-2006. What is dramatically changing in the same period is the relative composition of the age classes. In particular, the class of under 30 individuals (living out of their family origin, i.e. living in their new family alone or with a partner/spouse) that in 1991 represents more than 10 percent of all individuals, in 2006 is reduced to less than 3 percent. The age group 31-40 passes from 31 to 21 percent. The individuals of these two groups contribute to the greatest expected stock of life cycle earnings. On the opposite, individuals with a lower expected stock of life time earnings, in particular over 50, pass from 23 to 35 percent of all individuals.

In other words, in the period 1991-2006 both the demographic and labor market behavior of the individuals is dramatically changed. Nevertheless, even though the average age of formation of an autonomous family unit and the average age of entry in the labor market have been significantly delaying, younger people plan to retire, on average, just two year later compared their parents.

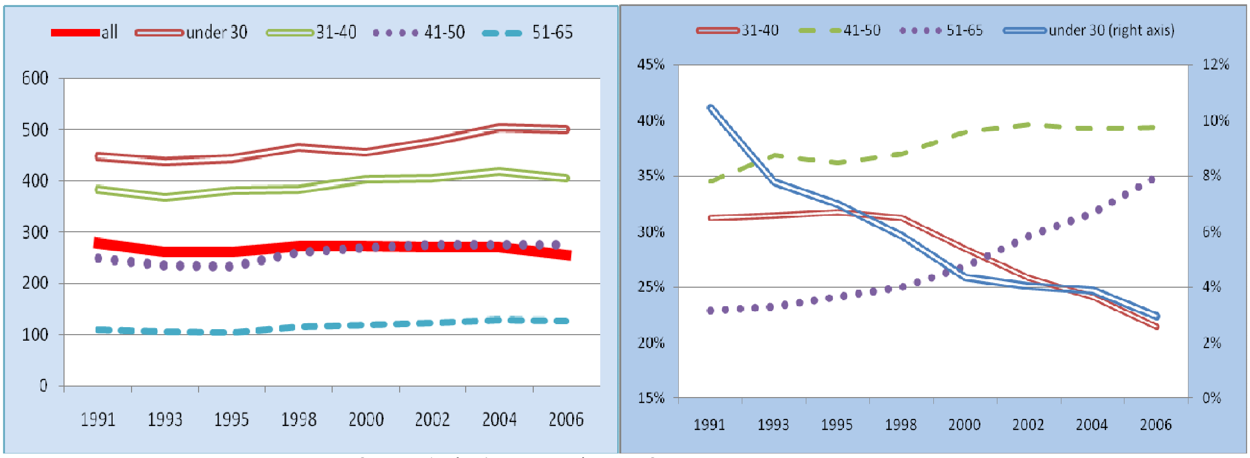
Of course, such results can be sensitive to the various hypotheses that underlie the construction of HR variable. Anyway, they raise several questions about the likely consequences in terms of savings, labour supply behaviours and, in the final analysis, long run wealth and income distributions of the changing institutional framework. The answers will depend, among other things, on the hypotheses that one formulates about the likely evolution of labor market and pension expectations as well as the actual rules of decision which will lead life time labour supply in the next decades.

***Figure 4.: Average evolution of pension expectations (left panel) and the number of household earners(right panel) (1989-2006)***




Source: Author's computations on SHIW 1991 -2006, Euros 2002

*Figure 5.:Avg expected life cycle earnings by age class (left) and relative composition (right)*




Source: Author's computations on SHIW 1991 -2006, Euros 2002

In the next subsections we discuss how we estimate and how we manage in the simulation program every single component of HR.

### *3.1.1 Individual life time income profiles*

Individual lifetime earnings are defined as the present discounted value of future expected labour income flows up to the planned age of retirement. The projection in *t* for income at time *t+i* (where *i* is a generic period between *t* – current year – and the age of retirement ($p_k$ - *t*)) for each individual *k* or *j* is obtained as the prediction of the deterministic part of the following econometric models[33] where age is $a_{k+i}$:

$$\ln y^{t}_{k,a+i} = \varrho \ln y^{t}_{k,a+i-1} + \beta' x^{t}_{k,a+i} + \gamma' pa^{t}_{k,a+i} + \underbrace{E_t \varepsilon^{t}_{ka+i}}_{=0} \quad \text{if wage} > 0 \text{ in t} \qquad (5a)$$

or

$$\ln y^{t}_{k,a+i} = \beta' x^{t}_{k,a+i} + \gamma' pa^{t}_{k,a+i} + u_k + \underbrace{E_t \nu^{t}_{ka+i}}_{=0} \qquad \text{if wage} = 0 \text{ in t} \qquad (5b)$$

$$\varepsilon^t_k \sim N\left(0, \sigma^2_{\varepsilon}\right)$$
$$u_k \sim N\left(0, \sigma^2_{u}\right)$$
$$\nu_k \sim N\left(0, \sigma^2_{\nu}\right)$$

where $\ln y^{t}_{k,a}$ is the log of individual labour income net of personal income tax and social security contribution, the *x* vector includes the set of observables such as educational level achieved, occupation, type of employer, full (part time), *pa* is a polynomial in age vector interacted with individual characteristics.

We employ two models estimated on the panel component of SHIW using 1989-2006 waves to obtain a projection of labour income up to retirement.

[33] In the simulation stage, the model uses the current disposable income - which is obtained by applying a netting algorithm (see appendix E) to the gross labour income generated by the "Incomes Module" in CAPP_DYN – as the initial condition for the projection of the income stream.

In particular, we use a dynamic specification to estimate the process to be simulated when the individual has a positive wage in the current period (which represents the lagged variable for the prediction of the expected wage for the following year) (5.a), while we use a static specification to estimate the process for active individuals with zero wage, e.g. in case of unemployment (5.b), which is fitted on both employed and unemployed individuals(see, appendix D).

Hence, the present value of the expected labour income at a generic age *a+i*, $y^{t}_{k,a_j+i}$ is then given by the predicted value of the earnings model when age=*a+i*:

$$y^{t}_{k,a_k+i} = \left(\frac{1}{1+\delta}\right)^{i} e^{(\rho y^{t}_{k,a_k+i-1}+\beta' x^{t}_{k}+\gamma' pa^{t}_{k,a_k+i})}(1+g)^{i} \qquad (5c)$$

where the *(1+g)* factor allows the wage level to be linked to the medium-long run productivity growth which is calibrated through the "Scenario" block of the pre-existing CAPP_DYN. For simplicity, we assume $\delta$ (the inter-temporal discount rate) to be equal to $g$.

Finally, in order to obtain individual lifetime income, we need to sum the present value of the projected labour incomes for every t from the current period up to the expected retirement age $p_k$. However, $p_k$ is not known *a priori* as well.

Indeed, $p_k$, along with the expected replacement rate $\omega^{t}_{k,p_j}$, plays a key role in determining both lifetime income as well as the expected social security wealth. Therefore, in the following section, a method - based on subjective expectations declared in SHIW coupled with conjectures about their evolution - is illustrated in order to estimate these two variables.

### *3.1.2 Planned retirement age and (related) expected replacement rate*

As we mentioned in the introduction, reforms implemented from 1992 to 2007 have significantly affected the institutional social security framework, introducing a tight actuarial link between contributions paid and pension received back reducing abruptly the expected replacement ratio for future pensioners and assuring the long term financial sustainability of the social security system.

These new computational rules are going to affect incentives to retire. While for individuals whose pension is computed with the old defined benefit (DB) formula the expected retirement age can be reasonably approximated with the legal provision (or with the age individuals accrue the seniority requirements), for workers falling under the mixed and especially under the notional defined contribution (NDC) regime, the expected retirement age presents troublesome elements. In fact, we need to model the behaviour of individuals which are going to face radically different scenarios and therefore will not be able to draw from the experience of previous generations.

For this purpose, since we consider subjective expectations to matter in economic decisions, we use the expected replacement rate and the planned retirement age information reported in the SHIW[34] survey and we build an econometric model for imputing *out-of-sample* values. As already showed in figure 4 (left), data support the hypothesis of an increase in the expected retirement age and a decrease in the expectations on future replacement rates as long as we consider recent survey waves, suggesting a partial internalization of the effect of pension reforms is taking place in the expectations formation process.

Because planned retirement age (plan_ret_age) and expected replacement rate (exp_repratio) are slightly negatively correlated ($\varrho$=-.14) but part of their variability may be jointly determined, there is a strong likelihood that there will be a correlation between plan_ret_age and the error term in the model of expected replacement rate. This correlation would violate one of the basic assumptions of independence in OLS regression. Therefore, as a check, we carry out a Hausman test to verify if differences between an OLS estimates of exp_repratio with plan_ret_age among the regressors and a 2SLS estimates are big enough to suggest OLS estimates are not consistent. Actually, we find a significant difference between OLS and 2SLS[35] estimates (chi-square = 26.54, df =1, p = 0.0000) and the reason for the inconsistency of OLS is endogeneity of plan_ret_age.

In order to better account for this kind of endogeneity we than choose to fit a three-stage estimation for systems of simultaneous equations, since plan_ret_age is simultaneously dependent of the first equation and explanatory variable in the second equation (exp_repratio) of the system. Moreover, 3sls is, in general, more efficient than 2sls. The estimates, reported in table 1, are obtained on a pooling of 2000 to 2006 SHIW waves. Since the dependent variables of the two equations are not normal but multi modal, though quite symmetric (see figure 6), we do not log transform them and therefore we can not interpret the estimated coefficients in terms of elasticities.

With regard to the first equation of the system i.e. the planned age of retirement we can notice the contributive seniority (and its square) have a coefficient equal to -0.5 (-0.009) while in order to account for the effect of age and its strong collinearity we interact the latter with the former. Then, we can interpret its positive and significant coefficient (.15) as counter effect of age (perhaps due to an adjustment of individuals planning when they approach to retirement), given the expected negative impact of seniority. Females, on average, plan to retire two year before males while individuals who fall under NDC regime (younger) declare a .6 years delay but with a very low statistical significance[36]. More educated individuals plan to retire later (also due to a delayed entry in the labour market) as well as self employed (1.2 year), while workers in the public sector and home owner plan to retire slightly before other individuals. Finally, southern people and singles plan to retire on average .6 years later. Time dummies catch the slight upward revision in planned retirement in the more recent waves, while

[34] For declared values of planned retirement age higher than 80 or lower than 50, we considered them to be misreported and drop them from the analysis. The non-reporting rate among the selected individuals (i.e. excluding students, pensioners, house wives and voluntarily well off individuals out of work) of these two expectation variables from 2000 to 2006 (the estimation period) is around 20% each wave. For an analysis of retirement expectations and pension reforms on SHIW, see Bottazzi et. al, 2006.

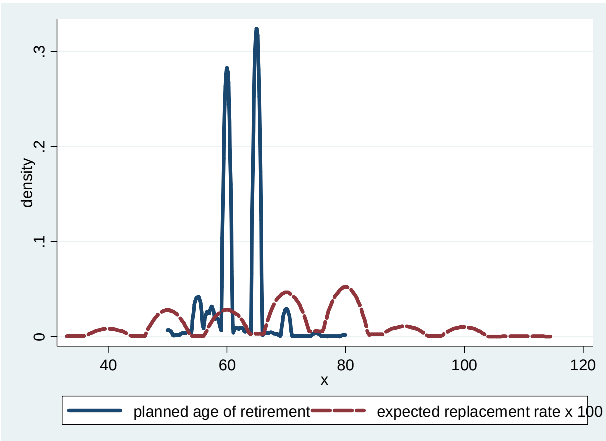
[35] In particular, the coefficient of plan_ret_age estimated by OLS has a negative sign, while, using instrumental variables it shows, as expected, a moderate but significant positive effect on the expected replacement rate.

[36] We guess for younger people is more difficult to have a clear idea of their likely age of retirement.

cohort dummies do not catch a clear cut pattern apart from the fact that individuals who were born after 1953 plan to retire later than older individuals.

Looking at the second equation, the expected replacement rate, we can see how the simultaneous estimation corrects the endogeneity of planned retirement age as a regressor by estimating a positive, significant, coefficient (0.026), the seniority, as expected, has a positive impact (0.0065) while its interaction with age has a low significance, small, negative effect. Individuals which fall under the NDC pension scheme expect, on average, 6 points less in their future replacement rate. Education is slightly positively related pension outcome expectations, while self-employed expect more than 11 points less than employees. Also in this equation, but with a more clear pattern, time dummies catch the recent (downward) revision in pension outcome expectations, while cohort dummies surprisingly show, *coeteris paribus,* that the younger the cohort the higher the expectation about future replacement rate. This evidence provide us with a further clue about the incomplete internalization of pension reforms, especially by younger individuals, those who are expected to bear the heaviest burden of the reform itself.

***Figure 6: kernel distribution of planned retirement age and the expected replacement rate***




Source: Author's computations on SHIW-HA 2000-2006

***Table 1: Three-stage least-squares regression of planned age of retirement and the expected replacement rate***

| Equation | Obs | Parms | RMSE | R-sq | chi2 | P |
|---|---|---|---|---|---|---|
| 1.Plan_ret_age | 27194 | 21 | 3.435451 | 0.257 | 9408.45 | 0.0000 |
| | | | 0.163388 | | | |
| 2.exp_repratio | 27194 | 21 | 1 | 0.149 | 5034.9 | 0.0000 |

| ***Planned Age of Retirement*** | b | | se | t | ci95 | |
|---|---|---|---|---|---|---|
| Year_contrib | -0.5005 | *** | 0.0117 | -42.7746 | -0.5234 | -0.4776 |
| $Year\_contrib^2$ | -0.0094 | *** | 0.0003 | -33.6790 | -0.0099 | -0.0088 |
| Age*contrib. | 0.0146 | *** | 0.0003 | 50.6142 | 0.0141 | 0.0152 |
| Female | -2.0850 | *** | 0.0445 | -46.8655 | -2.1722 | -1.9978 |
| NDC | 0.6392 | | 0.4316 | 1.4810 | -0.2067 | 1.4852 |
| upper_secondary | 0.2882 | *** | 0.0473 | 6.0992 | 0.1956 | 0.3808 |
| degree_or_more | 0.9429 | *** | 0.0722 | 13.0645 | 0.8014 | 1.0843 |
| self_employed | 1.2191 | *** | 0.0548 | 22.2332 | 1.1116 | 1.3265 |
| Public | -0.2453 | *** | 0.0541 | -4.5317 | -0.3514 | -0.1392 |
| home_owner | -0.1130 | * | 0.0473 | -2.3889 | -0.2057 | -0.0203 |
| South | 0.6049 | *** | 0.0496 | 12.1973 | 0.5077 | 0.7021 |
| Single | 0.6131 | *** | 0.0850 | 7.2156 | 0.4466 | 0.7796 |
| tau2002 | 0.2049 | *** | 0.0594 | 3.4480 | 0.0884 | 0.3213 |
| tau2004 | 0.4154 | *** | 0.0618 | 6.7182 | 0.2942 | 0.5366 |
| tau2006 | 0.1333 | * | 0.0651 | 2.0498 | 0.0058 | 0.2608 |
| coor_53 | 1.2315 | *** | 0.0881 | 13.9715 | 1.0587 | 1.4042 |
| coor_58 | 2.1149 | *** | 0.1063 | 19.8864 | 1.9064 | 2.3233 |
| coor_63 | 2.3574 | *** | 0.1239 | 19.0261 | 2.1145 | 2.6002 |
| coor_68 | 2.3954 | *** | 0.1403 | 17.0789 | 2.1205 | 2.6703 |
| coor_73 | 2.2184 | *** | 0.1547 | 14.3440 | 1.9153 | 2.5216 |
| coor_78 | 1.9241 | *** | 0.1718 | 11.2020 | 1.5874 | 2.2608 |
| Intercept | 61.2566 | *** | 0.1635 | 374.6603 | 60.9362 | 61.5771 |

| ***Expected Replacement Rate*** | b | | se | t | ci95 | |
|---|---|---|---|---|---|---|
| Plan_ret_age | 0.0026 | ** | 0.0008 | 3.0374 | 0.0009 | 0.0042 |
| Year_contrib | 0.0065 | *** | 0.0007 | 9.0171 | 0.0051 | 0.0079 |
| Age*contrib | -0.00003 | * | 0.00001 | -2.3585 | -0.0001 | 0.0000 |
| NDC | -0.0602 | ** | 0.0205 | -2.9305 | -0.1004 | -0.0199 |
| Single | 0.0095 | * | 0.0040 | 2.3591 | 0.0016 | 0.0174 |
| Upper secondary | 0.0147 | *** | 0.0022 | 6.5689 | 0.0103 | 0.0191 |
| Degree or more | 0.0180 | *** | 0.0035 | 5.1788 | 0.0112 | 0.0248 |
| Self emplolyed | -0.1161 | *** | 0.0028 | -40.9061 | -0.1217 | -0.1105 |
| Public | 0.0404 | *** | 0.0026 | 15.5535 | 0.0353 | 0.0455 |
| Partime | -0.0395 | *** | 0.0041 | -9.5667 | -0.0476 | -0.0314 |
| Centre | 0.0349 | *** | 0.0025 | 13.7470 | 0.0299 | 0.0399 |
| South | 0.0424 | *** | 0.0026 | 16.2899 | 0.0373 | 0.0475 |
| tau2002 | -0.0339 | *** | 0.0028 | -12.0049 | -0.0395 | -0.0284 |
| tau2004 | -0.0506 | *** | 0.0030 | -17.1257 | -0.0564 | -0.0448 |

| | | | | | | |
|---|---|---|---|---|---|---|
| tau2006 | -0.0789 | *** | 0.0030 | -25.8982 | -0.0848 | -0.0729 |
| coor_53 | 0.0119 | ** | 0.0041 | 2.8883 | 0.0038 | 0.0200 |
| coor_58 | 0.0221 | *** | 0.0050 | 4.4482 | 0.0124 | 0.0318 |
| coor_63 | 0.0334 | *** | 0.0056 | 5.9518 | 0.0224 | 0.0444 |
| coor_68 | 0.0449 | *** | 0.0061 | 7.3957 | 0.0330 | 0.0568 |
| coor_73 | 0.0607 | *** | 0.0064 | 9.4358 | 0.0481 | 0.0733 |
| coor_78 | 0.0704 | *** | 0.0069 | 10.1260 | 0.0567 | 0.0840 |
| Intercept | 0.4337 | *** | 0.0539 | 8.0513 | 0.3281 | 0.5392 |

***Endogenous variables:*** plan_ret_age, exp_repratio

Source: Author's computations on SHIW 2000-2006

In the light of this empirical analysis, since the adjustment process of expectations has not fully accomplished yet, assuming pension expectations will remain unchanged in the future would be unreasonable. On the opposite, we guess these expectations to become more and more accurate with the process of time.

Therefore, the projected values for these two variables $p_k$ and $\omega^{\ell}_{k,p_j}$ (both generically called $y$) are computed as a weighted average between the *predicted* values by the econometric model above (ŷ) and the values simulated by the "Pension module" (y*)[37] of CAPP_DYN for those individuals retiring during the simulation period (within 2050). For the individuals not retiring in the simulation period (the younger), we assume the predicted value of the model to converges linearly towards a long run mean value estimated (by a regression on the 2045-2050 simulated data) for subgroups of population. Therefore:

$$y = \gamma \hat{y} + (1-\gamma)\, y^* \quad (6)$$

The weight of this average $\gamma \in (0,1)$ is closer to zero the closer the year of simulation to 2050 (i.e. the more the pension outcomes of the new NDC regime become observable) and the more the worker is close to his/her retirement age (the more one is close to the retirement age, the more he/she is aware about the exact moment of retirement and about his/her pension amount).

$$\gamma = [1 - \frac{1}{2050\text{-}2003} * (\text{year-}2003)] * (\ell^{0.5} - 1)/\ell^{0.5} \quad (7)$$

$$\ell = \textit{year of } \text{retirement - t}$$

We believe the assumption of a convergence in pension expectations toward actual (simulated) future values is sensible, albeit arbitrary. In fact, although those values are exogenous to the Wealth module because, as previously discussed, feedbacks from this latter to the former modules are not allowed yet and we are aware this fact is open to criticism on several grounds, nevertheless, the social security module of CAPP_DYN -following a rule of exit which essentially plays along with the increase in the legal provision- provides an evaluation of the pension benefit and therefore of the replacement rate which is consistent with a given seniority and with the computational rules related to the particular pension scheme an individual falls in. In other words, we assume

[37] As mentioned before, these information are produced by pre-existing CAPP_DYN blocks before the *Wealth module* starts to simulate.

that, given a simulated age of exit from the labour market which only partially adjusts to offset the future decreasing pension coverage, the expectation about the implied replacement rate should converge towards this actual value. Therefore the assumption of the convergence provides a further link between the Wealth module and the other modules of CAPP_DYN which, at the state of the art, is not yet fully accomplished. We believe a right and proper future improvement will consists of allowing for feedbacks from the Wealth module to demographic, labour market and pension decisions.

Once the expected retirement age has been determined, the number of addenda of the first sum in *HR* is known and then the stock of lifetime human resources can be computed.

### *3.1.3 Social Security wealth*

In order to estimate the expected value of future pension benefits, the model computes the expected value of the first annuity by multiplying the estimated expected replacement rate $\omega^{t}_{k,p_j}$ by the projection of last labour income (in $p_k$-1) :

$$P^{t}_{k,p_k} = \omega^{t}_{k,p_{kj}} \, \mathrm{y}^{\mathrm{t}}_{\mathrm{k},p_k} \qquad (8)$$

The expected present value of future pension flows is obtained as the sum of present values of pension annuities from retirement to the expected death time ($T_k$)[38] (calibrated according to ISTAT projections)

$$SSW^{p_k}_{k} = \sum_{i=p_k}^{T_k} \left( \frac{1}{1+r} \right)^{i} P_{k,i} \qquad (9)$$

Finally, *SSW* values are discounted back to the current period are aggregated for the spouses. By aggregating the life-time labour incomes component plus the pension component the model produces an estimate of the expected value of household human resources (*HR*).

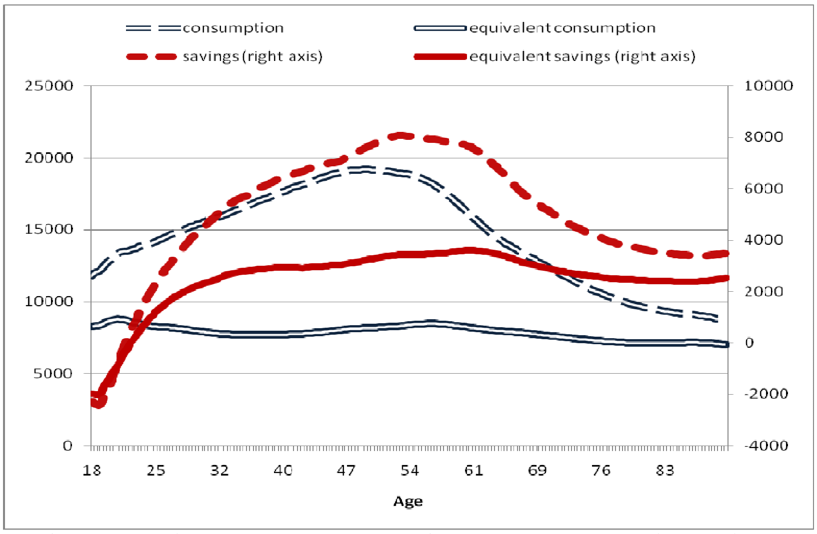
## *4. Estimation of the consumption rule*

In this section we discuss the specification and the estimation of the consumption rule whose parameters we employ in the simulation program. As mentioned in the introduction, the idea that drives our approach is that the likely impact of radical social security reforms on the consumption/savings age profile of Italian households asks for a step beyond the estimation of a traditional reduced form Keynesian equation. In fact, if we look at the recent past (i.e. our 1991-2006 panel dataset, figure 7) through a set of kernel regressions, we notice that the (equivalent) savings profile of Italian Household is characterized by a quasi-flat pattern from around 35 onward, with pensioners having, on average, a positive propensity to save even at older ages.

[38] Another assumption which improves the fit of our model is the expected residual life for the household (which in turn is equal to max between the residual lives of the two spouses, if any) can never be lower than five years. Therefore min $t_k$-$T_k$>=5

A broad literature has investigated the so called "retirement consumption puzzle" in several countries (Lunberg et al. 2001, Fernandez and Krueger, 2003 and 2004) and, for Italy, some authors explained - at least partially - the high (private) savings propensity of elderly with the generosity of the social security system (Miniaci et. Al, 2003) which, so far, provided pensioners with rather high rate of returns on contributions and high replacement rates. Once the social security wealth is included in the total wealth, the savings profile of Italian Households turn to be more consistent with the life cycle hypothesis, with a positive propensity up to retirement, and a spend down phase in the following period.[39]

***Figure 7: Consumption and saving age profiles in the estimation dataset***




Source: Author's computations on SHIW 1991-2006, Nadaraya-Watson nonparametric regression, Euros 2002

We believe that thinking of this pattern as given and projecting it in the next decades - when social security reforms will be fully operational and the generosity of public pensions will be sensibly reduced - would miss an important part of the distributional story. In fact, reforms affect especially current young and future workers whose life cycle consumption is not or only partially observed and whose expectations have only partially embodied the long run effects of the reforms themselves. Therefore, we believe that linking consumption behavior to a life-cycle theoretical framework, while at the same time searching for a specification that fits more closely our data, is an appropriate strategy in order to account for such issues.

As mentioned in section 3., the empirical specification is the following:

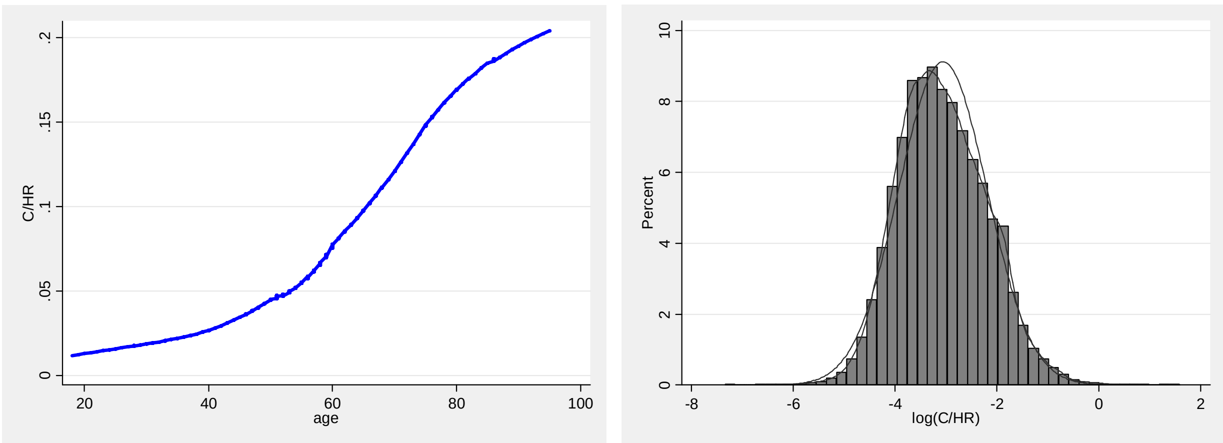
$$\frac{C_h^t}{HR^{t+1}} = \rho \underbrace{\frac{C_h^{t-1}}{HR^t}}_{\substack{\text{lagged}\\\text{dependent}}} + \underbrace{\delta' pa_h^t}_{\substack{\text{Polynomial}\\\text{in age of the hh}\\\text{and relative}\\\text{interactions}}} + \sum_m \beta_m \underbrace{D_{m,h}^t(H)}_{\substack{\text{Households'}\\\text{and hh}\\\text{Characteristics}\\\text{Dummies}}} + \psi \ln \underbrace{\left(y_h^t\right)}_{\substack{\text{Current}\\\text{Disposable}\\\text{Incomes}}} + k \ln \underbrace{AF_h^t}_{\substack{\text{Financial}\\\text{Assets}}} + \varsigma \ln \underbrace{AH_h^t}_{\substack{\text{House}\\\text{Equity}}} + \vartheta \ln \underbrace{PF_h^t}_{\substack{\text{Financial}\\\text{Debt}}} + u_h + \varepsilon_h^t \quad (10)$$

[39] A drop in consumption after retirement still remains to be clarified. Several theoretical and empirical works propose different explanations for this stylized fact (Hurd and Rohwedder, 2008; Laitner and Silverman 2005; Fernandèz-Villaverde and Krueger, 2005. For Italy, Miniaci et al., 2009)

Such a functional form, where the dependent is (log of the) consumption to HR ratio, proves to better fit our household consumption data all over the distribution, while at the same time, considering the role of habit persistence[40] and the effect of future expectations about incomes and pensions outcomes as a crucial determinants of current consumption. Moreover, by estimating a propensity instead of a level, in the simulation program we get rid of the necessity to make arbitrary assumptions due to the non-stationarity of consumption which would have implied a moving average and therefore a dynamics in the intercept of the equation.

In the left panel of figure 8 we depict the lowess regression of the dependent variable over household head's age in SHIW data (which increases non-monotonically) while in the right panel we check the distribution of its logarithm which is particularly well-behaved, closely approximating a normal distribution, with a slight right skewness.

***Figure 8.: Consumption over human resources ratio: all households, lowess by age (left) and distribution (right)***



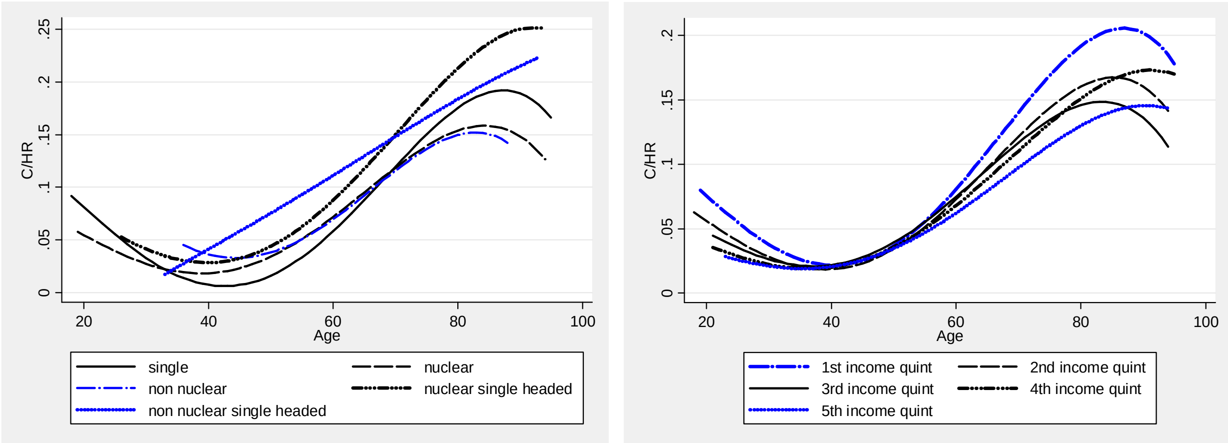

Source: Author's computations on SHIW 1991-2006, lowess regression (left) kernel distribution (right)

As a last exploratory analysis of our dependent variable, in figures 9 we show its average pattern, approximated by a cubic fit, by subgroups household types (left) and income quintiles (right). In particular, for the former, we divided the household population in five categories: singles, nuclear families (two spouses plus children, if any), non-nuclear families (households with spouses and active children only, not properly composite non-nuclear families[41]), nuclear single headed and non-nuclear single headed. As we can notice these household types systematically differ each other in their propensity to consume out of their human wealth; therefore, controlling for them allows us to account for the effect of demography on consumption in our simulation program. Concerning income quintiles, we can notice a different consumption pattern related to current income, with, as expected, richer households saving more out of their human resources compared to low-income households.

[40] We also estimate a static version of the model for new households with no lagged value of consumption to set the initial condition.

[41] Consistently with the demographic hypotheses which ground CAPP_DYN, that is to simulate the evolution of the Italian population allowing for nuclear families only, we dropped the household with a non-nuclear, composite structure by the econometric analysis.

***Figure 9.: Consumption over human resources ratio, by age: by household type (left) and income quintile (right)***




Source: Author's computations on SHIW 1991-2006, cubic fit.

In order to estimate the dynamic[42] consumption function (10) we use a GMM system estimator[43] (Arellano, Bover, 1995; Blundell, Bond, 1998) with robust standard errors in order to purge the estimations from the bias induced by the endogeneity due to individual fixed effect.

As we discussed above, due to the periodicity of the survey, the reference consumption propensity is the two year lag causing a weaker estimated persistence parameter (0.115) when implemented in the discrete yearly simulation program.

Both the enlarged financial wealth and financial debt exert 1.3 percent elasticities on the propensity to consume out of human resources while house equity shows a negative 2.4 percent elasticity which, however, is to be evaluated in the light of the interaction with the number of owned dwellings (0.7 percent). The positive sign of the interaction probably indicates a non linear effect of real wealth on the dependent with owners of more than one property often enjoying actual rents (besides imputed rents for owner-occupied dwellings) that constitute an extra-source of (capital) income which can be addressed to consumption; all these coefficients are statistically significant at (at least) 1 percent level. The following coefficients shows the consumption to HR ratio is decreasing in current household income quintiles (implying, *coeteris paribus*, better off households saving a greater share of current income than poorer), than the non-monotonic age pattern and some interactions of age with occupational and educational dummies. It is worth noting the negative effect of household head being retired (-7 percent), which confirms the well-known one-off drop in consumption at the time of retirement.

Moreover, as expected, the higher the ratio of earners to household members the lower the propensity to consume (-27 percent). Finally, the *coeteris paribus* effects of household types suggests nuclear families - the

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[42] Following Bond (2002), allowing for dynamics in the underlying process "may be crucial for recovering consistent estimates of other parameters […] Even when coefficients on lagged dependent variables are not of direct interest"

[43] This method proves to be particularly suitable in the estimation of distributed lag models from panels with a large number of cross-sectional units (N), each observed for a small number of periods (T)

reference (omitted) category- are characterized by a lower propensity to consume out of the human life-time resources[44]. The estimation ends up with the time dummies[45].

***Table 2: Dynamic panel-data estimation of the consumption rule, two-step system GMM***

Number of obs = 21776
Number of groups = 10138
Number of instruments = 52
Wald chi2(27) = 18813.27
Prob > chi2 = 0.000

| **ln{C/HR}** | b | | se | t | Ci95 | |
|---|---|---|---|---|---|---|
| Lag.ln{C/HR} | 0.1152 | *** | 0.0259 | 4.4556 | 0.0645 | 0.1659 |
| ln_af_en | 0.0128 | *** | 0.0026 | 4.8835 | 0.0077 | 0.0179 |
| ln_ar_h | -0.0244 | *** | 0.0052 | -4.7274 | -0.0345 | -0.0143 |
| ln_ar_h*n_houses | 0.0069 | *** | 0.0018 | 3.8106 | 0.0034 | 0.0105 |
| ln_pf | 0.0135 | *** | 0.0019 | 7.1701 | 0.0098 | 0.0172 |
| Q2_income | -0.1185 | *** | 0.0197 | -6.0043 | -0.1571 | -0.0798 |
| Q3_income | -0.1589 | *** | 0.0222 | -7.1707 | -0.2024 | -0.1155 |
| Q4_income | -0.2282 | *** | 0.0249 | -9.1813 | -0.2769 | -0.1795 |
| Q5_income | -0.2908 | *** | 0.0289 | 10.0710 | -0.3474 | -0.2342 |
| age | 0.1892 | *** | 0.0507 | 3.7288 | 0.0898 | 0.2887 |
| age2 | -0.0061 | *** | 0.0014 | -4.4608 | -0.0088 | -0.0034 |
| age3 | 0.0001 | *** | 0.0000 | 6.0067 | 0.0001 | 0.0001 |
| age4 | 0.0000 | *** | 0.0000 | -7.4470 | 0.0000 | 0.0000 |
| age_self | 0.0010 | * | 0.0004 | 2.4646 | 0.0002 | 0.0019 |
| age_upsec | -0.0011 | *** | 0.0003 | -4.1302 | -0.0017 | -0.0006 |
| age_degree | -0.0034 | *** | 0.0004 | -8.1461 | -0.0042 | -0.0025 |
| Retired | -0.0704 | ** | 0.0233 | -3.0183 | -0.1162 | -0.0247 |
| earners_ratio | -0.2705 | *** | 0.0283 | -9.5756 | -0.3259 | -0.2152 |
| South | -0.0505 | *** | 0.0119 | -4.2364 | -0.0739 | -0.0271 |
| Single | 0.0171 | | 0.0198 | 0.8618 | -0.0218 | 0.0560 |
| Nusihehh | 0.1080 | ** | 0.0355 | 3.0388 | 0.0383 | 0.1777 |
| non_nusihehh | 0.3959 | *** | 0.0376 | 10.5271 | 0.3222 | 0.4696 |
| non_nuclfam | 0.1787 | *** | 0.0163 | 10.9877 | 0.1468 | 0.2106 |
| tau1991 | -0.0204 | | 0.0167 | -1.2196 | -0.0532 | 0.0124 |
| tau1993 | 0.0500 | ** | 0.0159 | 3.1525 | 0.0189 | 0.0811 |
| tau1995 | 0.0890 | *** | 0.0148 | 6.0144 | 0.0600 | 0.1180 |
| tau1998 | 0.0379 | * | 0.0161 | 2.3605 | 0.0064 | 0.0694 |
| tau2006 | 0.0232 | | 0.0131 | 1.7736 | -0.0024 | 0.0488 |
| Intercept | -5.7109 | *** | 0.7040 | -8.1118 | -7.0908 | -4.3311 |

Arellano-Bond test for AR(1) in first differences: z = -15.34 Pr > z = 0.000

Arellano-Bond test for AR(2) in first differences: z = 0.59 Pr > z = 0.552

Sargan test of overid. restrictions: chi2(23) = 72.23 Prob > chi2 = 0.000

[44] It is worth to stress once more that our definition of non-nuclear household does not include proper "composite structure" families with more than two adult members (except children) living in. Actually, if we allowed for this group in the analysis it would probably represent the highest savers group.

[45] These latter coefficients obviously are not employed in the simulation program but serve for purging the equation from time-specific effects only.

Hansen test of overid. restrictions: chi2(23) = 22.33 Prob > chi2 = 0.500

Difference-in-Hansen tests of exogeneity of instrument subsets:

GMM instruments for levels

Hansen test excluding group: chi2(20) = 19.55 Prob > chi2 = 0.486

Difference (null H = exogenous): chi2(3) = 2.78 Prob > chi2 = 0.427

Source: Author's computations on SHIW data, Historical Archive, panel component, waves 1991-2006

In the next section we discuss the estimation and the simulation mechanics of the intergenerational transfers sub-module.

### *5. The intergenerational transfers sub-module*

This section describes the functioning of another important block of the Wealth module. Indeed, this part of the model proves to be of fundamental importance in modeling private wealth within a dynamic microsimulation framework which aims at explicitly accounting -in a probabilistic fashion- for inter-generational links[46] and, therefore, at evaluating the between generations/cohorts role of private wealth transmission contemporaneously to a demographic as well as an institutional transitions. In fact, long since a broad consensus in the economic and sociological literature has been reached about the important role of intergenerational transfers on the process of household wealth accumulation and in the impact of social policies on the well being of individuals. For what concern the former issue several studies shows that *inter vivos* cash transfers and bequests involve a huge amount of resources every year which represents the most strait financial link across generations and may modify saving behaviour across them. Concerning the latter aspect, on a macro perspective the national saving rate depends strongly on how elderly – which typically hold a large share of total wealth - allocate their resources among consumption, *inter vivos* transfers to their children and bequest. On a micro perspective, intergenerational transfers may reduce inequality across generations but, in contrast, may enhance economic disparities within cohorts representing an important transmission channel of economic inequalities.

How social security reforms will affect the well being of individuals and the effectiveness of government redistribution to reduce inequalities will depend on the determinants of intergenerational transfers (Altonji *et al.*, 1997; Hurd *et al.*, 2007). Assessing the underlying reason for the intergenerational transmission of wealth, distinguishing in particular between the altruistic and the strategic motive, goes beyond the scope of the present work. However, the analysis of such phenomenon plays an important role in our study for at least two reasons:

i) on the one hand, since the empirical evidence shows the size of the wealth transfers is not negligible (although some uncertainty surrounds the exact magnitude of it) and that they are very concentrated, assessing the main statistical determinants of such choices is important since they have a significant impact on the overall wealth distribution;

[46] For instance, as far as we understand of SESIM III, in the Swedish MSM the transmission of private wealth is not explicitly modeled, that is a proper link across following generations is not allowed for, meaning that at an accumulation (for gifts and bequests) in a group in the sample does not correspond an equal and opposite de-cumulation in another group. Rather, SESIM each period, estimates the probability of owning a given stock of a certain asset for the households that have a null amount of it, then it imputes an amount to the selected units and, in the following periods, let it evolve, partly deterministically e partly stochastically, as a random walk.

ii) on the other hand, intergenerational transfers may support or even substitute social security transfers, especially whenever the latter are going to play a decreasing role in the future, as it is expected in Italy as a consequence of recent social security reforms. The question is even more crucial if we bear in mind three main features of Italian demography and economy: the secular decline in fertility, which is more pronounced in comparison with other European countries, the high saving rate of the elderly and the mortgage market imperfection which, determining important borrowing constraints for the young, would reduce even more their consumption capabilities as well as the decision and the possibility to purchase a house in the absence of substantial private wealth transmission.

In other words, we wonder what could be – in Italy - the likely evolution in the role of private transfers in the next decades wealth distribution, when cohorts which have been characterized by a higher saving rate and a lower number of descendants, compared with previous generations, will grow up and extinguish.

For this purposes, development in dynamic micro simulation represents a more and more powerful tool compared with other kind of methods since it provides a complete account of predicted transfers given and received each year which can be compared with actual data, incorporating any demographic transition and generating the future path of characteristics that determine choices. Moreover, it would accommodate differential saving rates and relevance of cohort and time effects by means of sensitivity analysis (Christelis, 2008).

A precedent of the use of micro simulation for the analysis of wealth transfers is the Wealth Transfer Microsimulation Model (WTMM) developed by the Center on Wealth and Philanthropy of the Boston College which is focused and dedicated on the wealth transmission phenomenon, focusing however on inter vivos philanthropic giving and charitable bequests, while, as far as we know, the modeling of intra-enlarged families wealth transmission in a "multitasking" dynamic population MSM is still very limited.

Concerning the quantitative evaluation of such a phenomenon, available data for Italy are still narrow. The only two sources are the Bank of Italy *Survey on Household Income and Wealth* (SHIW, 1992 and 2002 waves) and the *Survey of Health, Ageing and Retirement in Europe* (SHARE), which collects information on a representative sample of a cross country of populations for individual aged over 50. According to Cannari and D'Alessio (2007) which employ the former source, intergenerational transfers represent a significant share of Italian households net wealth: direct estimates referring to 2002 range from 30 to 55 percent, depending on the inclusion of the income stream produced by transferred assets. Moreover, transfers would be concentrated on the top of the distribution and therefore would represent an important factor in explaining wealth inequality persistence in Italy.

Similar results have been found in works based on SHARE data. This survey, collects more rich and detailed information compared with SHIW on wealth (and time in the form of reciprocal care) intergenerational transfers and provides the possibility to carry out cross country comparisons. To this end, Albertini, Kohli e Vogel (2008) show that the share of Italian households making a financial transfer in a year is smaller compared with northern countries families. Nevertheless, the share of transferred wealth is higher compared with the European average.

### *5.1 SHARE data and sample selection*

We base our econometric analysis of *inter vivos* monetary transfers on *SHARE* a cross-country, longitudinal survey which collects economic and socio-demographic information on a population of (mainly European) individuals aged over 50.

The sample includes "all individuals born in 1954 or earlier, speaking the official language of the country and not living abroad or in an institution such as a prison during the duration of the field work, and their spouses/partners independent of age"[47]. The recall period is 12 months preceding the interview. The survey includes a rich set of information concerning this population subgroup such as physical and mental health, employment, pensions, wealth, consumption, incomes, expectations and other piece of information on households standard of living.

In particular, SHARE represents a precious source on "intergenerational exchange both in terms of money – financial transfers (or material gifts) – and social reciprocal support.

To this purpose, our empirical analysis employs the release 2.2.0 of the first wave (surveyed in 2004) – composed of about 32,000 individuals whereof 3,100 Italians – in order to investigate the phenomenon of *inter vivos* monetary transfers towards children (and grandchildren) living out of the family of origin[48].

This micro data source has the peculiarity, unusual in other surveys, of collecting detailed information on respondents' children living out of the family of origin and allows the reconstruction of a correspondence between parents and children characteristics (influencing transfers) and, like this, a donor-recipient matching which is hardly obtainable by using other sources. Such an element is crucial when one wants to evaluate a phenomenon which stands out for its distributional implications and, in particular, for its role in the intergenerational transmission of inequality.

Moreover, SHARE is explicitly focused on detecting intergenerational relationships by means of specific modules collecting a set of targeted questions and cross-checks which should curb under-reporting and mis-reporting phenomena with reference to monetary transfers[49] compared to other sources – as SHIW – in which this aspect is surveyed non-continuatively, less in detail and with a much longer recall period.

The original sample includes both nuclear (i.e. composed of one or two married people (parents) plus children (if any)) and non-nuclear (families in which more than one family unit live together) households. Consistently with the demographic hypotheses which ground CAPP_DYN, that is to simulate the evolution of the Italian population allowing for nuclear families only, we dropped the household with a non-nuclear, composite structure by the econometric analysis.

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[47] For further information see: Klevmarken, N.A., Swensson, and Patrik Hesselius (2005)

[48] For couples, question on financial transfers and on social support received are addressed to only one member who is asked to answer for the couple, but if the two members declare they have separate finances , information on financial transfers is surveyed from each member individually. Such a survey design called for a complex building procedure of our dependent and explanatory variables.

[49] Missing values for financial wealth are filled in using multiple imputations as described in Christelis *et al.* In particular, by means of a Monte Carlo technique, missing values are replaced by five simulated versions.

In order to evaluate the determinants of transfers we further restrict the sample by considering only household with children living out of the family of origin. Such a selection reduces the sample size to 16,871 households whereof 1,533 are Italian. Such a size does not allow to focus the analysis on Italian families only, but we will control for systematic differences from other countries by means of dummy variables.

### *5.2 The econometric models*

The empirical analysis we carried out aims at estimating simplified econometric models of *inter vivos* financial transmission, in order to get the parameters to be implemented in the simulation program, within the probabilistic part of the intergenerational transfers sub-module. In fact, as we will discuss in paragraph 5.3 this block also manages bequests that, nevertheless, follow a mechanical logic, being residually determined. Indeed, this *mortis causa* component of wealth transmission is the final results of the dynamics of savings provided by the consumption rule coupled with the probabilistic decisions of *inter vivos* transmission as well as all the demographic and incomes processes simulated by the pre-existing modules of CAPP_DYN. In this sense, bequests represent the closing process of the whole set of probabilistic and behaviuoral processes carried out by the other modules of CAPP_DYN.

The methodology we adopt in the *inter vivos* estimates is based on a traditional two part approach (where the first equation estimates the probability and the second the amount) and, in order to control for possible selection biases, draws on the micro-econometric literature of estimation using a control function. In fact, the basic assumption according to which the data we seek to analyze is a random sample from a population is not met if being observed in the data is the outcome of a choice by the unit of analysis (individuals or households). In our case, some households choose to make a transfers to a child or to a grandchild. For those who choose not to make a transfer, then their (transferring) behavior is not observed. It follows the data is selected and not a random sample. In other words, we are interested in the population average effect of some determinants on the amount transferred but the sub-sample of observed donors (or recipients) could not represent the whole population. Therefore we will introduce a Heckman correction in the OLS estimation of the amount, whether it is needed.

In SHARE, i*nter vivos* financial transfers are defined as “gifts, financial or material support (other than food or shared house) of at least 250 euros from/to someone within or outside the household”. For our purposes we isolate transfers towards children or grandchildren living outside the respondent household.

The practical needs in order to implement *inter vivos* giving and receiving processes in the current dynamic simulation structure of CAPP_DYN impose some constraints to the empirical analysis. In particular, on the one hand they ask for the exclusion of several statistical controls that would be informative in econometric terms (as well as on a theoretical perspective) but that the current version of CAPP_DYN cannot dynamically age. On the other, they make us consider the separate modeling of the two sides of the transfer (donor and recipient) as an appropriate strategy. Therefore, we also had to construct a child level dataset[50] where the unit of analysis is the child's family (which is more likely to be recipient), rather than his/her parents, by means of an "inversion" of the original dataset. In practice, we had to convert the original dataset -representative of a population of over 50 individuals- from wide to long form, by keeping the household heads only, by using household ID as the logical observation by which to re-organize the data and by choosing the variables that contain the numbers of the children who were selected by the program as the variables over which we carry out the reshape[51]. We end up with two datasets. The original one, that we call "potential donors" and the derived one, that we call "potential recipients"[52]. Then we estimate the two sides of the exchange separately on the two datasets using, however, some mutual characteristics (i.e. recipients characteristic in the donor equation and *vice versa*).

In other terms, the two sides of the wealth transmission are analyzed independently of each other. Nevertheless, the inclusion of characteristics of both observational units in the equations (especially, controlling for parents financial wealth in the recipient regression) allows to explain a quite similar share of the variance of the dependent variables in the two outcome equations (i.e. transfers given and received), thus providing predicted values characterized by a quite similar variability. This property, as we will better clarify in the next paragraph, will prove to be important in the simulation stage in order to avoid an excessive under-estimation of the intergenerational transmission of inequality through an unrealistic *within* cohort redistributive effect of private wealth inter-generational transfers.

Finally, since we are interested in the simulation of transfers of a certain amount, we restrict the estimation to transfers which are above the floor of 1500 euros.

Therefore for the donor model we construct two dependent variables each for each estimation step:

a) in the selection equation (discrete choice) we employ a binary variable which is equal to one if the interviewed household has made at least a transfer (from 1 to 3) towards children or grandchildren in the 12 months preceding the interview, zero otherwise.

b) For the outcome equation the dependent is built as the natural logarithm of the transferred amount on donor financial wealth[53] (gross of transfer) ratio.

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[50] To restrict the recipient estimation (besides the donor) on the original unit of observation (the over 50 population) would have been easier. Nevertheless, in this age group the *inter vivos* financial receiving is quantitatively less considerable, being such a group currently characterized by a marked net outflow. On the contrary, the most significant inflows for this subgroup are bequests.

[51] In fact, in the survey the questions about children are only asked for a maximum of four children. When there are more than four children, the CAPI program selects the four children following a set of given criteria.

[52] Of course the latter dataset, given its derived nature, contains just a limited number of information that is directly related to the new observational units (i.e. the children of the original observational units). Moreover, it may not satisfy all the requirements of a random sample of the population. In particular, it could show a typical hierarchical structure where the levels are 1.child, 2.household and 3.country which, whether not properly accounted for, could determine a residual cross-correlation. A suitable methodology could consist of fitting multilevel models. At the stage of the research, given our practical needs, we neglect such a potential source of distortion, trusting it is not too strong.

[53] Financial wealth includes bank accounts, government and corporate bonds, stocks, mutual funds, individual retirement accounts, contractual savings for housing and life insurance policies.

***Table 3***
***Descriptive statistics of donor dependent variables on the whole and on the Italian sample***

| | whole sample | | | | | Italy | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Obs | Mean | Sd | min | max | Obs | Mean | Sd | min | max |
| Donor | 16871 | 0.259 | 0.438 | 0 | 1 | 1533 | 0.216 | 0.412 | 0 | 1 |
| Amount | 4371 | 6012 | 18492 | 250 | 421931 | 332 | 5775 | 13683 | 250 | 150000 |
| Tr/ fin_wealth ratio | 4371 | 0.22 | 0.315 | 0.0001 | 1 | 332 | 0.359 | 0.39 | 0.0005 | 1 |

Source: Author's computation on SHARE data (2004)

The final distribution on household sample of potential donors shows that 25.9% "European", over 50 families, with at least a child living outside, has made at least a transfer towards children or grandchildren in 2004. For Italy, the share of donor households is slightly lower (21.6%). This evidence is far above the information which emerges from SHIW (2002) according to which households who declare making at least a gift *over their whole life* are about 5%, while those who declare receiving a transfer in the same year are 0.18% only.

The average transferred amount on the entire sample is about 6000 euros and for Italy is 5775 euros.

The average value of the transfer on financial wealth ratio (conditioned to a positive transfer) is about 0.22 on the overall sample and about 0.36 on the Italian sub-sample. At first glance, it seems Italian households have a quite lower frequency of transfer compared to other countries but, when they do transfer, the relative amount is higher with respect to the net wealth of recipients. Moreover, we have to bear in mind that in Italy, and generally in Mediterranean countries, children use to exit from the family of origin later than their European contemporaries. Therefore, part of the (implicit) intergenerational transfer in Italy could pass through an extended cohabitation with parents.

The set of explanatory variables of the donor model includes:

- polynomial in age of household head;
- gender;
- education: diploma, degree or postgraduate (ref.: lower secondary)
- household structure: single or married and living with the partner;
- employment status: in work, unemployed, retired;
- net wealth quintiles (gross of transfers, if any) computed by country

explanatory variables of the recipient side in the donor models are:

- dummy equal to 1 if the aim of the transfer is the financial support for a child marriage or a grandchild birth (marr_or_birth);
- dummy equal to 1 whether *at least a child* is unemployed (ch_unemp).

For the recipient model:

a) The dependent of the selection equation is a binary variable which is equal to one if the child household being observed received a transfer in the 12 months preceding the interview, zero otherwise.

b) In the outcome equation, the dependent variable is the natural logarithm of the transfer received (in level)

***Table 4***
***Descriptive statistics of recipient dependent variables on the whole and on the Italian sample***

| | *Whole sample* | | | | | *Italy* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Obs | Mean | Sd | Min | Max | Obs | Mean | Sd | min | max |
| Recipient | 31835 | 0.1502 | 0.3572 | 0 | 1 | 2259 | 0.1217 | 0.3270 | 0 | 1 |
| Amount | 4782 | 4015 | 13527 | 250 | 371931 | 275 | 4530 | 12555 | 250 | 150000 |

Source: Author's computation on SHARE data

The final distribution on household sample of potential recipients shows that 15 percent of overall derived families receives at least a transfer in 2004 amounting, on average, to 4000 Euros. For the Italian subgroup the frequency is a bit lower (0.12) an the average amount is a bit higher (4500) than the overall sample.

Among the covariates of the recipient model, besides a polynomial in age we use some occupational and household structure controls plus the existence of children (which in turn are grandchildren for the donors) and, as a cross-explanatory variable, the (pre-transfer) financial wealth of the family of origin.

In the tables 5 and 6 we report estimated coefficients for the two separate models. For the donors model, the evidence reported in the descriptive statistics of a lower probability joint to a larger share of transferred wealth for Italian households is also confirmed in the regression coefficients; in fact, in the selection equation, estimated by means of a *logit* model, ITA dummy coefficient is negative and significant (-0.27), while in the outcome equation is positive and significant, with an elasticity of 70 percent.

The effect of age (positively concave and negatively convex in the selection and in the outcome equations, respectively) should be interpreted with caution as it is not feasible to disentangle cohort effects in a cross sectional analysis.

Belonging to higher net wealth quintiles still has a positive sign in the *logit,* but has a negative sign in the outcome equation. Therefore, better off households show a higher transfer probability but, as a share of their financial wealth, they transfer less compared to less richer families. Donor household head's educational level has a positive impact on the probability while not on the intensity. Employed household heads show a higher transfer probability but a lower ratio (probably due to a greater denominator). Turning to the recipients characteristics, the determinant role for parents giving of some specific events in the recipient life (such as unemployment, marriage, child birth) is confirmed and increase both the probability to be donor and the amount. In particular, we use latter variable, i.e. wed_or_birth - that is strongly significant and very powerful (coefficient 3.2) in predicting the financial giving event - in the selection equation only, in order to satisfy the exclusion restriction for the Heckman correction. Such augmentation proves to be opportune in controlling for the selection bias, as (the inverse of the) Mills ratio coefficient is extremely significant and positive (.27).

Turning to the recipient equations (table 6), due to the derived nature of the dataset, we can estimate just a model with a reduced number of covariates and controls and no valid exclusion restrictions. Therefore, we do not control for selectivity that however, in the case of recipients, is likely to be less severe than for donors. Moreover, the dependent variable in the outcome equation is the level amount of received transfer, rather than the ratio to financial wealth, information on children's household wealth being not available in the data.

In particular, the presence of a child in the recipient family (i.e. a grandchildren for the donor) as well as the status of divorced or single strongly increase the probability to receive a transfer (being .28 and .64 the estimated coefficients of the first and the other covariates), while the former characteristic negatively influences the amount, though with a low statistical significance. Moreover, households with a graduated head seem to enjoy a higher receiving probability than less educated people[54]. Italian recipients show both a higher average probability (.20) and a greater average amount (.24) compared to the other European homologues. This evidence seems at odds with the evidence of a lower giving probability in the table 5. Nevertheless Italian households tend to transfer more often to all of their children (if they have more than one) when they do that and have, on average, a slightly few number of children (2.04) compared to the overall sample (2.13) therefore, from the population of recipients point of view, this fact translates in a higher probability of taking a more generous gift. Finally, a powerful determinant of transfer receiving is, as expected, the financial wealth of the family of origin which shows .17 coefficient and 9 percent elasticity in the selection and in the amount equation, respectively. We will show in the next section how we impute the values of this variable for the households we cannot link to any potential donor in the simulated sample because the household of origin is not observable and will clarify why we decided to account for this determinant of the transfer receiving (at least, stochastically) in the dynamic simulation program, even if it is not always observable.

[54] Children' education is partially correlated with parents economic resources therefore it is a channel of transmission of inequality.

***Table 5:Two-step estimation for intergenerational giving with Heckman correction***

| | | | | | | |
|---|---|---|---|---|---|---|
| | | ***Donor side*** | | | | |
| **Logit Probability of being Donor** | b | | Se | t | ci95 | |
| Age | 0.0807 | *** | 0.0243 | 3.3247 | 0.0331 | 0.1282 |
| age2 | -0.0007 | *** | 0.0002 | -3.6454 | -0.0010 | -0.0003 |
| in work | 0.3522 | *** | 0.0520 | 6.7709 | 0.2502 | 0.4541 |
| Q3_wealth | 0.4146 | *** | 0.0543 | 7.6407 | 0.3082 | 0.5209 |
| Q4_wealth | 0.6046 | *** | 0.0531 | 11.3847 | 0.5005 | 0.7087 |
| Q5_wealth | 0.6989 | *** | 0.0531 | 13.1703 | 0.5949 | 0.8029 |
| child_unemp | 0.2835 | *** | 0.0625 | 4.5362 | 0.1610 | 0.4060 |
| wed_or_birth | 3.2668 | *** | 0.1205 | 27.0990 | 3.0305 | 3.5030 |
| upper_secondary | 0.5074 | *** | 0.0463 | 10.9505 | 0.4166 | 0.5982 |
| degree_or_more | 0.7420 | *** | 0.0502 | 14.7720 | 0.6435 | 0.8404 |
| Ita | -0.2737 | *** | 0.0747 | -3.6648 | -0.4201 | -0.1273 |
| _intercept | -4.4368 | *** | 0.8158 | -5.4386 | -6.0358 | -2.8379 |
| **OLS ln{Ratio }** | b | | se | t | ci95 | |
| Age | -0.7785 | ** | 0.2404 | -3.2378 | -1.2498 | -0.3071 |
| age2 | 0.0113 | ** | 0.0036 | 3.1508 | 0.0043 | 0.0183 |
| age3 | -0.0001 | ** | 0.0000 | -3.0735 | -0.0001 | 0.0000 |
| in work | -0.4384 | *** | 0.0866 | -5.0614 | -0.6081 | -0.2686 |
| Retired | -0.2449 | ** | 0.0849 | -2.8834 | -0.4114 | -0.0784 |
| Unemp | -0.4619 | ** | 0.1649 | -2.8011 | -0.7851 | -0.1386 |
| ch_unemp | 0.3006 | *** | 0.0817 | 3.6810 | 0.1405 | 0.4606 |
| Q3_wealth | -0.5422 | *** | 0.0752 | -7.2122 | -0.6896 | -0.3948 |
| Q4_wealth | -0.8931 | *** | 0.0736 | -12.1293 | -1.0374 | -0.7487 |
| Q5_wealth | -1.4278 | *** | 0.0733 | -19.4826 | -1.5715 | -1.2841 |
| Ita | 0.7029 | *** | 0.0951 | 7.3954 | 0.5166 | 0.8893 |
| ***mills_ratio*** | 0.2653 | *** | 0.0414 | 6.4036 | 0.1841 | 0.3465 |
| _intercept | 15.5409 | ** | 5.3305 | 2.9154 | 5.0904 | 25.9915 |

Source: Author's computations on SHARE data, wave 2004

***Table 6: Two-step estimation for intergenerational receiving without Heckman correction***

| | | | | | | |
|---|---|---|---|---|---|---|
| | | ***Recipient side*** | | | | |
| **Logit Probability of being Recipient** | b | | t | ci95 | | |
| log (af parents) | 0.1690 | *** | 0.0061 | 27.9277 | 0.1572 | 0.1809 |
| Age | -0.0883 | *** | 0.0105 | -8.4309 | -0.1089 | -0.0678 |
| $age^2$ | 0.0007 | *** | 0.0001 | 5.1123 | 0.0004 | 0.0009 |
| Married | 0.3004 | ** | 0.1119 | 2.6837 | 0.0810 | 0.5198 |
| Single | 0.6497 | *** | 0.1125 | 5.7755 | 0.4292 | 0.8702 |
| Divorced | 0.6462 | *** | 0.1288 | 5.0152 | 0.3936 | 0.8987 |
| in work | -0.2689 | *** | 0.0403 | -6.6680 | -0.3479 | -0.1898 |
| Degree | 0.3421 | *** | 0.0414 | 8.2639 | 0.2610 | 0.4232 |
| Grandchildren | 0.2863 | *** | 0.0442 | 6.4715 | 0.1996 | 0.3729 |
| Ita | 0.1984 | ** | 0.0709 | 2.7981 | 0.0594 | 0.3374 |
| _Intercept | -1.3815 | *** | 0.2094 | -6.5968 | -1.7920 | -0.9710 |
| **OLS ln{Amount}** | b | | se | t | ci95 | |
| ln{af parents} | 0.0892 | *** | 0.0079 | 11.3639 | 0.0738 | 0.1046 |
| Age | 0.0253 | * | 0.0147 | 1.7236 | -0.0035 | 0.0540 |
| $age^2$ | -0.0004 | * | 0.0002 | -1.8941 | -0.0007 | 0.0000 |
| Grandchildren | -0.1051 | * | 0.0567 | -1.8541 | -0.2163 | 0.0061 |
| Married | 0.1911 | *** | 0.0494 | 3.8684 | 0.0942 | 0.2880 |
| Ita | 0.2481 | ** | 0.0944 | 2.6275 | 0.0629 | 0.4333 |
| _Intercept | 7.0280 | *** | 0.2699 | 26.0390 | 6.4987 | 7.5574 |

Source: Author's computations on SHARE data, wave 2004

### *5.3 Implementation of the transfers sub-module in CAPP_DYN*

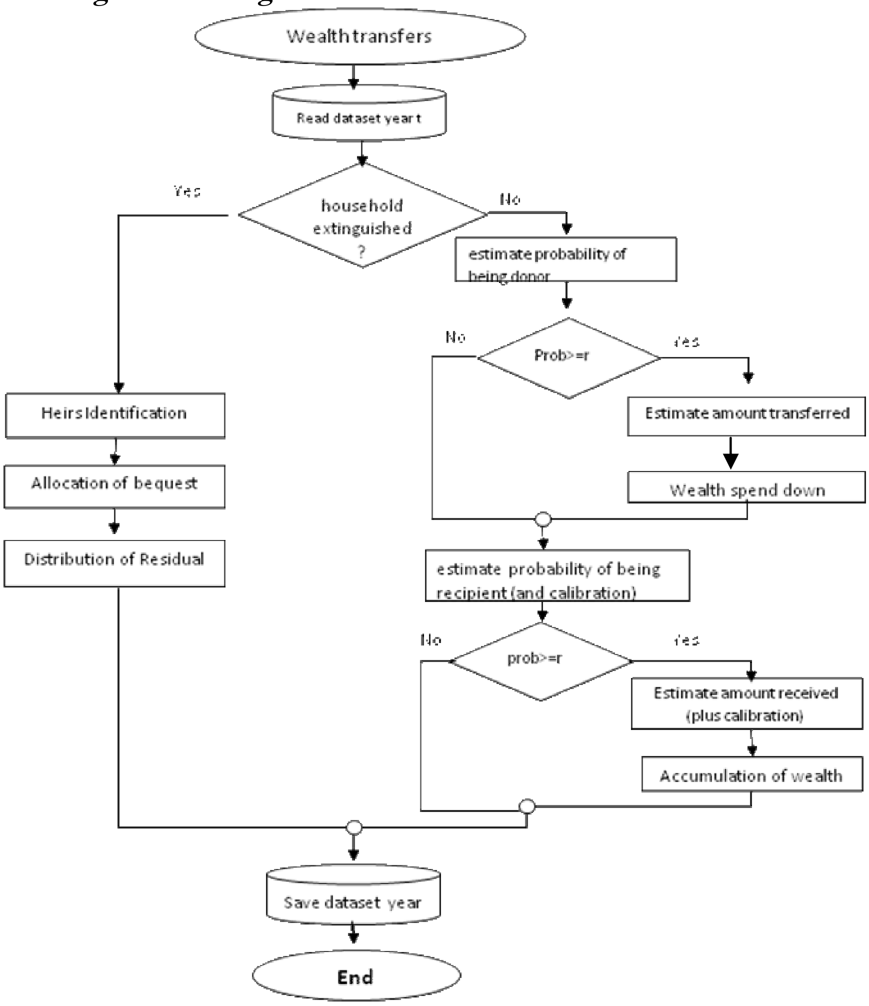
In this section we describe the structure of the intergenerational transfer sub-module of CAPP_DYN. This module includes the set of procedures which allow the transmission of financial and real (only in bequest processes) wealth among the family units in every year of simulation.

In the simulation program, as we mentioned in the previous paragraph, wealth transfers may occur *inter vivos* or *mortis causa*. The former involve redistribution of wealth from donor to recipient family units which are linked by ties of blood during their all life cycle. The latter occur when a household extinguishes in the model (because all of their member died), through the distribution of net wealth (whether positive) among heirs.

In the current release of the model we assume *inter vivos* transfer decisions depend on socio-economic characteristics of the observational unit, according to the estimates reported in the regression tables showed in the previous section. In other terms, every year of simulation, first the model within the original blocks determines such characteristics then, conditional to these observables, wealth transfers are simulated. As already discussed, feedbacks from wealth decisions to demographic, occupational and pension choices are not allowed yet. In practice, household wealth endowment of period t-1 is dynamically brought up to date in t, allowing for possible wealth transfers - given or received in – t, before the other Wealth module processes start to run.

Figure 10 shows a simplified structure of the sub-module. The starting point is the identification of alive households in the current year. Among households with head aged over 50 and with a positive wealth in the previous period, the model selects those with the highest transfer probability. This selection follows a pseudo-random lottery, that is, the model compute the deterministic prediction of the discrete choice model reported in table 5, upper panel. Such a conditional probability (score) coupled with a Monte Carlo process allows the selection of the actual donor households among those with the highest score. The model endogenously determine the donors share, depending on the interaction of the econometric model and the Monte Carlo stochastic ranking . The second step determines the transferred wealth as a share of household enlarged financial wealth, on the basis of the estimated coefficients reported in table 5, lower panel.

***Figure 10: Intergenerational transfers sub-module structure***



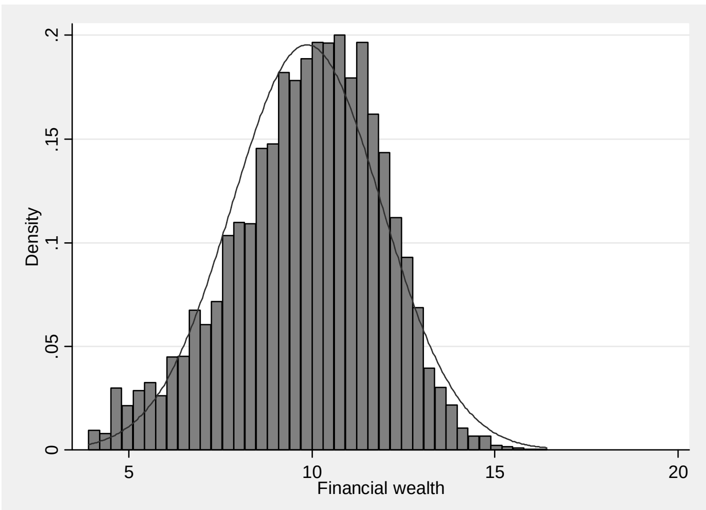

Once donor households have been identified and the wealth to be transferred has been determined, the model brings up to date the stock of household financial assets. The down spending of donors' wealth is deterministically simulated, by subtracting the amount transferred by the pre-transfer held stocks.

The following step starts from the identification of the potential recipients of a wealth transfer. The model deterministically predicts a conditional probability according to econometric model reported in table 6, upper panel. The received amount is determined by using the coefficients got by the regression of log-levels reported in lower panel of the same table.

In particular, the (log) value of parents' financial assets for those family units the model cannot link to a potential donor in the sample in a period t is obtained as a draw from a normal distribution with mean and variance equal to the actual first and second moments of the financial wealth distribution among over 50 families in period t. This strategy issues from the empirical evidence that the current over 50s financial wealth distribution approximates a log-normal distribution, as reported in figure 11. This procedure implicitly assumes the future distribution of financial wealth will change in its mean and variance only (not a really strong assumption) and that such a draw is independently distributed over time[55] and across families.

We follow this approach rather than simply exclude this variable from the set of recipient equations regressors, in order to warrant a pretty good matching between the variances of given and received simulated transfers. On the opposite, the exclusion of such a covariate (which explains much of the selection/outcome equations) in the recipient equation would have implied a much lower variability in the predicted amount of the received transfers (inflows) compared to the variance in the predicted amount of the given transfers (outflows). This fact would have ended up to make the transfer sub-module work as a progressive tax-benefit module, with obvious distorting rebounds on the transmission of inequality among generations. In practice, we introduce an important explanatory factor in the recipient equations that, whenever unobservable, is substituted by a random-component whose first two moments, however, are not fixed over the simulation period, but are time-varying according to the distributional evolution of the enlarged financial wealth among over 50 households.

***Figure 11***
***Distribution of financial assets among over 50 households***




Source: Author's computation on SHARE data (2004)

[55] This is a stronger, less realistic assumption. Nevertheless, just few households are selected for receiving an inter vivos transfer more that once or twice in a life cycle, so this implicit assumption proves to be quite innocuous in distributional terms.

Next, the model verifies the consistency between the total (out-and-in)flows and, every year, imposes the following condition to hold:

$$\sum_{i=1}^{J} af_t^G = \sum_{i=1}^{K} af_t^R \qquad (1)$$

Where J and K are the households which give (G) and receive (R) a transfer, respectively, while *af* is the amount of transferred financial wealth. Condition (1) ensures an accounting consistency in the process of *inter vivos* transmission.

In case a family unit extinguishes due to the death of the last member, the model simulates the (proportional) transmission of the whole wealth endowment to the heirs. It is worth pointing out that it would be very difficult to allow for the whole family relationship in sample population. The most of the dynamic micro simulation models developed in Northern Europe, United States and Australia consider the individual as the unit of analysis, explicitly admitting the serious technical difficulties in simulating the evolution of familiar links. Such a drawback is of great importance when the focus of the analysis is on the distribution of wealth. To this end, we try to account for the main family relationships in order to define the heir stall of bequests. Currently CAPP_DYN allows to consider the relationships among individuals which, during the survey (2002) shared the same house plus those individuals who lived outside the family of origin at that time but whose existence was, however, reported by the survey respondents[56]. Therefore, we consider among potential heirs all the children, grandchildren and common-law spouses in the initial population plus the children living outside (i.e. not included in the sample) plus children and grandchildren born during the simulation period. In this way we should account for the most part of the heir stall.

Once the number of heir family units are defined, bequests are deterministically simulated with the stock of wealth being proportionally distributed among them in the form of financial wealth while the flows toward out-of-sample heirs is initially destroyed. Then, in order to ensure the accounting consistency of the wealth stocks in the economy the model imposes every year the following identity to hold:

$$\sum_{i=1}^{J} nw_t^G = \sum_{i=1}^{K} nw_t^R + \text{Res} \qquad (2)$$

Where J is the number of extinguishing family units in each year which pass on their wealth (G) *mortis causa*, K is the number of in-sample heirs which receive a bequest (R), *nw* is the net wealth transferred amount (in the form of financial wealth) and Res is the residual amount consisting of the net wealth of households which extinguishes without heirs plus the wealth shares received by out-of-sample heirs.

At this stage we decided to impute such a residual through calibration, where Res is distributed as a proportion of net worth already held by the household, in order not to alter the sample wealth distribution.

[56] For these individuals the assumption is they die after their parents with probability equal to 1.

**Appendix A: SHIW data**

As already mentioned, all estimates of the Wealth – except for the equations of the transfers sub-module - are based on the Bank of Italy's Survey of Households Income and Wealth (SHIW), the Italian official source for distributional analysis. The survey collects information on economic situation - income and wealth (since 1987) - savings and consumption behaviour (since 1980) - and social features of a sample of families (sample size varying from 3000 families in the 1966 to 8000 since 1986) in the period 1977-2006[57].

The sampling scheme is organized in two-stages: firstly, municipalities are selected according to 51 strata; in a second step households are randomly selected within the stratum.

The historical archive used for the analysis collects waves since 1977 (no micro-data are available for earlier years) and provides files containing income and wealth adjusted according to homogeneous definitions (excluding variables which were not collected in a systematic way) both at household and individual level; weights aligning socio-demographic distributions with ISTAT population statistics and labour force survey (post-stratification) are also provided for (Brandolini, 1999).

The survey unit is the household, i.e. "group of individuals linked by ties of blood, marriage or affection, sharing the same dwelling and pooling all or part of their incomes" (Brandolini, 1999); however, as information are gathered at individual level (interest, dividends and financial assets being recorded at family level only), analyses on personal income are allowed as well.

SHIW income is net of taxes and social security contributions, hence it does not provide any information on tax and redistribution issues.

Since 1989, a panel section composed of households already interviewed in the previous wave is provided for. The panel size was 15% of the sample in the 1989 but increased over time to reach the 45% in the 1995. Moreover, since 1995 people leaving a family included in the panel and creating a new family were included (Brandolini, 1999). We exploited this component in our estimates of the consumption rule.

Anyway, these datasets should be used with great caution for several reasons. Differential response rate among groups, under-reporting and mis-reporting (especially for capital income) are in fact likely to bias estimation based on this source. In particular, under-reporting seems significantly widespread among self-employed (nearly 20% in 1987, according to Cannari and Violi's (1995) estimates) and inversely correlated to household income and wealth, causing an underestimation of mean income and inequality[58] (Cannari and D'Alessio, 1993).

In addition, a comparison with National Accounts data (through a grossing-up procedure) shows a slight overestimation of wages while a severe underestimation for self-employment income and net interest on financial assets is recorded (respectively by 50% and 65-70%), resulting in an underestimation of total income of about 30% (32% when interest and dividends are included, Brandolini, 1999).

Concerning wealth, analyses based on the comparison between micro and macro data showed the amounts recorded in the SHIW under-estimate both real and financial components of wealth (Brandolini et al., 2004). In

[57] Starting in 1966, the SHIW was conducted yearly up to 1987 (except for 1985) and every two years since then, the last wave being in 2006. The new wave 2008 is available from January 2010.

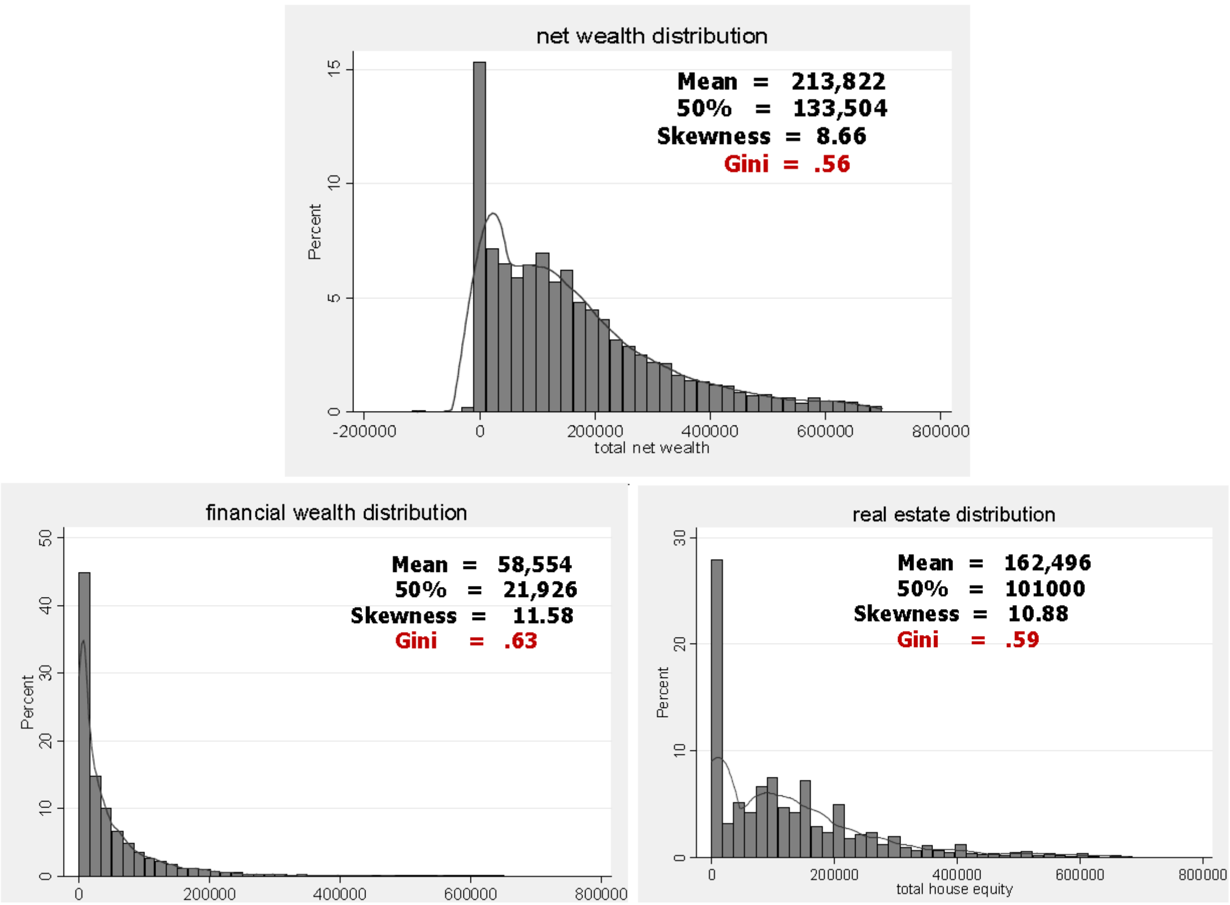
[58] Response rate seems declining sharply from 26% of poorest to 14% of richest (Cannari, D'Alessio, 1992).

2002 the total financial assets estimates derived from the survey is about one third of the corresponding value from Financial Accounts (Bonci et al., 2005).

To this end, concerning misreporting, no comparable data are available for real wealth in the official National Accounts, therefore we do not make any adjustment for the level of reported real wealth.

Finally, concerning financial wealth, we employ the adjusted values provided by D'Aurizio et al. (2006)[59] which matched the 2002 SHIW wave with anonymous data from a sample survey of customers of the Unicredit group on the assets actually owned by the customers. By using advanced econometric techniques, this procedure determines a substantial correction for private bonds and mutual funds, particularly significant for single household and increasing with age. We do not employ the adjusted data in the econometric stage (except for the estimation of the risk propensity, reported in appendix B), but we replace them in the initial population (SHIW 2002) in order to simulate more realistic distributions.

**Figures 12: distribution of household net wealth (upper), financial wealth (bottom left) and house equity (bottom right)**



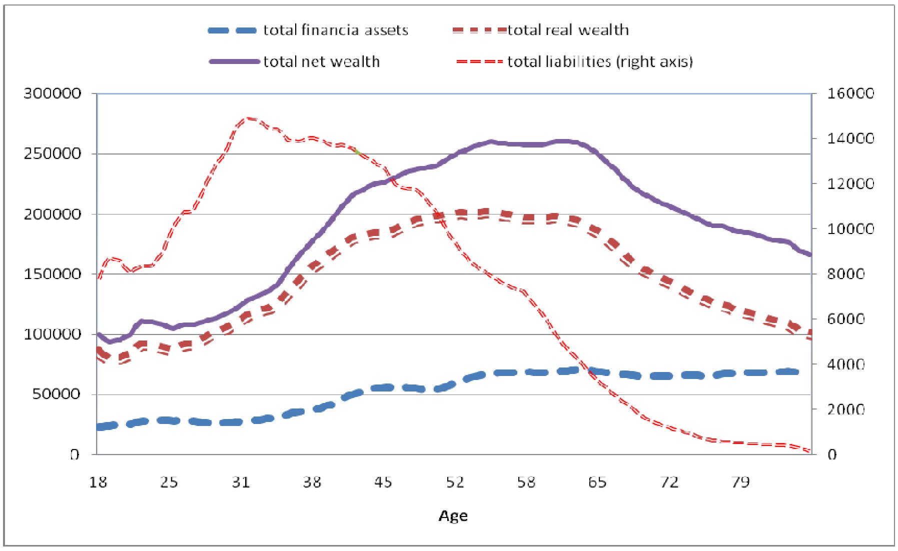

Source: Author's computations on SHIW 2002, Euros 2002

[59] We are grateful to Leandro D'Aurizio, Ivan Faiella, Stefano Iezzi and Andrea Neri for providing us with data adjusted for under-reporting resulting from their work "L'under-reporting della ricchezza finanziaria nell'Indagine sui Bilanci delle Famiglie Italiane".

Here above in figures 12 we show the distribution of net wealth (upper panel) financial wealth (bottom left) and real estate (bottom rignt) in the initial dataset (SHIW 2002) across Italian households, emboding the correction on financial assets we described above. As we can see, the 2002 distribution of net worth in Italy is pretty unequal and right skewed with a mean of 212,000 euros, a median of 133,000 and the Gini is equal to 0.56. Financial assets aggregate, as expected, is the most unequally and skewed distributed (Gini is 0.63 with a skewness of 11.58) and its mean value is about 58,000 euros. Finally, real estate (without corrections) is the most important wealth component with a mean of 162,000 euros and Gini of 0.59.

In figure 13 we show the age profile[60] of each wealth component in the initial dataset 2002, while in the following figure 14 the age profile of the risky and non-risky components of financial assets as well as the share of household holding risky assets in 2002

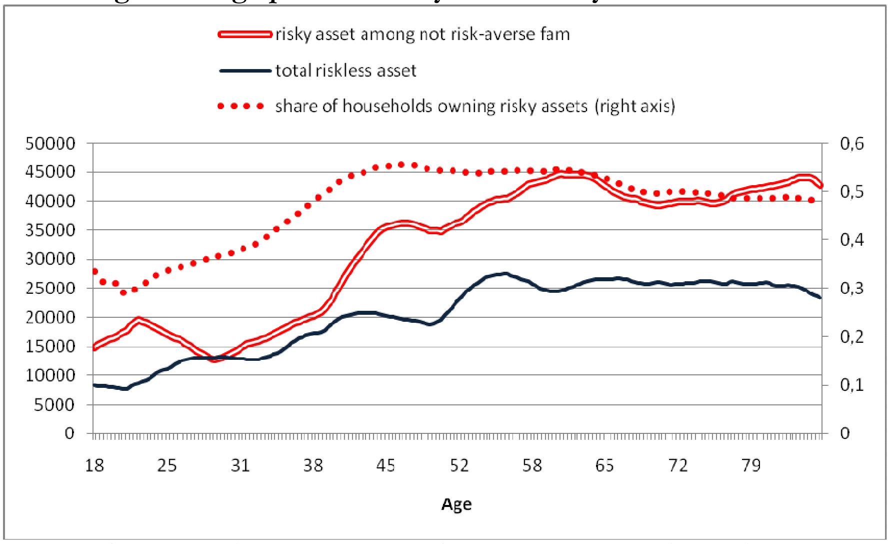
**Figure 13: wealth component age profiles**




Source: Author's computations on SHIW 2002, Nadaraya-Watson nonparametric regression, Euros 2002

[60] Given the cross-sectional nature of this fit, age and cohort effects are confused.

**Figure 14: age profile of risky vs non-risky financial assets**




Source: Author's computations on SHIW 2002. Nadaraya-Watson nonparametric regression, Euros 2002

***Appendix B: Heckman estimation of enlarged financial wealth allocation between risky and non risky assets***

***Table 7: Two-step Heckman estimation for financial allocation***

| **Share of AF invested in risky assets (outcome)** | B | se |
|---|---|---|
| Age | 0.0089 | 0.0023 |
| $age^2$ | 0.0000 | 0.0000 |
| Public | 0.0502 | 0.0141 |
| Q2_wealth | -0.1224 | 0.0192 |
| Q3_ wealth | -0.1179 | 0.0198 |
| Q4_ wealth | -0.1704 | 0.0218 |
| Q5_ wealth | -0.2712 | 0.0269 |
| South | -0.1377 | 0.0177 |
| second_house | 0.0328 | 0.0135 |
| Intercept | 0.3641 | 0.0786 |
| **Probability of holding Risky assets (selection)** | B | Se |
| Age | 0.1364 | 0.0328 |
| $age^2$ | -0.0020 | 0.0006 |
| $age^3$ | 0.0000 | 0.0000 |
| Public | 0.1379 | 0.0525 |
| Q2_wealth | 0.3815 | 0.0505 |
| Q3_ wealth | 0.4467 | 0.0501 |
| Q4_ wealth | 0.5771 | 0.0508 |
| Q5_ wealth | 0.8781 | 0.0585 |
| upper_secondary | 0.4300 | 0.0397 |
| degree_or_more | 0.4807 | 0.0654 |
| Nuclfam | 0.1231 | 0.0333 |
| Center | -0.1789 | 0.0411 |
| South | -0.7548 | 0.0364 |
| second_house | 0.1334 | 0.0581 |
| Intercept | -3.4097 | 0.5876 |
| Mills | | |
| Lambda | 0.0494 | 0.0337 |
| Rho | 0.1875 | |
| Sigma | 0.2634 | |
| mu_res | 0.0000 | |
| sd_res | 0.2608 | |

Source: Author's computations on SHIW data, Historical Archive, wave 2002

## *Appendix C: House property decisions*

***Table 8: logit estimation for buying first house (top left) second houses (top right) and Selling (bottom right)***

| **Buy 1st dwelling Probability** | B | se |
|---|---|---|
| Q2_age | -0.8422 | 0.1459 |
| Q3_age | -1.1084 | 0.1459 |
| Q4_age | -1.6072 | 0.1589 |
| Q5_age | -1.8556 | 0.1627 |
| Q6_age | -1.8798 | 0.1608 |
| Q7_age | -2.2899 | 0.1839 |
| Q8_age | -2.6652 | 0.2303 |
| Q9_age | -2.7448 | 0.2503 |
| Q10_age | -3.1097 | 0.3068 |
| Q3_income | 0.3533 | 0.1302 |
| Q4_income | 0.3284 | 0.1263 |
| Q5_income | 0.5198 | 0.1239 |
| Intercept | -2.6902 | 0.1240 |
| sd_residual | 0.5508 | |

| **Buy 2nd houses Probability** | B | Se |
|---|---|---|
| Q7_age | 0.4558 | 0.2942 |
| Q4_income | 0.2132 | 0.3779 |
| Q5_income | 0.9777 | 0.3021 |
| Q5_wealth | 1.9461 | 0.3100 |
| Intercept | 6.9155 | 0.2992 |
| sd_residual | 1.0302 | |

| **Selling Probability** | b | Se |
|---|---|---|
| q_eta7 | 0.8393 | 0.1896 |
| q_eta8 | 0.4566 | 0.2281 |
| Q2_wealth | 0.7548 | 0.3510 |
| Q3_ wealth | 0.7777 | 0.3671 |
| Q4_ wealth | 1.3940 | 0.3349 |
| Q5_ wealth | 1.9592 | 0.3247 |
| upper_secondary | 0.6642 | 0.1609 |
| degree_or_more | 0.9349 | 0.1972 |
| Intercept | 6.9076 | 0.2952 |

Source: Author's computations on SHIW data, Historical Archive, waves 1991-2006

***Table 9: OLS estimation for 1st house (left) and 2nd houses (right) values as net worth ratios***

| **1st house value ratio** | B | Se |
|---|---|---|
| Age | -0.0275 | 0.0021 |
| $age^2$ | 0.0002 | 0.0000 |
| Q3_income | -0.0342 | 0.0105 |
| Q4_income | -0.0595 | 0.0109 |
| Q5_income | -0.1821 | 0.0128 |
| Center | 0.0422 | 0.0091 |
| upper_secondary | -0.0619 | 0.0097 |
| degree_or_more | -0.1022 | 0.0160 |
| self employed | -0.3865 | 0.0148 |
| Widowed | 0.0799 | 0.0106 |
| tau1993 | -0.0686 | 0.0170 |
| tau1995 | -0.0670 | 0.0142 |
| tau1998 | -0.0442 | 0.0154 |
| tau2000 | -0.0223 | 0.0140 |
| tau2004 | 0.0390 | 0.0136 |
| tau2006 | 0.0547 | 0.0131 |
| Intercept | 0.7966 | 0.0618 |

| **2nd houses value ratio** | b | Se |
|---|---|---|
| Age | -0.0459 | 0.0081 |
| $age^2$ | 0.0003 | 0.0001 |
| Q4_income | -0.0445 | 0.0330 |
| Q5_income | -0.1657 | 0.0314 |
| Center | 0.0801 | 0.0274 |
| upper_secondary | -0.0948 | 0.0284 |
| degree_or_more | -0.1697 | 0.0336 |
| self employed | -0.3592 | 0.0332 |
| widowed | 0.1313 | 0.0402 |
| tau1993 | -0.1616 | 0.0420 |
| tau1995 | -0.0622 | 0.0398 |
| tau1998 | -0.0644 | 0.0442 |
| tau2000 | -0.0285 | 0.0430 |
| tau2004 | 0.0647 | 0.0440 |
| tau2006 | 0.0640 | 0.0491 |
| Intercept | 0.4230 | 0.2294 |

Source: Author's computations on SHIW data, Historical Archive, waves 1991-2006

***Appendix D: Estimations for projecting life cycle earnings which are a component of lifetime Human Resources***

***Table 10: OLS[61] estimation for dynamic (left panel) and GLS for static (right panel) projection of earnings equations***

| *dynamic* | B | se |
|---|---|---|
| earnings_l | 0.3484 | 0.0049 |
| Age | 0.0146 | 0.0019 |
| age$^2$ | -0.0002 | 0.0000 |
| Public | 0.0181 | 0.0063 |
| N_perc | -0.0262 | 0.0030 |
| Partime | -0.3413 | 0.0118 |
| age_center | -0.0003 | 0.0002 |
| age_south | -0.0028 | 0.0001 |
| age_fem | -0.0034 | 0.0001 |
| age_empl | 0.0091 | 0.0008 |
| age_self | 0.0092 | 0.0008 |
| age_upsec | 0.0036 | 0.0001 |
| age_degree | 0.0073 | 0.0002 |
| tau1991 | 0.0101 | 0.0106 |
| tau1993 | -0.0105 | 0.0096 |
| tau1995 | -0.0458 | 0.0094 |
| tau1998 | -0.0028 | 0.0104 |
| tau2000 | 0.0059 | 0.0093 |
| tau2004 | 0.0220 | 0.0094 |
| tau2006 | 0.0221 | 0.0093 |
| Intercept | 5.7400 | 0.0546 |

| *static* | B | Se |
|---|---|---|
| Age | 0.1822 | 0.0131 |
| age$^2$ | -0.0033 | 0.0003 |
| age$^3$ | 0.0000 | 0.0000 |
| Nperc | -0.0267 | 0.0062 |
| age_upsec | 0.0008 | 0.0005 |
| age_degree | 0.0054 | 0.0009 |
| tau1991 | 0.0041 | 0.0115 |
| tau1993 | -0.1003 | 0.0117 |
| tau1995 | -0.1257 | 0.0112 |
| tau1998 | -0.0842 | 0.0100 |
| tau2000 | -0.0190 | 0.0096 |
| tau2004 | 0.0518 | 0.0114 |
| tau2006 | 0.0930 | 0.0139 |
| Intercept | 6.4457 | 0.1805 |
| sd_u | 0.5540 | |

Source: Author's computations on SHIW data, Historical Archive, panel component, waves 1989-2006

[61] OLS estimator is upward biased in estimating the coefficient of the lagged dependent variable (a GMM estimator would provide us a biannual income persistence of .137). Indeed, we employ this estimated persistence from a biannual panel as a parameter for the yearly dynamic simulation in order to give more importance to the current labor income in projecting expectations about future labor income. Given the frequency of our estimated dataset, which is different from the frequency of the expected earnings projection, we could simply neglect the role of past earnings in the projection of future expected earnings stream. Nevertheless we think we would have lost an important piece of information, therefore we decided to adopt this "second best" solution.

***Appendix E: The taxation sub module***

This part of the model uses all the available information (among the variables which are simulated in the model) in order to reproduce as much completely as possible the personal income taxation structure (IRPEF) at year 2007. The main processes of this module are:

1. Identification of individuals falling in the *no tax area*;
2. computation of basic tax deductions;
3. computation of gross tax according to the brackets progressive structure being in law;
4. computation of tax allowances for pensioners under 75;
5. computation of tax allowances for pensioners over 75;
6. computation of tax allowances for self employed;
7. computation of tax allowances for dependent spouse;
8. computation of tax allowances for dependent children.

The output of this module are the individual after tax incomes which, once aggregated over the household, enter as explanatory into the consumption function.

In practice, the taxation sub module is propedeutic and preliminary to the Wealth module programs. It takes all the gross labour and pension incomes provided by the pre-existing blocks of CAPP_DYN and process them recursively from 2003 to 2050 (last year of simulation).

Therefore, summarizing, in every single loop the module computes the individual tax base and evaluates deductions and allowances for family burdens or for particular occupational status or age. Then, the module computes the gross income tax by applying a marginal tax rate of 23% up to 15,000 Euros, 27% between 15,000 and 28,000 Euros, 38% between 28,000 and 55,000 Euros, 41% between 55,000 and 75,000 and 43% over 75,000 Euros. Finally, after deducting all base deductions and the allowances above reported, the module evaluates the net personal income tax.

We than assume this tax schedules to remain stable all over the simulation period and account for real growth by increasing all the bracket thresholds by the growth in productivity that is used for the alignment of the endogenous labour incomes to exogenous macro projections of the Ragioneria Generale dello Stato (RGS).

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